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10-AMCP-0098

MAR 09 2010

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:

TANKS/LINES/PITS/BOXES/SEPTIC TANK AND DRAIN FIELDS WASTE GROUP OPERABLE UNIT RI/FS WORK PLAN AND RCRA TSD UNIT SAMPLING PLAN; INCLUDES: 200-IS-1 AND 200-ST-1 OPERABLE UNITS, DOE/RL-2002-14, REVISION 1

This letter transmits the Tanks/Lines/Pits/Boxes/Septic Tank and Drain Fields Waste Group Operable Unit RI/FS Work Plan and RCRA TSD Unit Sampling Plan; Includes: 200-IS-1 and 200-ST-1 Operable Units, DOE/RL-2002-14, Revision 1 for review and approval. The U.S. Department of Energy Richland Operations Office (RL) believes this document was previously informally approved for use by the State of Washington Department of Ecology (Ecology) Unit Manager; however, it was not transmitted for formal approval. RL has incorporated comments that came out of the workshops and meetings held with Ecology.

We appreciate Ecology's willingness to hold workshops and arrive at the approvable work plan and sampling and analysis plan. Ecology's approval is requested by April 8, 2010. It is anticipated that future work plan activities will be modified to better align with the proposed Central Plateau Tri-Party Agreement Change Packages.

If you have any questions, please contact me, or your staff may contact, Briant Charboneau, of my staff, on (509) 373-6137.

Sincerely,

Matthew S. McCormick, Assistant Manager
for the Central Plateau

AMCP:KDL

Attachment

cc: See Page 2

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DOE/RL-2002-14
Revision 1

Tanks/Lines/Pits/Boxes/Septic Tank and Drain Fields Waste Group Operable Unit RI/FS Work Plan and RCRA TSD Unit Sampling Plan; Includes: 200-IS-1 and 200-ST-1 Operable Units

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

United States Department of Energy
P.O. Box 550
Richland, Washington 99352

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DOE/RL-2002-14
Revision 1

Tanks/Lines/Pits/Boxes/Septic Tank and Drain Fields Waste Group Operable Unit RI/FS Work Plan and RCRA TSD Unit Sampling Plan; Includes: 200-IS-1 and 200-ST-1 Operable Units

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CONTENTS

1.0 INTRODUCTION 1-1
1.1 SCOPE AND OBJECTIVES 1-2
1.1.1 Input from Data Quality Objectives Process for Pipeline Systems 1-4
1.1.2 Pipeline Systems 1-5
1.1.3 Pipeline Bins 1-6
1.1.4 Approach for Characterization and Remedial Decision Making 1-8
1.2 WORK PLAN CONTENT AND STRUCTURE 1-10
1.2.1 200-IS-1 Operable Unit Waste Sites 1-10
1.2.2 Scope and Content of the Sampling and Analysis Plans 1-25
1.2.3 Milestones 1-25
1.3 STREAMLINING APPROACHES 1-26
1.4 WORK PLAN CHANGE CONTROL 1-27

2.0 BACKGROUND AND SETTING 2-1
2.1 SUMMARY OF HYDROGEOLOGIC CONDITIONS 2-1
2.1.1 Topography 2-1
2.1.2 Geology 2-2
2.1.3 Vadose Zone 2-6
2.1.4 Groundwater 2-6
2.2 PROCESS OPERATION DESCRIPTIONS AND HISTORY 2-10
2.2.1 Primary Processes 2-11
2.2.2 Waste Streams 2-17
2.3 WASTE-SITE DESCRIPTIONS 2-19
2.3.1 Pipeline Systems 2-19
2.3.2 Pipeline Appurtenances 2-24
2.3.3 CX Tank System 2-27
2.3.4 Hexone Storage and Treatment Facility 2-35

3.0 INITIAL EVALUATION 3-1
3.1 KNOWN AND SUSPECTED CONTAMINATION 3-1
3.2 MONITORING 3-2
3.2.1 Environmental Monitoring 3-2
3.2.2 Groundwater-Monitoring Results 3-3
3.3 ECOLOGICAL INFORMATION 3-9
3.3.1 Central Plateau Ecological Evaluation and Central Plateau Terrestrial Ecological Risk Assessment 3-9
3.3.2 200-IS-1 Operable Unit Specific Ecological Data 3-10
3.4 NATURE AND EXTENT OF CONTAMINATION 3-13
3.4.1 Process-Waste Pipeline Systems 3-14
3.4.2 Historical Sampling and Analysis of Pipelines 3-14
3.4.3 Historical Sampling and Analysis for Pipeline Appurtenances 3-20
3.4.4 Conceptual Contaminant-Distribution Models for Pipelines and Appurtenances 3-21
3.4.5 CX Tank System 3-24

3.4.6 Hexone Storage and Treatment Facility 3-28
3.5 RCRA TREATMENT, STORAGE, AND DISPOSAL UNIT INTERIM-STATUS GROUNDWATER MONITORING 3-32
3.6 POTENTIAL IMPACTS TO HUMAN HEALTH AND THE ENVIRONMENT 3-32
3.6.1 Land and Groundwater Use 3-32
3.6.2 Contaminant Sources and Release Mechanisms 3-34
3.6.3 Potential Receptors 3-34
3.6.4 Potential Impacts 3-36
3.7 DEVELOPMENT OF CONTAMINANTS OF CONCERN 3-36
3.7.1 Use of Exclusion Rationale and Refinement of the Contaminants of Potential Concern 3-37
3.7.2 List of Contaminants of Potential Concern for Facilities Process-Waste Pipeline Systems 3-37
3.7.3 List of Contaminants of Potential Concern for Tank Farms Process-Waste Pipeline Systems 3-40

4.0 WORK PLAN APPROACH AND RATIONALE 4-1
4.1 SUMMARY OF DATA QUALITY OBJECTIVES PROCESSES FOR THE 200-IS-1 OPERABLE UNIT 4-1
4.1.1 Approach for Data Collection and Decision Making 4-2
4.1.2 Data Acquired for Process-Waste Pipeline Systems 4-3
4.1.3 Data Acquired for the 241-CX-72 Storage Tank 4-5
4.2 CHARACTERIZATION APPROACH 4-5
4.2.1 Characterization of Pipeline Systems 4-7
4.2.2 Analysis of Pipe Interiors 4-9
4.2.3 Surface Geophysical Techniques for Pipeline Evaluations 4-10
4.2.4 Evaluation of Associated Soils 4-11
4.2.5 Test-Pit Excavations 4-12
4.2.6 Characterization of the 241-CX-72 Storage Tank 4-12

5.0 REMEDIAL INVESTIGATION/FEASIBILITY STUDY PROCESS 5-1
5.1 INTEGRATED REGULATORY PROCESS 5-2
5.2 REMEDIAL INVESTIGATION ACTIVITIES 5-5
5.2.1 Planning 5-5
5.2.2 Field Investigation 5-6
5.2.3 Management of Investigation-Derived Waste 5-8
5.2.4 Laboratory Analysis and Data Validation of Process-Facility Pipelines 5-9
5.2.5 Laboratory Analysis and Data Validation of Tank-Farm Pipeline-System Samples 5-9
5.3 EVALUATION OF PHASE I DATA 5-9
5.4 REMEDIAL INVESTIGATION REPORT 5-9
5.4.1 Data-Quality Assessment 5-10
5.4.2 Data Evaluation and Conceptual-Model Refinement 5-10
5.4.3 Baseline Risk Assessment 5-11
5.4.4 Ecological Evaluation and Risk Assessment 5-14

5.4.5 Treatability Studies Needs 5-14
5.5 FEASIBILITY STUDY/CLOSURE PLAN 5-15
5.5.1 Remedial-Action Alternatives 5-15
5.5.2 Remedial Alternatives, Performance Standards, and Selection Criteria 5-19
5.6 FEASIBILITY STUDY/CLOSURE PLAN 5-21
5.6.1 Waste Sites Identified for Early Action 5-21
5.6.2 Regional-Site Closure 5-21
5.6.3 Waste-Site Grouping by Characteristics or Hazards 5-21
5.7 REMEDY SELECTION, RECORD OF DECISION, RCRA PERMIT MODIFICATION, AND POST-RECORD OF DECISION ACTIVITIES 5-22
5.7.1 Remedy Selection, Record of Decision, RCRA Permit Modification 5-22
5.7.2 Post-Record of Decision Activities 5-23

6.0 PROJECT SCHEDULE 6-1

7.0 REFERENCES 7-1

APPENDICES

A SAMPLING AND ANALYSIS PLAN FOR THE PHASE 1 CHARACTERIZATION OF THE FACILITY PROCESS-WASTE PIPELINE SYSTEMS ..... A-i

B PHASE 1 SAMPLING AND ANALYSIS PLAN FOR 200-IS-1 OPERABLE UNIT TANK FARM PIPELINES (PUBLISHED SEPARATELY AS RPP-PLAN-31715 BY CH2M HILL HANFORD GROUP, INC.) ..... B-i

C SAMPLING AND ANALYSIS PLAN FOR THE 241-CX-72 STORAGE TANK ..... C-i

D SITE-SPECIFIC INFORMATION FOR 200-IS-1 OPERABLE UNIT PIPELINE-SYSTEM WASTE SITES ..... D-i

FIGURES

Figure 2-1. Topographic Map of the Central Plateau at the Hanford Site. 2-3
Figure 2-2. Generalized Stratigraphic Columns for the 200 Areas. 2-4
Figure 2-3. Water-Table Map of the 200 East Area, July 2005. 2-7
Figure 2-4. Water-Table Map of the 200 West Area, 2005. 2-8
Figure 2-5. Generalized Cross-Sectional View of a Direct-Buried Single Pipeline. 2-20
Figure 2-6. Generalized Configuration of a Typical Diversion Box and Catch Tank. 2-25
Figure 2-7. CX Tank Farm System Area Plan View. 2-28
Figure 2-8. 241-CX-70 Storage Tank Construction Diagram. 2-31
Figure 2-9. 241-CX-71 Neutralization Tank Construction Diagram. 2-33
Figure 2-10. 241-CX-72 Storage Tank Construction Diagram. 2-34
Figure 2-11. 276-S-141 and 276-S-142 Hexone Storage Tanks Location Map. 2-36
Figure 2-12. 276-S-141 and 276-S-142 Hexone Storage Tanks Construction Diagram. 2-37
Figure 3-1. Groundwater Contaminant Plume in the 200 East and 200 West Areas. 3-4
Figure 3-2. Conceptual Contaminant-Distribution Model for Buried Process-Waste Pipelines. 3-22
Figure 3-3. Conceptual Contaminant-Distribution Model for a Diversion Box and Catch Tank. 3-23
Figure 3-4. Conceptual Exposure-Pathway Model. 3-35

TABLES

Table 1-1. Pipeline-System Waste-Stream Bins. 1-7

Table 1-2. Identification of Process-Waste Pipeline Bins in 200 Areas Facility Areas. 1-8

Table 1-3. Waste Sites Included in the 200-IS-1 OU as of March 2008. (4 Pages) 1-11

Table 1-4. Pipelines Proposed for Future Inclusion in the 200-IS-1 OU. (10 Pages) 1-15

Table 2-1. General Attributes of Pipelines in Each Bin 2-21

Table 2-2. Summary Information for the CX Tank Farm System and Hexone Storage and Treatment Facility Tanks. (2 Pages) 2-29

Table 3-1. Detectable Radionuclide Concentrations in Vegetation at the 216-U-8 Vitrified Clay Pipeline 3-12

Table 3-2. Vegetation Concentrations of Radionuclides for the V021 Monitoring Site Near the 200-W-59 Diversion Box. 3-13

Table 3-3. Facilities Process-Waste Pipeline Systems Contaminants of Potential Concern. (2 Pages) 3-38

Table 3-4. Tank-Farms Process-Waste Pipeline Systems Constituents List. (3 Pages) 3-40

Table 6-1. Project Schedule for 200-IS-1 Operable Unit Pipelines. 6-2

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TERMS

amsl	above mean sea level
ARAR	applicable or relevant and appropriate requirement
bgs	below ground surface
CERCLA	*Comprehensive Environmental Response, Compensation, and Liability Act of 1980*
CFR	*Code of Federal Regulations*
CMS	corrective measures study
COPC	contaminant of potential concern
CZ	contamination zone
DOE	U.S. Department of Energy
DQO	data quality objective
DST	double-shell tank
Ecology	Washington State Department of Ecology
EPA	U.S. Environmental Protection Agency
Fluor Hanford	Fluor Hanford, Inc.
FS	feasibility study
GPR	ground-penetrating radar
HSTF	Hexone Storage and Treatment Facility
HWMA	Hazardous Waste Management Act (short title of RCW 70.105)
Implementation Plan	DOE/RL-98-28, *200 Areas Remedial Investigation/Feasibility Study Implementation Plan – Environmental Restoration Program*
ITS	in-tank solidification
K_d	distribution coefficient
MIBK	methyl isobutyl ketone (hexone)
NPH	normal paraffin hydrocarbon or kerosene
ORP	DOE Office of River Protection
OU	operable unit
UO_3 Plant	Uranium Trioxide Plant
PFP	Plutonium Finishing Plant
PUREX	Plutonium-Uranium Extraction (Plant or process)
RCRA	*Resource Conservation and Recovery Act of 1976*
RE	Ringold Formation unit E
RECUPLEX	Recovery of Uranium and Plutonium by Extraction (process)
REDOX	Reduction-Oxidation (Plant or process)
RESRAD	RESidual RADioactivity
RFI	RCRA facility investigation
RFI/CMS	RCRA facility investigation/corrective measures study
RI	remedial investigation
RI/FS	remedial investigation/feasibility study
RL	DOE Richland Operations Office
ROD	record of decision

RPP	RCRA past practice
SAP	sampling and analysis plan
SST	single-shell tank
TBP	tributyl phosphate
TEDF	Treated Effluent Disposal Facility
TPH	total petroleum hydrocarbon
Tri-Parties	Ecology, EPA, and DOE
Tri-Party Agreement Action Plan	*Hanford Federal Facility Agreement and Consent Order Action Plan* (Ecology et al., 1989b)
Tri-Party Agreement	*Hanford Federal Facility Agreement and Consent Order* (Ecology et al., 1989a)
TSD	treatment, storage, and disposal
TWINS	*Tank Waste Information Network System* database
UPR	unplanned release
WAC	*Washington Administrative Code*
WIDS	*Waste Information Data System* database
WMA	waste management area

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	0.454	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

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1.0 INTRODUCTION

This work plan supports the remedial investigation/feasibility study (RI/FS) activities for the 200-IS-1 Tanks/Lines/Pits/Boxes Waste Group Operable Unit (OU). The U.S. Department of Energy (DOE) is completing an RI/FS to satisfy requirements under the *Comprehensive Environmental Response, and Liability Act of 1980* (CERCLA) and Washington's Hazardous Waste Management Act[1] (HWMA). The HWMA and the corresponding regulations in WAC 173-303, "Dangerous Waste Regulations," implement Washington's federally-authorized program under the *Resource Conservation and Recovery Act of 1976* (RCRA).

As discussed in the *Hanford Federal Facility Agreement and Consent Order Action Plan* (Ecology et al., 1989b) (Tri-Party Agreement Action Plan), the RI/FS work plan is prepared to present information on how the remedial investigation (RI) and feasibility study (FS) processes will be conducted and eventually lead to proposed remedies for the waste sites in an OU. This work plan integrates the CERCLA investigation/response and HWMA corrective action requirements and uses the framework established in DOE/RL-98-28, *200 Areas Remedial Investigation/Feasibility Study Implementation Plan – Environmental Restoration Program* (hereinafter referred to as the Implementation Plan), which is the implementation plan for integrating the RCRA treatment, storage, and disposal (TSD) unit closure process with CERCLA RI/FS and RCRA facility investigation/corrective measures study (RFI/CMS) processes.

Revision 0 of this work plan (DOE/RL-2002-14, *Tanks/Lines/Pits/Boxes/Septic Tank and Drain Fields Waste Group Operable Unit RI/FS/Work Plan and RCRA TSD Unit Sampling Plan; Includes 200-IS-1 and 200-ST-1 Operable Units*) was submitted to the Washington State Department of Ecology (Ecology) in May 2003; however, Ecology did not approve the document. Ecology issued a letter to the DOE in August 2003 (Price, 2003, "Tanks/Lines/Pits/Boxes/Septic Tank and Drain Field Waste Group Operable Units Remedial Investigation/Feasibility Study Work Plan and RCRA TSD Unit Sampling Plan, DOE/RL-2002-14, Revision 0"), directing the DOE to include appropriate DOE, Office of River Protection (ORP)-owned 200-IS-1 OU waste sites with the DOE, Richland Operations Office (RL)-owned waste sites already in Revision 0 of the work plan. This work plan revision (Revision 1) satisfies Ecology's requirement for inclusion of the ORP-owned 200-IS-1 OU waste sites.

The DOE, Ecology, and the U.S. Environmental Protection Agency (EPA) recently concluded negotiations on milestone changes for completing the RI/FS process and the RCRA RFI/CMS process for 200 Area (Central Plateau) non-tank-farm OUs. The milestones were changed to allow additional site characterization to be completed before making several Central Plateau cleanup decisions. In addition, M-015 and M-013 interim milestones are added and existing milestones are modified.

---

[1] RCW 70.105, "Public Health and Safety," "Hazardous Waste Management" (also known as the Washington State Hazardous Waste Management Act of 1976).

The negotiations also identified that approximately 350 waste sites have shallow contamination that can be addressed by straightforward remove, treat, and dispose methods. These sites were shifted into two new OUs named MG-1 and MG-2. All the sites previously identified as 200-ST-1 were moved into the new MG-1 OU. As such, the 200-ST-1 OU is not discussed further in this document. Separate decision documents for the MG-1 and MG-2 OUs will be submitted to the EPA and Ecology.

The RCRA TSD tanks included in this work plan that require actions to comply with RCRA closure/postclosure requirements are the CX Tank System (Tanks 241-CX-70, 241-CX-71, and 241-CX-72) and the Hexone Storage and Treatment Facility (HSTF) (Tanks 276-S-141 and 276-S-142). Components of the RCRA TSD units associated with single-shell tank (SST) and double-shell tank (DST) systems, such as ancillary piping and equipment that is located outside tank farm waste management areas (WMA), also are addressed by this work plan.

The data generated through investigations associated with the 200-IS-1 OU will support activities in other core projects in the RL and ORP offices. Integration of the data-collection activities with other projects on the Hanford Site will result in more efficient and consistent remediation processes.

1.1 SCOPE AND OBJECTIVES

The work plan presents background information, existing contaminant distribution data, and the approach that will be used for characterization and remedial decision making. The likely response scenarios, potentially applicable technologies, and the need for treatability study(ies) are discussed later in the document.

This work plan addresses the following:

- The 200-IS-1 OU, which includes:
  - Pipelines, diversion boxes, catch tanks, related structures, and associated unplanned releases to the soil
  - RCRA TSD tanks.

The work plan contains a sampling and analysis plan (SAP) for the Phase 1 characterization of the process-waste pipeline systems associated with facility process-waste streams (Appendix A) and an additional SAP for Phase 1 characterization of tank farm waste-transfer pipeline systems (Appendix B). The SAPs include a quality assurance project plan and the sampling specifications for the characterization activities in the field. Information from other OUs and/or projects that have generated information pertaining to the pipeline systems has been used in the development of this work plan. Data-gathering activities included compiling and reviewing existing process-knowledge information. Pertinent site-characterization data available for pipelines associated with liquid-waste disposal sites and tank farm WMA investigations also have been gathered and evaluated. This existing pipeline information and the new characterization data that will be acquired as part of the 200-IS-1 OU phased sampling approach will be used in the RI report. Information presented in the RI report will support the evaluation

of the remedial alternatives and closure options that will be included in the FS and RCRA TSD unit closure plans.

The results from sampling and other characterization activities will be used to update the contaminant distribution models as needed and to support the remedial decision-making process. This work plan focuses on identifying and gathering the information that will be needed for selection of the preferred remedy(s). Key attributes associated with a process-waste transfer structure (e.g., pipelines, diversion boxes, catch tanks) are presented in the work plan. Results obtained from all phases of the characterization activities will be used for evaluating risk to potential receptors and for the FS remedial alternative analyses.

To focus the activities needed for future remedy selection for the pipeline systems, this RI/FS work plan has incorporated the following.

1. A logic for binning (i.e., a methodology for grouping items with similar characteristics) is used for the process-waste pipeline systems that is suited for both characterization activities and subsequent remedial decisions. This binning logic uses waste-stream categories as a fundamental attribute associated with the pipelines.

2. Information-gathering activities are continuing, including location and characterization of pipelines, throughout the RI/FS process. A pipeline-systems location map and an attribute database are being created. Waste-site codes will be assigned to identified pipeline segments in accordance with RL-TPA-90-0001, *Tri-Party Agreement Handbook Management Procedures*, Milestone TPA-MP-14, "Maintenance of the Waste Information Data System (WIDS)" procedures and placed in the *Waste Information Data System* (WIDS) database. WIDS serves as the data-management tool listing current OU waste sites and providing site-specific information. As characterization results become available, they will be compared with information concerning operational history and construction details. This approach will allow for any subsequent data-collection needs to be adapted as needed. Data-gathering requirements are tailored to accommodate the characteristics of the entire network of underground process-waste pipelines that are disseminated throughout the Central Plateau.

3. Potential remedial alternatives are identified and described. Potential remedies associated with pipeline characteristics initially are identified in the work plan. Using the data collected and risk evaluations completed in the RI, a comprehensive remedial alternatives analysis will be completed in the FS.

The scope and approach for the other waste sites addressed in this work plan are summarized below.

<u>276-S-141 and 276-S-142 Tank System (Hexone Storage Tanks)</u>

Existing summary characterization information is presented for the 276-S-141 and 276-S-142 Hexone Storage Tank System. The closure plan prepared for the 276-S-141 and 276-S-142 Hexone Storage Tank System (DOE/RL-92-40, *Hexone Storage and Treatment Facility Closure Plan*) will be amended (as needed) and used to complete the closure process for these tanks. The tanks will be removed and the surrounding soil will be sampled and analyzed as

described in the closure plan to verify RCRA clean closure and meet CERCLA site close-out requirements.

241-CX-70, 241-CX-71, and 241-CX-72 Tank System

The 241-CX-70 Storage Tank and the 241-CX-71 Neutralization Tank will be clean closed. Summary information concerning these tanks and the 241-CX-72 Storage Tank is provided. Waste characteristics of the remaining residue in the 241-CX-72 Storage Tank need to be determined. A SAP to determine the composition of residual waste present in the 241-CX-72 Storage Tank is included in Appendix C. A closure plan for the entire CX Tank System (241-CX-70, -71, and -72) will be submitted in accordance with Milestone M-020-54, "Submit Closure Plan for 241-CX-70, 241-CX-71, and 241-CX-72 Tanks for Regulatory Review by December 31, 2008."

1.1.1 Input from Data Quality Objectives Process for Pipeline Systems

The outcome of the recent 200-IS-1 data quality objectives (DQO) process (D&D-30262, *Data Quality Objectives Summary Report for the IS-1 Operable Unit Pipelines and Appurtenances*) forms the basis for development of a large portion of this work plan and the associated SAPs (Appendices A and B). Because of uncertainties associated with the process-waste pipelines, an outcome of the DQO process was a determination that a phased approach to data gathering would be the most effective mechanism to acquire the information needed to make remedial decisions. The strategy developed for characterization permits the integration of new data in a phased manner. Data-collection specifications are tailored for each phase to allow for efficient use of resources and are linked to the data-sufficiency requirements and the level of uncertainty that is acceptable for remedial decision making.

Because of the regulatory complexities and technical challenges associated with pipeline systems, the DQO process and work-plan development have been ongoing for several years. The initial DQO process conducted for the 200-IS-1 OU was completed in 2002; it resulted in defining radiological and nonradiological constituents to be characterized and specified the number, type, and location of samples to be collected for five RCRA TSD tank system units in the 200-IS-1 OU.

A second DQO process was undertaken in 2004, after receipt of a letter from Ecology (Price, 2003) requesting inclusion of the ORP-owned waste sites in a revised work plan. Although this DQO process was not documented as a formal DQO summary report, the assumptions made and conclusions generated in the process were used for development of a revised work plan. A meeting was held with Ecology on November 1, 2004, and a presentation was given outlining a revised work-plan approach and content.

Beginning in August 2005, a collaborative DQO activity was initiated and included participation by representatives from Fluor Hanford, Inc. (Fluor Hanford); CH2M HILL Hanford Group, Inc.; RL; ORP; and Ecology. A working group was assembled and meetings were conducted with input from all representatives to complete the DQO process and develop a DQO summary report (D&D-30262). The content of the completed DQO report provides a basis and direction for

development of this work plan and the SAPs. Specific elements of the DQO report used in the development of this work plan include the following:

- The binning strategy to group pipelines for further evaluation, based on the process-waste stream(s) handled by the lines
- Separate contaminants of potential concern (COPC) lists for facility pipeline versus tank farm pipeline sampling analytical requirements
- Sampling designs for two SAPs. One SAP is for the facility process-waste pipelines that are associated with liquid-waste disposal sites (i.e., cribs, trenches, french drains, ponds, injection/reverse wells), and another SAP is for process-waste pipeline systems associated with tank farm operations.

1.1.2 Pipeline Systems

The process-waste pipeline systems include the extensive network of pipelines, diversion boxes, catch tanks, valve pits, related infrastructure, and associated unplanned releases in surrounding soils. The pipeline systems were used to transport process waste from the separations facilities to the SSTs and DSTs and to control or divert flow to disposal waste sites that received liquid-waste streams. This work plan addresses the inactive process-waste pipeline systems in the Central Plateau area; it does not include evaluation of waterlines; utility lines; inert gas lines; sanitary sewer, storm water, and aboveground pipelines; or active pipelines. This includes those waste sites currently identified in the Tri-Party Agreement Action Plan, Appendix C (Ecology et al., 1989b), as part of the 200-IS-1 OU, as well as the new waste sites (i.e., pipelines, related infrastructure, and associated unplanned releases in surrounding soils) that will be added.

Most of the pipelines and associated structures in the Central Plateau currently have not been assigned to the 200-IS-1 OU through the regulatory procedures identified in the Tri-Party Agreement Action Plan; in particular, those pipelines connected to liquid-waste disposal sites that are associated with other OUs. Pipelines and associated structures that occur within the boundaries of tank farm WMAs will be addressed by the designated WMA RCRA closure or corrective actions. Many of the pipelines that are connected to the tank farms and extend outside the WMA currently are not assigned to a specific OU. Because both the tank farms and the 200 Areas process-facility operations used the pipeline network for waste-transfer operations, RL and ORP share responsibilities for the characterization and remedial actions for the pipeline system. Designation of these responsibilities for specific pipeline segments is based on whether the pipeline or associated structure is considered ancillary equipment associated with a tank farm RCRA TSD unit.

1.1.3 Pipeline Bins

Considerable process knowledge is available concerning the waste streams generated at the facilities in the 200 Areas. The 200 Areas have been the center for separations and concentration processes of plutonium. These separation and concentration processes can be grouped into six general processes:

1. Fuel processing
2. Plutonium isolation
3. Uranium recovery
4. Cesium/strontium recovery
5. Waste storage/treatment
6. Tank farm waste transfers.

DOE/RL-96-81, *Waste Site Grouping Report for 200 Areas Soil Investigations*, translated the first five general processes into logical waste-site groups based on waste-stream type (e.g., solid waste, cooling water, process waste), followed by waste-site type (e.g., burial ground, pond, trench, ditch, crib). Inventory estimates for the major radionuclide, inorganic, and organic constituents comprising the waste streams generated from the 200 Areas facilities and discharged to waste-disposal sites are presented in DOE/RL-96-81, Appendix A, and the soil inventory model (RPP-26744, *Hanford Soil Inventory Model, Rev. 1*).

The general waste-stream categories identified in DOE/RL-96-81, Section 3.2, and in DOE/RL-98-28, Appendix H, form the basis for the OU designations used for the Central Plateau liquid-waste disposal sites. These OU waste-stream categories also support a framework with which to organize the pipeline systems for characterization activities. The waste-stream categories share common radiological and chemical attributes and allow for a systematic approach with which to group or "bin" the pipelines that handled each type of process liquid. This grouping or "binning" logic relies on process knowledge associated with the facility operations and the fact that the pipelines in each designated bin conveyed liquid wastes that generally share common compositional attributes.

The bins for the pipeline systems are shown in Table 1-1. Summary information provided in this table includes the five bins, organized by OUs identified for the 200 Areas facilities waste sites, and a general description of the waste-stream characteristics. Information on the general characteristics of each of the waste streams was obtained primarily from DOE/RL-96-81, DOE/RL-98-28, and the results of completed RI reports for the associated OUs. Variations noted in the general waste-stream attributes also are identified in the table. A sixth bin is included for the tank-transfer waste streams. This sixth group is unique to the other five bins, because it contains pipeline systems that received waste from varying generating sources and therefore may not share common compositional attributes, as do the other bins. Process operations and waste-stream attributes for each of the bins are discussed in more detail in Chapter 2.0. Table 1-2 identifies the Hanford Site process-facility areas where the waste streams identified in Table 1-1 were conveyed by pipelines.

Table 1-1. Pipeline-System Waste-Stream Bins.

Bin Number	Waste Category	Waste Steam Description
1	Process Condensate and Process Waste (Waste streams associated with the 200-PW-1, -2, -3, -4, -5, and -6 OUs) Chemical-Laboratory Waste (Waste streams associated with the 200-LW-1 and -2 OUs)	• Process condensate generally is water condensed from the closed process system and that was in direct contact with radioactive and chemical materials. • Process waste is low-level and/or hazardous waste that directly contacted radioactive material and that may contain organic complexants that could enhance their mobility. • Potential transuranic waste associated with the 200-PW-1, -2, and -6 OU waste streams. • CCl_4 associated with the 200-PW-1 OU waste stream. • Laboratory process wastes and/or laboratory decontamination waste streams that generally are low in radionuclides, although some have significant inventories of plutonium, uranium, and fission products. Liquid volumes typically are lower. • Potential transuranic waste associated with some 200-LW-2 OU waste streams.
2	Steam Condensate and Cooling Water (Waste streams associated with the 200-CW-1, -2, -3, -4, and -5 OUs and the 200-SC-1 OU)	• These waste streams were run in a noncontact manner; i.e., a barrier separated the liquids in this category from contaminated process liquids, with little consequent potential for routine radiological contamination. However, contamination did enter these streams in generally negligible to very small quantities through pinhole leaks or through rare pipe ruptures. • Potential transuranic waste associated with the 200-CW-5 OU waste stream.
3	Chemical-Sewer Waste (Waste streams associated with the 200-CS-1 OU)	• Chemical-sewer waste sites received solvent-extraction waste that was generally low in all radiological contaminants.
4	Miscellaneous Waste (Waste streams associated with the 200-MW-1 OU)	• Generally consists of waste streams generally low in radionuclide and chemical constituents. Waste streams associated with plant ventilation and stack drainage, equipment decontamination, and a number of small- to medium-volume radioactive waste streams from multiple sources. • The relationship of the 216-A-4 Crib's high radiological-constituent levels to the general waste characteristics of this group is uncertain.
5	Tank/Scavenged Waste (Waste streams associated with the 200-TW-1 and -2 OUs)	• Consists of waste streams with relatively high concentrations of radiological constituents. These liquid wastes are associated directly or indirectly with tank wastes collected from the bismuth-phosphate process. • Potential transuranic waste associated with the 200-TW-2 OU waste stream.
6	Tank Farm Waste Transfers	• Multiple waste-stream compositions, generally consisting of high concentrations of radionuclides. • Variability in the waste-stream composition.

OU = operable unit.

Table 1-2. Identification of Process-Waste Pipeline Bins in 200 Areas Facility Areas.

Facility Area	Waste Streams Transferred Within Pipeline Systems					
	Bin 1 Process Condensate, Process Waste, and Chemical-Laboratory Waste	Bin 2 Steam Condensate and Cooling Water	Bin 3 Chemical Sewer	Bin 4 Miscellaneous Waste	Bin 5 Tank/ Scavenged Waste	Bin 6 Tank Farm Waste Transfers
200 East Area						
A Plant (PUREX)	X	X	X	X	---	X
B Plant	X	X	X	X	X	X
C Plant (Hot Semiworks)	X	X	---	X	X	X
200 West Area						
S Plant (REDOX)	X	X	X	X	---	X
T Plant	X	X	---	X	X	X
Z Plant (PFP)	X	X	---	X	---	X

X – Indicates that pipeline systems present in the facility area were used to transfer the specified waste stream.
--- Indicates that no pipeline system was identified that carried the waste stream.
PFP = Plutonium Finishing Plant. REDOX = Reduction-Oxidation Plant.
PUREX = Plutonium-Uranium Extraction Plant.

1.1.4 Approach for Characterization and Remedial Decision Making

1.1.4.1 Pipeline Systems

A characterization approach has been identified that is directed toward determining whether residual contamination occurs within the pipelines and if the surrounding soil has been impacted by any leakage that may have occurred. To optimize data gathering, phased characterization will be used to evaluate and assess the data.

Phase 1

Based on existing information that indicates that contamination likely is present (discussed in D&D-30262 for Phase 1), data will be collected to determine whether contamination is above preliminary cleanup levels and if remediation is required. As indicated in D&D-30262, Phase 1 will consist of a biased sample approach targeting specific pipelines and specific locations within or around the pipelines; however, if a suspected area of waste accumulation cannot be identified, then pipelines and surrounding soil locations will be selected randomly. Evaluation of the Phase 1 sampling data will guide the remaining activities in the RI/FS process. The characterization data collected will be used to support remedial decision making (other than the no-action alternative). These data may be determined to be sufficient for proposing a streamlined remedial decision-making process (e.g., CERCLA removal action, interim actions, voluntary actions, plug into existing record of decision [ROD]).

Preliminary cleanup levels are based on potential applicable or relevant and appropriate requirements (ARAR) and preliminary remediation goals, which are regulatory thresholds and/or standards or derived risk-based thresholds. Preliminary cleanup levels provide the basis for establishing final cleanup levels in the CERCLA ROD and dictate analytical performance levels (i.e., laboratory detection limit requirements). Preliminary cleanup levels identified for use in determining analytical detection limit requirements for this OU are provided in D&D-30262, Tables 3a and 3b.

Phase 2

As presented in D&D-30262, the Phase 2 investigation will be used if Phase 1 results show a range of concentration values that are below, both above and below, or close to preliminary cleanup levels. Further characterization of unplanned releases (UPR) will be performed unless the known release is designated as a removal, treatment, and disposal site. Proceeding directly to Phase 2 sampling would be appropriate for those pipelines where existing information indicates that contamination will not be present and/or where there is expected to be considerable variability in potential results. Phase 2 sampling will be required if all remedial alternatives need to be assessed, including the no-action alternative. Phase 2 will entail collection of a larger data set, to include the no-action alternative in decision making. The Phase 2 evaluation will include more laboratory analyses than Phase 1. Phase 2 data will support decision documents and RI/FS processes.

Information regarding the current condition of pipeline system appurtenances (e.g., catch tanks, diversion boxes, valve pits) is limited. These components have a higher degree of complexity with regard to access and sampling for conducting characterization. This complexity does not make these components amenable to the Phase 1 characterization. This current work plan focuses on characterization of pipelines. Pipeline system appurtenances will be addressed as part of the more rigorous Phase 2 sampling and analysis. Based on the results of Phase 1, the DQO report (D&D-30262) may be revised to address these components, or an existing approved SAP will be identified and modified, as needed, to support Phase 2 data collection and characterization requirements for pipeline system appurtenances.

1.1.4.2 241-CX-70 Storage Tank, 241-CX-71 Neutralization Tank, and Hexone Storage Tanks 276-S-141 and 276-S-142

Five RCRA TSD tanks in the 200-IS-1 OU are identified as interim-status units under WAC 173-303. These tanks are listed in two WA7890008967, *Hanford Facility Resource Conservation and Recovery Act Permit, Dangerous Waste Portion, Revision 8, for the Treatment, Storage, and Disposal of Dangerous Waste*, Part A, Form 3's: three tanks in the Part A, Form 3, for the 241-CX Tank System (241-CX-70, -71, and -72); and two tanks in the Part A, Form 3 for the HSTF (276-S-141 and 276-S-142).

Closure activities that have been initiated for the two hexone tanks include pumping out the tank contents (excluding the tank heels and sludge) and decontaminating the distillation system and railcars (temporarily used to store the distillate). The tanks will be removed, and surrounding soil will be evaluated during tank removal to determine if it is contaminated. As part of the removal process, soil sampling and analysis will be performed to verify that the remaining soil is clean. Sampling requirements and the closure strategy will be provided in the closure plan.

Waste removal has been undertaken for the 241-CX-70 Storage Tank, and decontamination flushes were undertaken for the limestone aggregate in the 241-CX-71 Neutralization Tank. A closure plan will be prepared to describe additional closure activities. The closure plan will recommend that the tanks be clean closed. Closure activities, including the sampling and analysis activities that will be performed to verify that the remaining soil is clean following removal of the tanks, will be presented in the closure plan.

1.1.4.3 241-CX-72 Storage Tank

Residual waste remaining in the 241-CX-72 Storage Tank will require sampling and analysis to determine its composition. This work plan contains a SAP (Appendix C) describing the sampling and laboratory analyses that will be completed. The analytical results will support decisions concerning health and safety and disposal options for the tank and the remaining residual-waste contents. The closure strategy for this tank will be included in the closure plan for the 241-CX-70 Storage Tank and the 241-CX-71 Neutralization Tank. Depending on the waste composition inside the tank and whether a release to surrounding soil has occurred, closure options include RCRA clean closure or RCRA protective closure (landfill).

1.2 WORK PLAN CONTENT AND STRUCTURE

The content and structure of this work plan follow the CERCLA and HWMA format, with modifications to concurrently satisfy the additional RCRA closure requirements. Modifications to the M-013 series of *Hanford Federal Facility Agreement and Consent Order* (Ecology et al., 1989a) (Tri-Party Agreement) milestones for non-tank-farm past-practice waste-site investigations approved in June 2002 (02-RCA-0341, "Hanford Federal Facility Agreement and Consent Order [Tri-Party Agreement] Change Requests for the Central Plateau Project [CPP] Activities," contains Modifications M-013-02-01, M-015-02-01, M-016-02-01, and M-020-02-01) included an approach to investigate similar OUs in a single RI/FS process. The milestone modification reduced the number of non-tank-farm work plans, RI reports, and FSs.

The strategy developed for closure of the CX Tank System and the Hexone Storage Tank System is addressed in this work plan. The work plan also outlines the regulatory pathway to site closeout for existing and newly identified RL and ORP pipeline-system waste sites. Conceptual contaminant-distribution models have been developed and are presented for the pipeline system structures that portray potential release characteristics. Final presentation of all supporting characterization data that will be used for remedial decision making for the pipeline systems will be presented in the RI report.

1.2.1 200-IS-1 Operable Unit Waste Sites

The 200-IS-1 OU initially was defined to include the waste sites identified in WIDS as being associated with the transfer of high-activity liquid wastes between separations plants and tank farms. The waste sites currently identified as part of the 200-IS-1 OU are listed in the Tri-Party Agreement Action Plan, Appendix C (Ecology et al., 1989b).

The waste-site grouping report (DOE/RL-96-81) provided the initial description of those sites to be included in the Tanks/Lines/Pits/Boxes Waste Group. This grouping (later formalized as an OU) included the large number of structures used in the transfer of high-activity liquid wastes from separations plants to tank farms, reprocessing facilities, and evaporators. The waste sites associated with the 200-IS-1 OU, composed of the diversion boxes, catch tanks, pipelines, and unplanned releases associated with high-activity waste transfer operations outside the tank farm OUs, subsequently were further identified and discussed in the Implementation Plan (DOE/RL-98-28, Appendix G).

Currently not all the 200-IS-1 OU waste sites, which include waste transfer structures and associated unplanned releases, are listed in the Tri-Party Agreement Action Plan, Appendix C. Data-collection activities to delineate pipelines and related structures and integrate them into WIDS as waste sites was initiated during development of this work plan and is continuing. Candidate waste sites for inclusion in the 200-IS-1 OU include all process-waste-carrying pipelines, diversion boxes, catch tanks, valve pits, and related structures outside the tank farm WMAs. Table 1-3 identifies the 200-IS-1 OU waste sites currently listed within WIDS and included in Appendix C of the Tri-Party Agreement Action Plan. Table 1-4 identifies the pipelines that have been added to WIDS and are proposed for inclusion in the 200-IS-1 OU and Appendix C of the Tri-Party Agreement Action Plan. If updates to these waste site lists occur following issuance of this work plan, the information will be shared with regulators through the Unit Managers meetings. As indicated in the Tri-Parties Agreement Action Plan, the mechanism for official dissemination of this information, addition of new waste sites and reclassification of accepted waste sites, will be conducted in accordance with RL-TPA-90-0001, TPA-MP-14 procedures.

Table 1-3. Waste Sites Included in the 200-IS-1 OU as of March 2008. (4 Pages)

Count	Site Code	Site Name	Site Type
1	200-E-111-PL	200-E-111-PL, Encased Pipeline From 241-ER-151 Diversion Box to 241-C Tank Farm and 244-AR Vault; 3-38 Encasement, V108/V837/8618/8653/8901PAS, 809, 818, V836, V834	Encased Tank Farm Pipeline
2	200-E-116-PL	200-E-116-PL, Pipelines from 241-B-154 Diversion Box to 241-C-151 and 241-C-152 Diversion Boxes, Direct Buried Pipeline, V111/V210/V130, 8902, V122	Direct Buried Tank Farm Pipeline
3	200-W-7	200-W-7, 246-L, 241-S-TK-1, 243S-TK-1, 243-S-TK1, 200-W Personnel Decontamination Facility Catch Tank, IMUST, Inactive Miscellaneous Underground Storage Tank	Catch Tank
4	200-W-16	200-W-16, 292-T Underground Tanks, IMUST, Inactive Miscellaneous Underground Storage Tank, 292-TK-1, 292-TK-2	Storage Tank
5	200-W-58	200-W-58, Z-Plant Diversion Box #1	Valve Pit
6	200-W-59	200-W-59, Z-Plant Diversion Box #2	Valve Pit
7	200-W-78-PL	200-W-78-PL; Pipeline Between 241-TX/TY and 241-T Tank Farms, Lines 6012, 6025, 7624 and 7630	Encased Tank Farm Pipeline
8	200-W-97-PL	200-W-97-PL, Encased Pipeline from 240-S-151 Diversion Box to 241-S-151 Diversion Box, Lines V508, V509, V512, V513, V514, V515, V516, V517/3603, V519/1115	Encased Tank Farm Pipeline
9	200-W-98-PL	200-W-98-PL, Encased Pipeline from 240-S-151 to 241-U-153 Diversion Box, V458,V459,V460	Encased Tank Farm Pipeline
10	200-W-99-PL	200-W-99-PL, Encased Pipeline from 241-U-151 to 241-S-151 Diversion Boxes, Lines V455 and V456	Encased Tank Farm Pipeline

Table 1-3. Waste Sites Included in the 200-IS-1 OU as of March 2008. (4 Pages)

Count	Site Code	Site Name	Site Type
11	200-W-100-PL	200-W-100-PL, Encased Pipeline from 241-UX-154 to 241-SX-152 Diversion Box, lines 4700, 4701, 4853, V762, V503 and V505	Encased Tank Farm Pipeline
12	200-W-105-PL	200-W-105-PL, Encased Transfer Line Between 241-UX-154 Diversion Box and 241-TX-155-Diversion Box; encased lines V375, V382, 4859/4703	Encased Tank Farm Pipeline
13	200-W-125-PL	200-W-125-PL, 216-Z-1 Ditch Replacement Pipeline (see subsites)	Radioactive Process Sewer
14	216-TY-201	216-TY-201, Supernatant Disposal Flush Tank, IMUST, Inactive Miscellaneous Underground Storage Tank	Settling Tank
15	240-S-151	240-S-151, 240-S-151 Diversion Box	Diversion Box
16	240-S-152	240-S-152, 240-S-152 Diversion Box	Diversion Box
17	240-S-302	240-S-302, 240-S-302 Catch Tank, IMUST, Inactive Miscellaneous Underground Storage Tank, line V556 and V557	Catch Tank
18	241-A-151	241-A-151, 241-A-151 Diversion Box	Diversion Box
19	241-A-302A	241-A-302A, 241-A-302-A Catch Tank, line V028	Catch Tank
20	241-A-302B	241-A-302B, 241-A-302-B Catch Tank, IMUST, Inactive Miscellaneous Underground Storage Tank, V062	Catch Tank
21	241-B-154	241-B-154, 241-B-154 Diversion Box	Diversion Box
22	241-B-302B	241-B-302B, 241-B-302-B Catch Tank, 241-B-302, IMUST, Inactive Miscellaneous Underground Storage Tank, Line V217	Catch Tank
23	241-BX-154	241-BX-154, 241-BX-154 Diversion Box	Diversion Box
24	241-BX-155	241-BX-155, 241-BX-155 Diversion Box	Diversion Box
25	241-BX-302B	241-BX-302B, 241-BX-302-B Catch Tank, IMUST, Inactive Miscellaneous Underground Storage Tank, Line V288	Catch Tank
26	241-BX-302C	241-BX-302C, 241-BX-302-C Catch Tank, IMUST, Inactive Miscellaneous Underground Storage Tank, Line V322	Catch Tank
27	241-C-154	241-C-154, 241-C-154 Diversion Box	Diversion Box
28	241-CX-70	241-CX-70, 241-CX-TK-70 Tank, Strontium Hot Semi-works, IMUST, Inactive Miscellaneous Underground Storage Tank	Storage Tank
29	241-CX-71	241-CX-71, 241-CX-TK-71, 241-CX Neutralization Tank, Strontium Hot Semi-works, IMUST, Inactive Miscellaneous Underground Storage Tank	Neutralization Tank
30	241-CX-72	241-CX-72, 241-CX-TK-72 Vault and Tank, 241-CX-72 Waste Self Concentrator, Strontium Hot Semi-works, IMUST, Inactive Miscellaneous Underground Storage Tank	Storage Tank
31	241-ER-151	241-ER-151, 241-ER-151 Diversion Box	Diversion Box
32	241-ER-152	241-ER-152, 241-ER-152 Diversion Box, line DR311	Diversion Box
33	241-ER-311	241-ER-311, 241-ER-311 Catch Tank, 241-ER-311A Replacement Tank	Catch Tank
34	241-ER-311A	241-ER-311A, 241-ER-311A Catch Tank, old 241-ER-311, Original 241-ER-311 Catch Tank, IMUST, Inactive Miscellaneous Underground Storage Tank	Catch Tank
35	241-SX-302	241-SX-302, 241-SX-302 Catch Tank, SX-304, IMUST, Inactive Miscellaneous Underground Storage Tank, Line V595	Catch Tank
36	241-TX-152	241-TX-152, 241-TX-152 Diversion Box	Diversion Box
37	241-TX-154	241-TX-154, 241-TX-154 Diversion Box	Diversion Box
38	241-TX-155	241-TX-155, 241-TX-155 Diversion Box	Diversion Box
39	241-TX-302B	241-TX-302B, 241-TX-302-B Catch Tank, IMUST, Inactive Miscellaneous Underground Storage Tank, Lines V414 and V415	Catch Tank
40	241-TX-302BR	241-TX-302BR, 241-TX-302BR Catch Tank, 241-TXR-302BR, IMUST, Inactive Miscellaneous Underground Storage Tank	Catch Tank
41	241-TX-302C	241-TX-302C, 241-TX-302-C Catch Tank, Lines V741 and V742	Catch Tank

Table 1-3. Waste Sites Included in the 200-IS-1 OU as of March 2008. (4 Pages)

Count	Site Code	Site Name	Site Type
42	241-U-151	241-U-151, 241-U-151 Diversion Box	Diversion Box
43	241-U-152	241-U-152, 241-U-152 Diversion Box	Diversion Box
44	241-UX-154	241-UX-154, 241-UX-154 Diversion Box	Diversion Box
45	241-UX-302A	241-UX-302A, 241-U-302 Catch Tank, 241-UX-302 Catch Tank, 241-UX-302, Lines V380 and V381	Catch Tank
46	241-WR VAULT	241-WR VAULT, 241-WR Vault (Tanks -001 through -009), 241-WR-01 thru 09, 241-WR Diversion Station Vault, 244-WR Vault, 296-U-6 Stack, IMUST, Inactive Miscellaneous Underground Storage Tank (see subsites)	Receiving Vault
47	241-Z	241-Z, 241-Z Treatment and Storage Tanks, 241-Z Tank Farm, 241-Z Treatment and Storage System, 241-Z-D-4, 241-Z-D-5, 241-Z-D-7, 241-Z-D-8, 241-Z Sump, 241-Z Tank Pit	Neutralization Tank
48	276-S-141	276-S-141, 276-S-TK-141, 276-S-306A, 276-S-141 Solvent Storage Tank, Tank 276-141, Hexone Storage Tank, 244-SX-15, IMUST, Inactive Miscellaneous Underground Storage Tank	Storage Tank
49	276-S-142	276-S-142, 276-S-TK-142, 276-S-306B, 276-S-142 Solvent Storage Tank, Tank 276-142, Hexone Storage Tank, 244-SX-15, IMUST, Inactive Miscellaneous Underground Storage Tank	Storage Tank
50	HSVP	HSVP, Hot Semiworks Valve Pit, 201-C Diversion Box, Semiworks Valve Pit, 201-C Valve Box	Valve Pit
51	UPR-200-E-1	UPR-200-E-1, Waste Line Failure on South Side of 221-B	Unplanned Release
52	UPR-200-E-3	UPR-200-E-3, Line leak from 221-B to 241-BX-154, UN-200-E-3	Unplanned Release
53	UPR-200-E-25	UPR-200-E-25, Contamination Spread from the 241-A-151 Diversion Box, UN-200-E-25	Unplanned Release
54	UPR-200-E-26	UPR-200-E-26, 241-A-151 Release, UN-200-E-26	Unplanned Release
55	UPR-200-E-117	UPR-200-E-117, Contaminated Liquid Spill, UN-200-E-117	Unplanned Release
56	UPR-200-E-31	UPR-200-E-31, 241-A-151 Release, UN-200-E-31	Unplanned Release
57	UPR-200-E-41	UPR-200-E-41, UN-200-E-41 Soil Contamination in the Vicinity of R-13 Stairwell (221-B), UPR-200-E-85	Unplanned Release
58	UPR-200-E-42	UPR-200-E-42, 241-AX-151 Release, UN-200-E-42	Unplanned Release
59	UPR-200-E-44	UPR-200-E-44, UN-200-E-44, BCS Waste Line Leak South of 221-B	Unplanned Release
60	UPR-200-E-45	UPR-200-E-45, UN-200-E-45, Contamination Spread from the 241-B-154 Diversion Box	Unplanned Release
61	UPR-200-E-65	UPR-200-E-65, UN-216-E-65, 241-A-151 Diversion Box Radioactive Contamination, UN-200-E-65	Unplanned Release
62	UPR-200-E-67	UPR-200-E-67, UN-216-E-67, Excavation of Radioactively Contaminated Pipe Encasement (V004, V005, V006, V007,V008) UN-200-E-67	Unplanned Release
63	UPR-200-E-77	UPR-200-E-77, UN-216-E-5, 241-B-154 Diversion Box Ground Contamination, UN-200-E-77	Unplanned Release
64	UPR-200-E-78	UPR-200-E-78, UN-216-E-6, 241-BX-155 Diversion Box Ground Contamination, UN-200-E-78	Unplanned Release
65	UPR-200-E-80	UPR-200-E-80, UN-216-E-8, 221-B R-3 Line Break, R-3 Radiation Zone, UN-200-E-80	Unplanned Release
66	UPR-200-E-84	UPR-200-E-84, 241-ER-151 Catch Tank Leak (241-ER-311A), UN-200-E-84, UN-216-E-12	Unplanned Release
67	UPR-200-E-85	UPR-200-E-85, Line Leak at 221-B Stairwell R-13, UN-216-E-13, UPR-200-E-41, UN-200-E-85, UN-200-E-41	Unplanned Release
68	UPR-200-E-87	UPR-200-E-87, UN-216-E-15, 224-B South Side Plutonium Ground Contamination, UN-200-E-87, 216-E-15	Unplanned Release

Table 1-3. Waste Sites Included in the 200-IS-1 OU as of March 2008. (4 Pages)

Count	Site Code	Site Name	Site Type
69	UPR-200-E-96	UPR-200-E-96, Ground Contamination SE of PUREX, UN-216-E-24, UN-200-E-96	Unplanned Release
70	UPR-200-W-2	UPR-200-W-2, UN-200-W-2, Underground Waste Line Leak	Unplanned Release
71	UPR-200-W-5	UPR-200-W-5, Overflow at 241-TX-155, UN-200-W-5	Unplanned Release
72	UPR-200-W-6	UPR-200-W-6, UN-200-W-6, Contamination Spread from 241-U-151 and 241-U-152 Diversion Boxes	Unplanned Release
73	UPR-200-W-20	UPR-200-W-20, UN-200-W-20, Spread of Contamination from a Diversion Box	Unplanned Release
74	UPR-200-W-21	UPR-200-W-21, UN-200-W-21, UN-216-W-36, Process Line Cave-in at 241-TX-154 Diversion Box	Unplanned Release
75	UPR-200-W-27	UPR-200-W-27, Transfer Line Leak at 23rd and Camden, UN-200-W-27, UN-216-W-5, Duplicate of UPR-200-W-29	Unplanned Release
76	UPR-200-W-28	UPR-200-W-28, Release from 241-TX-155 Diversion Box, UN-200-W-28	Unplanned Release
77	UPR-200-W-29	UPR-200-W-29, Transfer Line Leak, UN-200-W-29, UPR-200-W-27, UN-200-W-27, UN-216-W-5, 23rd and Camden Line Break	Unplanned Release
78	UPR-200-W-32	UPR-200-W-32, UNH Transfer Line Break, UN-200-W-32	Unplanned Release
79	UPR-200-W-35	UPR-200-W-35, Ground Contamination Near UNH Process Line, UN-200-W-35, REDOX to 224-U UNH Line Leak	Unplanned Release
80	UPR-200-W-38	UPR-200-W-38, Line Break at 241-TX-302C, UPR-200-W-160, UPR-200-W-40, UN-200-W-38, 216-T-30	Unplanned Release
81	UPR-200-W-40	UPR-200-W-40, Line Break near 241-TX-154, UPR-200-W-38, UPR-200-W-160, 216-T-30, UN-200-W-40,	Unplanned Release
82	UPR-200-W-49	UPR-200-W-49, Contamination Southeast of 241-SX, UN-200-W-49	Unplanned Release
83	UPR-200-W-64	UPR-200-W-64, Road Contamination at 23rd and Camden, UN-200-W-64	Unplanned Release
84	UPR-200-W-76	UPR-200-W-76, UN-200-W-76, Contamination Found at 241-TX-155	Unplanned Release
85	UPR-200-W-79	UPR-200-W-79, Contamination Spread at 241-Z, UN-200-W-79	Unplanned Release
86	UPR-200-W-97	UPR-200-W-97, Transfer Line Leak, UN-216-W-5, UN-200-W-97	Unplanned Release
87	UPR-200-W-98	UPR-200-W-98, UN-216-W-6, 221-T Waste Line Break at R-19, UN-200-W-98	Unplanned Release
88	UPR-200-W-102	UPR-200-W-102, UN-216-W-12, UN-200-W-102, 224-T Underground Line Leak	Unplanned Release
89	UPR-200-W-113	UPR-200-W-113, Soil Contamination East of 241-TX, UN-216-W-23, Contamination Areas Around 241-TX-155 Diversion Box, UN-200-W-113	Unplanned Release
90	UPR-200-W-114	UPR-200-W-114, UN-216-W-24, Ground Contamination East of 241-SX Tank Farm, UN-200-W-114	Unplanned Release
91	UPR-200-W-115	UPR-200-W-115, UN-216-W-25, Ground Contamination above Transfer Line Along Cooper Street	Unplanned Release
92	UPR-200-W-131	UPR-200-W-131, Release from 241-TX-155	Unplanned Release
93	UPR-200-W-135	UPR-200-W-135, Release from 241-TX-155, UN-200-W-135	Unplanned Release
94	UPR-200-W-160	UPR-200-W-160, Line Break at 241-TX-302C, UPR-200-W-38, UPR-200-W-40, 216-T-30	Unplanned Release
95	UPR-200-W-161	UPR-200-W-161, UN-216-W-35, UN-200-W-161, Large Area east of 241-U Tank Farm	Unplanned Release
96	UPR-200-W-164	UPR-200-W-164, Overhead UNH Line Leak, UN-216-W-29	Unplanned Release
97	UPR-200-W-167	UPR-200-W-167, Contamination Migration from 241-TY, UN-216-W-32	Unplanned Release
98	UPR-600-20	UPR-600-20, UN-216-E-41, Old Cross Site Transfer Line Surface Contamination	Unplanned Release

Table 1-4. Pipelines Proposed for Future Inclusion in the 200-IS-1 OU. (10 Pages)

Count	Site Code	Site Name	Site Type
1	200-E-112-PL	200-E-112-PL; B Plant Process Sewer, 2904-E-1, Pipeline from B Plant to 207-B Retention Basin, 24 inch VP line (see subsites)	Radioactive Process Sewer
2	200-E-113-PL	200-E-113-PL; Pipeline from PUREX to 216-A-6 and 216-A-30 Crib, 216-A-42C Valve Box, line 8824	Process Sewer
3	200-E-114-PL	200-E-114-PL, Pipeline From 241-BY Tank Farm to 241-C Tank Farm and BC Cribs Trenches, 2805-E1, 2805-E2, 2805-E3, 2805-E4, 216-BC-2805, Pipeline from 216-BY-201 to 216-BC-201 (see subsites)	Radioactive Process Sewer
4	200-E-126-PL	200-E-126-PL, Underground Pipeline From 207-B to 216-B-3 Ditch and B Pond Disposal System (see subsites)	Radioactive Process Sewer
5	200-E-127-PL	200-E-127-PL, PUREX Cooling Water Line, Pipeline From PUREX to Gable and B-Ponds (216-A-25 and 216-B-3), line 1601	Radioactive Process Sewer
6	200-E-143-PL	200-E-143-PL, Tank Farm Transfer Lines 4101, 4102, 4103, 4104, 4105, 4106, 4107/V033, 4017, 4018, 8656; Encased Transfer Line From 241-AX-151 Diversion Box to 241-A Tank Farms and 244-CR Vault in 241-C Tank Farm	Radioactive Process Sewer
7	200-E-144-PL	200-E-144-PL, Tank Farm Transfer Line 4012, Transfer Line 4013 (A-4013), Encased Transfer Line From 241-CR-152 and 241-CR-153 to 241-AX-151; Lines 4006 and 4007 from 244-AR Vault to 241-AX-151	Encased Tank Farm Pipeline
8	200-E-145-PL	200-E-145-PL, Interplant Transfer Line, Tank Farm Transfer Line V228, Transfer Pipeline From 241-CR-153 to 241-ER-153, 241-ER-152 and 241-ER-151	Encased Tank Farm Pipeline
9	200-E-146-PL	200-E-146-PL, Tank Farm Transfer Line A-4013, Transfer Line From 241-CR-152 to 241-AX-151	Encased Tank Farm Pipeline
10	200-E-147-PL	200-E-147-PL, Interplant Transfer Line, Tank Farm Transfer Line PAS-244, Transfer Line From 244-CR-TK-003 to 241-ER-153	Direct Buried Tank Farm Pipeline
11	200-E-148-PL	200-E-148-PL, Tank Farm Transfer Line V109, Direct Buried Transfer Line From 241-C-151 to 241-A-01A	Direct Buried Tank Farm Pipeline
12	200-E-149-PL	200-E-149-PL, Tank Farm Transfer Line V175, Direct Buried Transfer Line From 241-C-252 to 201-C Hot Semi Works, Tank Farm Pipeline	Direct Buried Tank Farm Pipeline
13	200-E-150-PL	200-E-150-PL, Tank Farm Transfer Line 8900, Direct Buried Transfer Line From 244-CR-TK-003 to 201-C Hot Semi Works Valve Box, Tank Farm Pipeline	Direct Buried Tank Farm Pipeline
14	200-E-151-PL	200-E-151-PL, Tank Farm Transfer Line V050, Direct Buried Transfer Line From 241-C-104 to 241-A-152, Tank Farm Pipeline	Direct Buried Tank Farm Pipeline
15	200-E-152-PL	200-E-152-PL, Tank Farm Transfer Line V051, Direct Buried Transfer Line From 241-C-104 to 241-A-152, Tank Farm Pipeline	Direct Buried Tank Farm Pipeline
16	200-E-153-PL	200-E-153-PL, Tank Farm Transfer Line V108/812, Direct Buried Transfer Line From 241-C-151 to 244-AR-TK-002, Tank Farm Pipeline	Direct Buried Tank Farm Pipeline
17	200-E-154-PL	200-E-154-PL, Tank Farm Transfer Line V113, Direct Buried Transfer Line From 241-C-151 To 241-AX-01A, Tank Farm Pipeline	Direct Buried Tank Farm Pipeline
18	200-E-155-PL	200-E-155-PL, Pipeline From 241-C-03A to Radioactive Process Sewer Line 2904-CR-1, Tank Farm Pipeline	Direct Buried Tank Farm Pipeline
19	200-E-156-PL	200-E-156-PL, 216-C-1 Pipelines, Pipelines from 201-C to 216-C-1	Radioactive Process Sewer
20	200-E-157-PL	200-E-157-PL, 216-C-10 Pipeline, Pipeline from 201-C to 216-C-10 Crib (see subsites)	Encased Tank Farm Pipeline
21	200-E-158-PL	200-E-158-PL, 216-A-1 Pipeline, Pipeline from Sample Pit #3 to 216-A-1 Crib	Direct Buried Tank Farm Pipeline
22	200-E-159-PL	200-E-159-PL, Pipeline from 203-A to 216-A-22, Pipeline from 203-A to 216-A-28 Crib, Pipeline from UNH Truck Apron to 216-A-22 (see subsites)	Direct Buried Tank Farm Pipeline

Table 1-4. Pipelines Proposed for Future Inclusion in the 200-IS-1 OU. (10 Pages)

Count	Site Code	Site Name	Site Type
23	200-E-160-PL	200-E-160-PL, Pipeline from 270-E-1 to 216-B-12 Crib, V219	Direct Buried Tank Farm Pipeline
24	200-E-161-PL	200-E-161-PL, Pipeline from 221-BB to 216-B-55 Crib, V841	Direct Buried Tank Farm Pipeline
25	200-E-162-PL	200-E-162-PL, Pipeline from 221-BB to 216-B-62 Crib, V842, Lateral Line to 216-B-12 Crib #2 (see subsites)	Direct Buried Tank Farm Pipeline
26	200-E-163-PL	200-E-163-PL, Pipeline from BCS Diverting Pit to 216-B-64 Retention Basin	Direct Buried Tank Farm Pipeline
27	200-E-164-PL	200-E-164-PL, Pipeline to 216-A-8 Crib, Pipeline between the 216-A-8 Control Structure and the 216-A-508 Control Structure	Radioactive Process Sewer
28	200-E-165-PL	200-E-165-PL, Pipeline to 216-A-24 Crib (see subsites)	Radioactive Process Sewer
29	200-E-166-PL	200-E-166-PL, Pipeline to 216-A-34 Ditch	Radioactive Process Sewer
30	200-E-167-PL	200-E-167-PL, Underground pipelines from 244-A Lift Station to 241-A-A and 241-A-B Valve Pits, Lines SN-215 and SN-216	Radioactive Process Sewer
31	200-E-168-PL	200-E-168-PL, Underground Pipeline to 216-A-3	Radioactive Process Sewer
32	200-E-169-PL	200-E-169-PL, Pipeline to the 216-C-3 Crib	Radioactive Process Sewer
33	200-E-170-PL	200-E-170-PL, Pipeline from 276-C to 216-C-4 Crib	Radioactive Process Sewer
34	200-E-171-PL	200-E-171-PL, Pipeline to the 216-C-6 Crib	Radioactive Process Sewer
35	200-E-172-PL	200-E-172-PL, Pipeline from 209-E to the 216-C-7 Crib	Radioactive Process Sewer
36	200-E-173-PL	200-E-173-PL, Pipeline from 241-CX-71 to 216-C-5 Crib	Radioactive Process Sewer
37	200-E-174-PL	200-E-174-PL, 216-B-10 (A&B) Pipeline, Pipeline from 221-BC and 222-B to 216-B-10 A&B Cribs (see subsites)	Radioactive Process Sewer
38	200-E-175-PL	200-E-175-PL, Pipeline from 292-B to 216-B-10 A&B	Radioactive Process Sewer
39	200-E-176-PL	200-E-176-PL, Pipeline from 242-B to 216-B-11-A&B	Radioactive Process Sewer
40	200-E-177-PL	200-E-177-PL, Pipeline Rerouting Waste from 216-B-8 Crib to 216-B-11A&B Wells	Radioactive Process Sewer
41	200-E-178-PL	200-E-178-PL, Pipeline from tank 241-B-110 to 216-B-8 Crib and Tile Field	Encased Tank Farm Pipeline
42	200-E-180-PL	200-E-180-PL, 216-B-57 Crib Pipeline	Radioactive Process Pipeline
43	200-E-181-PL	200-E-181-PL, 216-B-61 Crib Pipeline	Radioactive Process Sewer
44	200-E-182-PL	200-E-182-PL, 216-A-7 Crib Pipeline	Radioactive Process Sewer
45	200-E-183-PL	200-E-183-PL, Pipelines from 241-A-151 Diversion Box to 216-A-2, lines V010 and V011	Encased Tank Farm Pipeline
46	200-E-184-PL	200-E-184-PL, 216-A-2 Crib Pipelines, V010, V011	Radioactive Process Sewer
47	200-E-185-PL	200-E-185-PL, 216-A-4 Crib Pipelines, V014, V016	Radioactive Process Sewer
48	200-E-186-PL	200-E-186-PL, 216-A-31 Crib Pipelines, V010, V011	Radioactive Process Sewer

Table 1-4. Pipelines Proposed for Future Inclusion in the 200-IS-1 OU. (10 Pages)

Count	Site Code	Site Name	Site Type
49	200-E-187-PL	200-E-187-PL, Chemical Sewer from 202-A to 216-A-29 Ditch, PUREX Chemical Sewer (CSL), Lines 8819, 5802, 5701	Radioactive Process Sewer
50	200-E-188-PL	200-E-188-PL, B Plant Chemical Sewer Line, 2904-E-2, 15 inch VP line, BCE	Radioactive Process Sewer
51	200-E-191-PL	200-E-191-PL, 216-B-63 Pipeline, Pipeline from valve pit to 216-B-63 Ditch	Radioactive Process Sewer
52	200-E-192-PL	200-E-192-PL, 216-A-10 Pipelines (see subsites), lines from Sample Pit 4 to 216-A-10 Crib	Radioactive Process Sewer
53	200-E-193-PL	200-E-193-PL, 216-A-21 Crib Pipeline, Line X015	Radioactive Process Sewer
54	200-E-194-PL	200-E-194-PL, 216-A-32 Crib Pipeline	Radioactive Process Sewer
55	200-E-195-PL	200-E-195-PL, 241-B-361 Settling Tank and 216-B-9 Crib Pipelines, line V204 (see subsites)	Radioactive Process Sewer
56	200-E-196-PL	200-E-196-PL, Lines T167 and T022, Stainless Steel line to 216-A-4, 216-A-21, and 216-A-27 Cribs	Radioactive Process Sewer
57	200-E-197-PL	200-E-197-PL, Encased Pipelines between 241-BR-152 Diversion Box and 241-B Tank Farm, Lines 9002, 9006, 9010, 9014, 9017, 9020, 9031, 9032, 9035, 9037, 9038, 9041, 9044, 9047	Radioactive Process Sewer
58	200-E-198-PL	200-E-198-PL, Encased Tank Farm Pipeline from 241-BX-154 Diversion to 241-BX-155 Diversion Box, Lines V282, V283, V284, V285	Process Sewer
59	200-E-199-PL	200-E-199-PL, Tank Farm Lines from 241-B-154 Diversion Box to 241-B Tank Farm, Lines V204, V206, V208, V209, V211, V213, V215, V285	Process Sewer
60	200-E-200-PL	200-E-200-PL, Pipelines from 244-AR Vault to 241-AY-152 and 241-A-153 Diversion Boxes, Lines 801, 802, 806, 805	Radioactive Process Sewer
61	200-E-201-PL	200-E-201-PL, Transfer Lines from 241-BX-155 to Diversion Boxes in 241-B Tank Farm, Lines V315 and V319	Radioactive Process Sewer
62	200-E-202-PL	200-E-202-PL, Transfer lines from 241-BX-155 Diversion Box to 241-BX-153 Diversion Box, Lines V315, V316, V317, V318, V319	Radioactive Process Sewer
63	200-E-203-PL	200-E-203-PL, Pipeline from 241-BYR-154 Diversion Box to 216-B-2-2 Ditch, line 9712	Radioactive Process Sewer
64	200-E-204-PL	200-E-204-PL, Pipeline to 216-B-2-1 and 216-B-2-2 Ditches (see subsites)	Radioactive Process Sewer
65	200-E-205-PL	200-E-205-PL, 216-B-2-3 Ditch Pipelines (see subsites)	Radioactive Process Sewer
66	200-E-206-PL	200-E-206-PL, Lines V716, V717, V718/817, Double Pipes from 244-AR Vault to 241-AR-151 Diversion Box	Radioactive Process Sewer
67	200-E-207-PL	200-E-207-PL, Encased Transfer Line from 241-A-151 Diversion Box to 241-A-152 Diversion Box; Lines V004, V005, V006, V007, V008	Radioactive Process Sewer
68	200-E-208-PL	200-E-208-PL, Lines V304 and V305 from 241-BY Tank Farm to 241-B-252 Diversion Box	Radioactive Process Sewer
69	200-E-209-PL	200-E-209-PL, Pipeline from 272-BB to 200-E-25 Dry Well	Radioactive Process Sewer
70	200-E-210-PL	200-E-210-PL, Encased lines between 241-AW Tank Farm and 242-A Evaporator Building, Lines SL-167, SL-168, SN-219, SN-220, SN-269, SN-270	Radioactive Process Sewer
71	200-E-211-PL	200-E-211-PL, Transfer Lines from 241-AW to 242-A Evaporator Building, Lines DR334, DR335, DR343	Radioactive Process Sewer
72	200-E-212-PL	200-E-212-PL, Transfer lines between 241-AW Tank Farm and 241-AP Tank Farm, Lines SL-509, SL-510, SN-609, SN-610	Radioactive Process Sewer
73	200-E-213-PL	200-E-213-PL, Transfer Lines from 221-B to 241-B-154 Diversion Box, Lines V200, V329, V330, V331, V332, V333, V334	Radioactive Process Sewer

Table 1-4. Pipelines Proposed for Future Inclusion in the 200-IS-1 OU. (10 Pages)

Count	Site Code	Site Name	Site Type
74	200-E-214-PL	200-E-214-PL, Pipeline to 200-E-55 French Drain, Pipeline from 291-B Sand Filter to French Drain	Radioactive Process Sewer
75	200-E-215-PL	200-E-215-PL, Transfer line between 241-ER-151 Diversion Box and 241-ER-152 Diversion Box, Line V229	Radioactive Process Sewer
76	200-E-216-PL	200-E-216-PL, Transfer Lines between 241-BX-153, 241-B-151 and 241-B-152 Diversion Boxes, Lines V235, V236, V237, V242, C251, V252, V253 (see subsites)	Radioactive Process Sewer
77	200-E-217-PL	200-E-217-PL, Encased Transfer Line from 241-ER-151 Diversion Box to 241-BX Tank Farm, Lines 9608, 9653, 9719, V225 (see subsites)	Radioactive Process Sewer
78	200-E-218-PL	200-E-218-PL, Transfer Lines between 241-A-151 Diversion Box and 241-AW Tank Farm, Lines V021, V022, V023	Radioactive Process Sewer
79	200-E-220-PL	200-E-220-PL, Pipeline from 241-BY Tank Farm to 216-BY-201 Flush Tank and Monitoring Pit (see subsites)	Process Sewer
80	200-E-221-PL	200-E-221-PL, Pipeline to 216-B-51 French Drain, BC Crib pipeline drain line	Radioactive Process Sewer
81	200-E-224-PL	200-E-224-PL, 241-A-151 Diversion Box Drain Line to 241-A-302A Catch Tank, Line V027	Radioactive Process Sewer
82	200-E-225-PL	200-E-225-PL, Transfer Line from 241-AR-151 Diversion Box to 241-AY-102 Tank, Line V720	Radioactive Process Sewer
83	200-E-226-PL	200-E-226-PL, Transfer Line from 221-B to 241-C-154, Promethium Transfer Line, V743	Radioactive Process Sewer
84	200-E-227-PL	200-E-227-PL, Transfer Lines between 244-AR Vault Facility and 241-AX-151 Diversion Box, Lines 4005/810, 4015/814, 4019/817	Radioactive Process Sewer
85	200-E-228-PL	200-E-228-PL, Drain Lines from 241-ER-151 Diversion Box to 241-ER-311 and 241-ER-311A Catch Tanks, Lines V224, V226, V226-1 (see subsites)	Radioactive Process Sewer
86	200-E-229-PL	200-E-229-PL, Transfer Line between Tank 241-AP-102 and 241-A-B Valve Pit, Line SN-650	Radioactive Process Sewer
87	200-E-230-PL	200-E-230-PL, Pipeline from 292-B to 216-B-4 Reverse Well	Radioactive Process Sewer
88	200-E-231-PL	200-E-231-PL, 216-A-45 Crib Pipeline	Radioactive Process Sewer
89	200-E-232-PL	200-E-232-PL, Pipeline from 207-A Basins to 216-A-30 and 216-A-37-1 Cribs (see subsites)	Radioactive Process Sewer
90	200-E-233-PL	200-E-233-PL, Pipeline from 216-A-30 Crib Distribution Box to the 216-A-37-2 Crib Distribution Box	Radioactive Process Sewer
91	200-E-234-PL	200-E-234-PL, Pipelines from 242-A Evaporator Building to the 207-A Basins (see subsites), Lines 300, 501, 505, 557	Radioactive Process Sewer
92	200-E-235-PL	200-E-235-PL, 207-A North Basin Distribution Lines	Radioactive Process Sewer
93	200-E-236-PL	200-E-236-PL, 207-A South Basin Distribution Lines	Radioactive Process Sewer
94	200-E-238-PL	200-E-238-PL, Pipeline from 206-A to 216-A-9 Crib	Radioactive Process Sewer
95	200-E-239-PL	200-E-239-PL, Pipeline from 216-A-5 Sample Pit #4 to 216-A-5 Crib	Radioactive Process Sewer
96	200-E-240-PL	200-E-240-PL, Pipeline from Valve Pit west of Sample Pit 4 to the 216-A-38-1 Crib	Radioactive Process Sewer
97	200-E-241-PL	200-E-241-PL, Pipeline from 200-E-58 Neutralization Tank to the 216-A-5 Sample Pit #4 (see subsites), lines 7717 and 7718	Radioactive Process Sewer
98	200-E-242-PL	200-E-242-PL, Pipeline from 216-A-5 Sample Pit #4 to 216-A-15 French Drain	Encased Tank Farm Pipeline

Table 1-4. Pipelines Proposed for Future Inclusion in the 200-IS-1 OU. (10 Pages)

Count	Site Code	Site Name	Site Type
99	200-E-243-PL	200-E-243-PL, Pipeline to the 216-B-13 French Drain	Encased Tank Farm Pipeline
100	200-E-244-PL	200-E-244-PL, Pipeline from 201-C Valve Pit to 241-CX-70	Direct Buried Tank Farm Pipeline
101	200-E-245-PL	200-E-245-PL, Pipeline from 201-C Hot Shop to 241-CX-71	Encased Tank Farm Pipeline
102	200-E-246-PL	200-E-246-PL, Pipeline from 201-C Valve Pit to 241-CX-72	Direct Buried Tank Farm Pipeline
103	200-E-247-PL	200-E-247-PL, Pipelines to the 209-E-WS-2 French Drain (see subsites)	Direct Buried Tank Farm Pipeline
104	200-E-248-PL	200-E-248-PL, Pipelines to the 209-E-WS-3 Valve Pit (see subsites)	Direct Buried Tank Farm Pipeline
105	200-E-249-PL	200-E-249-PL, Pipelines to 200-E-4 French Drain (see subsites)	Direct Buried Tank Farm Pipeline
106	200-E-250-PL	200-E-250-PL, Pipeline from 2704-C to 2704-C-WS-1 Quench Tank	Direct Buried Tank Farm Pipeline
107	200-E-251-PL	200-E-251-PL, Pipeline from 291-C Stack to 216-C-2 Reverse Well	Direct Buried Tank Farm Pipeline
108	200-E-252-PL	200-E-252-PL, Pipeline from 291-C Air Filter Building to 216-C-2 Reverse Well	Radioactive Process Sewer
109	200-E-253-PL	200-E-253-PL, Pipeline from 202-A to 216-A-36A and 216-A-36B Cribs	Radioactive Process Sewer
110	200-E-254-PL	200-E-254-PL, Pipeline from 209-E to 216-C-9 Pond	Radioactive Process Sewer
111	200-E-255-PL	200-E-255-PL, Pipeline connecting 216-C-9 Pond to Pipeline 200-E-169-PL	Radioactive Process Sewer
112	200-E-256-PL	200-E-256-PL, Pipelines from 201-C (south side) to 216-C-9 Pond	Direct Buried Tank Pipeline
113	200-E-257-PL	200-E-257-PL, Pipeline from 201-C (east side) to 216-C-9 Pond	Encased Tank Farm Pipeline
114	200-E-258-PL	200-E-258-PL, 216-C-9 Pond Lobe Distribution Piping	Direct Buried Tank Pipeline
115	200-E-259-PL	200-E-259-PL, Pipeline from 291-C Fan House to 216-C-9 Pond	Radioactive Process Sewer
116	200-E-260-PL	200-E-260-PL, Steam Condensate By-Pass Line from PUREX to 216-A-30, line 8824A	Encased Tank Farm Pipeline
117	200-E-261-PL	200-E-261-PL, Effluent Recycle line from 216-A-42 Basin to PUREX	Direct Buried Tank Farm Pipeline
118	200-E-262-PL	200-E-262-PL, Pipelines Associated with 216-A-42 Basin, 216-A-42A Pump Station, 216-A-42B Valve Box and 216-A-42C Diversion Box	Direct Buried Tank Farm Pipeline
119	200-E-263-PL	200-E-263-PL, 216-A-42 Basin Pipeline to 216-A-42C Diversion Box	Direct Buried Tank Farm Pipeline
120	200-E-264-PL	200-E-264-PL, Pipeline from 242-B Evaporator Building to 207-B Retention Basin	Radioactive Process Sewer
121	200-E-265-PL	200-E-265-PL, 241-BY and 241-BX Tank Farm Cooling Water Pipeline to 207-B Retention Basin (see subsites)	Direct Buried Tank Farm Pipeline
122	200-E-266-PL	200-E-266-PL, Pipeline from PUREX Trap Pit #1 to 216-A-11 French Drain	Direct Buried Tank Farm Pipeline
123	200-E-267-PL	200-E-267-PL, Pipeline from PUREX Trap Pit #3 to 216-A-12 French Drain	Encased Tank Farm Pipeline
124	200-E-268-PL	200-E-268-PL, Pipeline from PUREX Vacuum Cleaner Filter Box to 216-A-14 French Drain, Line T073	Direct Buried Tank Farm Pipeline

Table 1-4. Pipelines Proposed for Future Inclusion in the 200-IS-1 OU. (10 Pages)

Count	Site Code	Site Name	Site Type
125	200-E-269-PL	200-E-269-PL, Pipeline from 291-A Fan Building to 216-A-33 French Drain	Direct Buried Tank Farm Pipeline
126	200-E-270-PL	200-E-270-PL, Pipeline from 291-A Fan Control House to 216-A-26 and 216-A-26A French Drains, line T022	Encased Tank Farm Pipeline
127	200-E-271-PL	200-E-271-PL, PUREX Cooling Water Header Pipeline, Line 8823	Direct Buried Tank Farm Pipeline
128	200-E-272-PL	200-E-272-PL, Pipeline to 216-A-35 French Drain	Direct Buried Tank Farm Pipeline
129	200-E-273-PL	200-E-273-PL, Pipeline to 216-A-13 French Drain (see subsites)	Radioactive Process Sewer
130	200-E-274-PL	200-E-274-PL, Pipeline from 244-A Lift Station to 216-A-40 Basin, Line 323	Radioactive Process Sewer
131	200-E-275-PL	200-E-275-PL, Cooling Water Pipeline to 216-A-40 Basin, line 815	Radioactive Process Sewer
132	200-E-276-PL	200-E-276-PL, 216-A-41 Crib Pipeline	Direct Buried Tank Pipeline
133	200-E-277-PL	200-E-277-PL, 216-B-59 and 216-B-59B Pipelines (see subsites)	Encased Tank Farm Pipeline
134	200-E-278-PL	200-E-278-PL, Process Sewer Pipeline from 272-E to CTFN 2703E, Pipeline to Chemical Tile Field North of 2703E	Encased Tank Farm Pipeline
135	200-E-279-PL	200-E-279-PL, Pipeline from 241-B-361 Settling Tank to 216-B-5 Reverse Well	Encased Tank Farm Pipeline
136	200-E-281-PL	200-E-281-PL, Pipeline from 241-B Tank Farm to 216-B-7A and 216-B-7B Cribs, Line V306	Radioactive Process Sewer
137	200-E-282-PL	200-E-282-PL, Process Waste Lines from 202-A to 241-AX-151 Diversion Box, Lines 4001, 4002, 4003, 4004	Direct Buried Tank Farm Pipeline
138	200-E-283-PL	200-E-283-PL, Pipeline from 242-A Bldg to 200-E-127-PL (to Gable and B Ponds)	Direct Buried Tank Farm Pipeline
139	200-W-79-PL	200-W-79-PL; 216-T-36 Crib pipeline; V663	Radioactive Process Sewer
140	200-W-84-PL	200-W-84-PL, U Plant Chemical Process Sewer to 216-U-14 Ditch, 200-W-84, VCP Process Sewer (see subsites)	Process Sewer
141	200-W-88-PL	200-W-88-PL, T Plant Process Sewer Pipeline, 221-T Process Sewer, 24 Inch Process Sewer, 200-W-88, (see subsites)	Radioactive Process Sewer
142	200-W-102-PL	200-W-102-PL, Pipeline from Laundry, Powerhouse and Shops to 216-U-14 Ditch, 200-W-102	Encased Tank Farm Pipeline
143	200-W-129-PL	200-W-129-PL, Encasement Containing Lines V399, V405, and V411	Direct Buried Tank Farm Pipeline
144	200-W-130-PL	200-W-130-PL, V445, V663, V601; Pipeline from 241-T-151 Diversion Box to 241-U-151 Diversion Box; V416	Direct Buried Tank Farm Pipeline
145	200-W-131-PL	200-W-131-PL, V601, Spur to 241-TX Tank Farm	Encased Tank Farm Pipeline
146	200-W-132-PL	200-W-132-PL, Pipelines from 221-T to 241-T-151 and 241-T-152, V653, V654, V667, V668, V669, V706, V707 (Direct Buried lines)	Direct Buried Tank Farm Pipeline
147	200-W-133-PL	200-W-133-PL, V682 Spare Line	Direct Buried Tank Pipeline
148	200-W-134-PL	200-W-134-PL, V683 Spare Line	Radioactive Process Sewer
149	200-W-135-PL	200-W-135-PL, V662, Spare Line	Radioactive Process Sewer
150	200-W-137-PL	200-W-137-PL, Pipeline from 241-S-151 Diversion Box to 216-S-1 & 2 Cribs, line V533	Radioactive Process Sewer

Table 1-4. Pipelines Proposed for Future Inclusion in the 200-IS-1 OU. (10 Pages)

Count	Site Code	Site Name	Site Type
151	200-W-138-PL	200-W-138-PL, Pipeline from 240-S-151 to 216-S-7 Crib, V547	Radioactive Process Sewer
152	200-W-139-PL	200-W-139-PL, Pipeline from 200-W-138-PL to 216-S-9 Crib, V547	Radioactive Process Sewer
153	200-W-140-PL	200-W-140-PL, Pipeline from 292-T(200-W-40)	Radioactive Process Sewer
154	200-W-141-PL	200-W-141-PL, Pipeline connecting 200-W-139-PL Pipeline to 216-S-23 Crib, V547	Radioactive Process Sewer
155	200-W-142-PL	200-W-142-PL, Pipeline from 222-T to 216-T-8 Crib	Radioactive Process Sewer
156	200-W-143-PL	200-W-143-PL, Encased Pipeline from 241-TX-154 Diversion Box 241-TX-155 Diversion Box, lines V383, V384, V385, V387, V388, V391, V392, V393	Radioactive Process Sewer
157	200-W-146-PL	200-W-146-PL, 216-S-22 Crib Pipeline	Radioactive Process Sewer
158	200-W-147-PL	200-W-147-PL, Pipeline from 207-SL to 216-S-19 Pond	Radioactive Process Sewer
159	200-W-148-PL	200-W-148-PL, 216-S-26 Crib Pipeline	Radioactive Process Sewer
160	200-W-149-PL	200-W-149-PL, Pipelines related to 216-S-20 Crib, (see subsites)	Radioactive Process Sewer
161	200-W-150-PL	200-W-150-PL, Pipelines Associated with 216-S-13 Crib, (see subsites)	Radioactive Process Sewer
162	200-W-151-PL	200-W-151-PL, 200-W-42 Pipe Remaining Under 16th Street	Radioactive Process Sewer
163	200-W-152-PL	200-W-152-PL, Pipeline from 202-S to 2904-S-170, 207-S Retention Basin and 216-S-17 Pond, REDOX Process Sewer	Radioactive Process Sewer
164	200-W-153-PL	200-W-153-PL, Steel Pipeline from 240-S-151 Diversion Box to the 2904-S-172 and 2904-S-171 Control Structures (see subsite)	Radioactive Process Sewer
165	200-W-154-PL	200-W-154-PL, Pipeline from 200-W-152-PL to 216-S-5 Crib	Radioactive Process Sewer
166	200-W-155-PL	200-W-155-PL, Pipeline from 2904-S-160 Control Structure to 216-S-16 Ditch	Radioactive Process Sewer
167	200-W-156-PL	200-W-156-PL, 216-S-6 Crib Pipeline, Pipeline from 200-W-155-PL to the 2904-S-171 Control Structure	Radioactive Process Sewer
168	200-W-157-PL	200-W-157-PL, REDOX Chemical Sewer, Pipeline from 202-S to 200-W-152-PL, pipeline from 205-S to REDOX Chemical Sewer (see subsites)	Radioactive Process Sewer
169	200-W-158-PL	200-W-158-PL, Pipeline from 293-S to 200-W-152-PL	Radioactive Process Sewer
170	200-W-159-PL	200-W-159-PL, Cooling water lines from 241-SX-401 and 241-SX-402 to 216-U-10 Pond	Radioactive Process Sewer
171	200-W-160-PL	200-W-160-PL, Pipeline from 241-SX-401 and 241-SX-402 to 216-S-21 Crib	Radioactive Process Sewer
172	200-W-161-PL	200-W-161-PL, Pipeline from 242-S to 216-S-25 Crib, Line 557	Radioactive Process Sewer
173	200-W-162-PL	200-W-162-PL, Pipeline from 241-SX-701 to 216-SX-2 Crib	Radioactive Process Sewer
174	200-W-163-PL	200-W-163-PL, T Plant Process Sewer, 18 inch 221-T Process Sewer Pipeline (see subsites)	Radioactive Process Sewer
175	200-W-164-PL	200-W-164-PL, Pipeline from 207-T Retention Basin to the 216-T-4 Ditch	Radioactive Process Sewer

Table 1-4. Pipelines Proposed for Future Inclusion in the 200-IS-1 OU. (10 Pages)

Count	Site Code	Site Name	Site Type
176	200-W-165-PL	200-W-165-PL, Pipeline from Tank 241-TX-112 to 207-T Retention Basin	Process Sewer
177	200-W-166-PL	200-W-166-PL, Pipeline from 242-T Evaporator Building to the 207-T Retention basin	Radioactive Process Sewer
178	200-W-167-PL	200-W-167-PL, Pipeline from 242-T Evaporator to 207-T Retention Basin, V610	Radioactive Process Sewer
179	200-W-168-PL	200-W-168-PL, 216-U-3 Crib and 216-U-14 Ditch Pipelines (see subsites)	Radioactive Process Sewer
180	200-W-169-PL	200-W-169-PL, Pipeline between 216-U-10 Pond and 216-U-11 Overflow	Radioactive Process Sewer
181	200-W-173-PL	200-W-173-PL, 216-T-33 Crib Pipeline, Pipeline from 2706-T to 216-T-33 Crib	Radioactive Process Sewer
182	200-W-174-PL	200-W-174-PL, Pipelines from 234-5Z to 216-Z-1A and 216-Z-18 Crib, 216-Z-1A Modified Pipeline, Lines 1035 and 1036 (see subsites)	Radioactive Process Sewer
183	200-W-175-PL	200-W-175-PL, Pipeline to Route Waste from 241-T-112 to 216-TY-201 Flush Tank and 216-T-26, 27, 28 Cribs, Line V681	Radioactive Process Sewer
184	200-W-176-PL	200-W-176-PL, Encased Transfer lines between 241-TX-153 Diversion Box and 241-TX-155 Diversion Box, Lines V396, V397, V401, V403, V407, V409, V413	Radioactive Process Sewer
185	200-W-177-PL	200-W-177-PL, Direct Buried Tank Farm Lines between 241-TXR-151 and 241-TX-155 Diversion Boxes, Lines V7616 and V7653	Radioactive Process Sewer
186	200-W-178-PL	200-W-178-PL, Pipeline from 241-Z to 244-TX DCRT, lines HSW-202 and HSW-203	Radioactive Process Sewer
187	200-W-179-PL	200-W-179-PL, Pipelines between 241-S-152 Diversion Box and 241-U Tank Farm, lines SL100, SL101, SN216/281, DR327	Radioactive Process Sewer
188	200-W-180-PL	200-W-180-PL, Pipelines to 216-T-1 Ditch (see subsites)	Radioactive Process Sewer
189	200-W-181-PL	200-W-181-PL, Transfer Lines between 241-U-152 and 241-U-153 Diversion Boxes, Lines V426, V427, V428/V461	Radioactive Process Sewer
190	200-W-182-PL	200-W-182-PL, Encased Transfer lines between 241-U-152 Diversion Box and 241-TX-152 and 241-TX-155 Diversion Boxes, Lines V398, V404, V410	Radioactive Process Sewer
191	200-W-183-PL	200-W-183-PL, Transfer Lines between 241-U-151 and 241-U-152 Diversion Boxes. Lines V422/V452, V421/V543	Radioactive Process Sewer
192	200-W-184-PL	200-W-184-PL, Drain Lines from 241-U-151,241-U-152 and 241-U-153 Diversion Boxes to 241-U-302 Catch Tank, Line V478	Radioactive Process Sewer
193	200-W-185-PL	200-W-185-PL, Transfer lines between 241-U-151 and 241-U-153 Diversion Boxes, Lines V450, V451	Radioactive Process Sewer
194	200-W-186-PL	200-W-186-PL, Transfer lines from 240-S-152 Diversion Box to 204-S and 205-S, Lines 1006 and 1045	Radioactive Process Sewer
195	200-W-187-PL	200-W-187-PL, Transfer lines between 240-S-151 and 240-S-152 Diversion Boxes, Lines V552, V553, V555	Radioactive Process Sewer
196	200-W-189-PL	200-W-189-PL, Transfer lines from 219-S to 241-SY Tank Farm, Lines SNL-5350 and SNL-5351	Radioactive Process Sewer
197	200-W-190-PL	200-W-190-PL, Discharge Line from 240-S-151 Diversion Box to 240-S-302 Catch Tank, Line V554	Radioactive Process Sewer
198	200-W-191-PL	200-W-191-PL, Encased Transfer line between 241-TX-155 and 241-TY-153 Diversion Boxes, Lines V402, V406, V408, V412	Radioactive Process Sewer
199	200-W-192-PL	200-W-192-PL, U Plant Process Sewer, Pipeline from 221-U, 222-U, and 224-U to the 207-U Retention Basin (see subsites)	Radioactive Process Sewer
200	200-W-196-PL	200-W-196-PL, Pipelines from Railcar Unloading Stations to 216-T-34 Crib	Radioactive Process Sewer

Table 1-4. Pipelines Proposed for Future Inclusion in the 200-IS-1 OU. (10 Pages)

Count	Site Code	Site Name	Site Type
201	200-W-197-PL	200-W-197-PL, Pipelines from Railcar Unloading Stations to 216-T-35 Crib	Radioactive Process Sewer
202	200-W-198-PL	200-W-198-PL, Pipelines from Truck Unloading Station to 216-T-34 and 216-T-35 Cribs	Radioactive Process Sewer
203	200-W-199-PL	200-W-199-PL, Pipelines from building 231-Z to 231-W-151 Vault	Radioactive Process Sewer
204	200-W-200-PL	200-W-200-PL, 216-Z-16 Crib Pipeline	Radioactive Process Sewer
205	200-W-201-PL	200-W-201-PL, 216-Z-17 Crib Pipeline	Encased Tank Farm Pipeline
206	200-W-202-PL	200-W-202-PL, Pipeline from 231-W-151 to 216-Z-5 Crib (see subsites)	Radioactive Process Sewer
207	200-W-203-PL	200-W-203-PL, Pipeline from 231-W-151 Vault to 216-Z-7 Crib	Radioactive Process Sewer
208	200-W-204-PL	200-W-204-PL, Pipeline from 231-W-151 Vault to 216-Z-10 Reverse Well	Radioactive Process Sewer
209	200-W-205-PL	200-W-205-PL, Pipelines from 235-5Z to 241-Z-8 Silica Storage Tank and 216-Z-8 French Drain (see subsites)	Radioactive Process Sewer
210	200-W-206-PL	200-W-206-PL, Pipelines from 234-5Z to 216-Z-9 Crib	Radioactive Process Sewer
211	200-W-208-PL	200-W-208-PL, Pipeline from Diversion Boxes 200-E-58 and 200-E-59 to 216-Z-12 Crib (see subsites)	Process Sewer
212	200-W-209-PL	200-W-209-PL, 207-Z Pipelines (see subsites)	Radioactive Process Sewer
213	200-W-210-PL	200-W-210-PL, Pipeline from 241-Z-361 Settling tank to 216-Z-1, 216-Z-2 and 216-Z-3 Cribs and 216-Z-1A Tile Field (see subsites)	Radioactive Process Sewer
214	200-W-212-PL	200-W-212-PL, Encased Transfer Line from 240-S-151 Diversion Box to Pipeline 200-W-153-PL, Lines V550, V551, V544, V546, V548, V549	Radioactive Process Sewer
215	200-W-213-PL	200-W-213-PL, Pipelines from 241-TX-153 Diversion Box and 241-TX-302A to 216-T-19 Crib, V795, V605 (see subsites)	Radioactive Process Sewer
216	200-W-214-PL	200-W-214-PL, Pipeline from 291-Z to 216-Z-13 French Drain	Radioactive Process Sewer
217	200-W-215-PL	200-W-215-PL, Pipeline from 291-Z to 216-Z-14 French Drain	Radioactive Process Sewer
218	200-W-216-PL	200-W-216-PL, Pipeline from 291-Z to 216-Z-15 French Drain	Radioactive Process Sewer
219	200-W-218-PL	200-W-218-PL, Pipeline from 216-U-10 Pond to 216-U-9 Ditch	Radioactive Process Sewer
220	200-W-219-PL	200-W-219-PL, Pipelines from 235-Z to the north side of 241-Z, 241-Z Primary Pipe Trench, Pipe Tunnel 3	Radioactive Process Sewer
221	200-W-220-PL	200-W-220-PL, Pipeline from 241-Z to 241-Z-361 Settling Tank	Radioactive Process Sewer
222	200-W-221-PL	200-W-221-PL, Laundry Waste Crib Pipeline	Radioactive Process Sewer
223	200-W-222-PL	200-W-222-PL, 207-U Retention Basin Outlet Pipeline to the 216-U-14 Ditch	Radioactive Process Sewer
224	200-W-223-PL	200-W-223-PL, Pipeline from 242-S Evaporator to 216-U-14 Ditch	Radioactive Process Sewer

Table 1-4. Pipelines Proposed for Future Inclusion in the 200-IS-1 OU. (10 Pages)

Count	Site Code	Site Name	Site Type
225	200-W-224-PL	200-W-224-PL, Pipeline from 234-5Z and 236-Z to West Side of 241-Z (see subsites)	Radioactive Process Sewer
226	200-W-225-PL	200-W-225-PL, PFP Six Inch Condensate Line	Radioactive Process Sewer
227	200-W-226-PL	200-W-226-PL, Pipeline from 224-T Plutonium Concentration Facility to 241-T-361 Settling Tank and 216-T-3 Reverse Well, Lines V326, V671, V706	Radioactive Process Sewer
228	200-W-227-PL	200-W-227-PL, Pipeline from 221-T Separations Facility to 216-T-6 Crib	Radioactive Process Sewer
229	200-W-228-PL	200-W-228-PL, Pipeline from 232-Z to 241-Z, 3 inch Contaminated Waste Line	Radioactive Process Sewer
230	200-W-229-PL	200-W-229-PL, Pipeline from 2736-ZB to 241-Z	Encased Tank Farm Pipeline
231	200-W-230-PL	200-W-230-PL, Pipeline from Railroad to 276-S-141 and 276-S-142-PL Tanks (see subsites)	Radioactive Process Sewer

Certain RCRA TSD tanks are part of the 200-IS-1 OU. These TSD tanks include the CX Tank System (the 241-CX-70 Storage Tank, 241-CX-71 Neutralization Tank, and 241-CX-72 Storage Tank), the HSTF tanks (276-S-141 and 276-S-142 Hexone Storage Tanks), and the 241-Z Treatment and Storage Tanks System (241-Z-D-4, 241-Z-D-5, 241-Z-D-7, and 241-Z-D-8 Storage and Treatment Tanks; 241-Z Sump; and 241-Z Tank Pit). Closure certifications were submitted to Ecology in December 2006 to grant the 241-Z Treatment and Storage Tank System clean closure and the completion of Tri-Party Agreement Milestone M-083-32.

Other structures listed in the Tri-Party Agreement Action Plan, Appendix C, as part of the 200-IS-1 OU include 216-TY-201 (Supernatant Disposal Flush Tank), 200-W-16 Storage Tank (292-T Underground Tanks), 241-WR Vault (Tanks-001 through 009, 241-WR Diversion Station Vault), and the Hot Semiworks Valve Pit. These structures will be addressed during the Phase 2 work plan/SAP.

In addition, SST and DST RCRA pipeline components occur outside of the WMAs that are considered ancillary equipment and, as such, are associated with the SST Dangerous Waste Permit Application, Part A Form and the DST draft Part B Permit Application (WA 7890008967). RCRA TSD ancillary equipment and/or TSD pipelines within the scope of the project will be referenced using the current RCRA Part A permits.

The other waste sites currently identified as part of the 200-IS-1 OU are RCRA past practice (RPP) sites. Waste sites assigned to the 200-IS-1 OU, as documented in the Tri-Party Agreement Action Plan, Appendix C (Ecology et al., 1989b), are tracked in WIDS. Addition of new waste sites and reclassification of accepted waste sites will be conducted in accordance with RL-TPA-90-0001, TPA-MP-14 procedures.

1.2.2 Scope and Content of the Sampling and Analysis Plans

Two SAPs are presented in this work plan for the Phase 1 characterization of the pipeline systems. The Phase 1 sampling specifications for selected facility process-waste pipeline systems (Bins 1-5) are provided in Appendix A and for the tank-farm waste-transfer pipelines (Bin 6) in Appendix B. The sampling designs developed include evaluation of contaminant characteristics inside pipelines and for soils adjacent to pipelines.

The characterization activities identified in the SAPs will provide data to refine the conceptual contaminant distribution models, support an assessment of risk, and evaluate remedial alternatives. The site evaluations and sampling requirements described in these SAPs are based on implementing the sampling-design elements identified in the DQO process documented in D&D-30262.

The field activities include investigations of both the interiors of selected pipelines and the adjacent soil areas. Pipeline interiors will be sampled to determine whether contamination is present as residual sediment, scale, or sludge. Known and suspected releases from pipelines in adjacent soil areas will be investigated by radiological logging and soil sampling. Field-screening techniques will be used to identify selected radiological and nonradiological contaminants. Laboratory analysis will be conducted on a limited number of samples for analyses of radiological and nonradiological COPCs. Sampling for waste designation will be addressed through a waste designation DQO process before the field-characterization activities begin.

The SAP prepared for the 241-CX-72 Storage Tank (Appendix C) has a limited scope and focuses on characterization of the waste remaining in the tank. Sampling of remaining waste will be conducted to determine the composition and concentrations of radionuclide and nonradionuclide constituents. A single borehole will be completed through the grout fill present in the tank and into the underlying residual waste material. Analytical results will be used in the assessment of the disposal options for the remaining waste, if removal of the tank is performed.

1.2.3 Milestones

The characterization and remediation of waste sites at the Hanford Site are addressed in the Tri-Party Agreement (Ecology et al., 1989a). The schedule of work at the Hanford Site is governed by Tri-Party Agreement milestones. Major milestones applicable for preparing the 200-IS-1 OU RI/FS work plan are as follows.

- M-013-00M: Submit one 200 Areas RI/FS (RFI/CMS) work plan for the 200-IS-1 Tanks/Lines/Pits/Diversion Boxes OU (includes waste sites in the 200-ST-1 Septic Tank and Drain Fields OU) by December 31, 2002. (NOTE: This milestone has been completed.)

- M-013-27: Submit a revised RI/FS work plan for the 200-IS-1 and 200-ST-1 OUs to Ecology to identify likely response scenarios and potential applicable technologies, identify the need for treatability investigations, and include SAPs. In instances where

RCRA authority requires investigation of past-practice units, Ecology agrees, pursuant to Ecology's Dangerous Waste Regulations, that DOE may satisfy the requirements for an RFI/CMS work plan by submitting an RI/FS work plan by June 30, 2007.

- M-020-00B: Submit closure/postclosure plans for the 216-A-10, 216-A-36B, 216-A-37-1, 207-A South Retention Basin, 216-S-10 Pond, 216-S-10 Ditch, 241-CX-70, 241-CX-71, and 241-CX-72 by December 31, 2008.

- M-020-54: Submit 241-CX-70 Storage Tank, 241-CX-71 Neutralization Tank, 241-CX-72 Storage Tank closure/postclosure plan to Ecology in coordination with the 200-IS-1 Tanks/Lines/Pits/Boxes and 200-ST-1 Septic Tank OUs work plan FS scheduled under M-013-00M by December 31, 2008.

- M-015-00: Complete the RI/FS process for all OUs. In instances where RCRA authority requires investigations of past-practice units, Ecology agrees, pursuant to Ecology's Dangerous Waste Regulations, that DOE may satisfy the requirements for an RFI/CMS report by submitting an RI/FS report by December 31, 2011.

- M-015-00C: Complete all 200 Area non-tank-farm OU site investigations under approved work plan schedules through submittal of FS reports and a recommended remedy(ies). In instances where RCRA authority requires investigation of past-practice units, Ecology agrees, pursuant to Ecology's Dangerous Waste Regulations, that DOE may satisfy the requirements for an RFI/CMS report by submitting an RI/FS report. The recommended remedy(ies) will be sufficiently comprehensive to satisfy the technical requirement of RCRA, HWMA, and CERCLA statutory authorities and respective regulations with respect to all hazardous substances, pursuant to the HFFACO,[2] Article IV, paragraph 178, and the Action Plan, Section 5.4, by December 31, 2011.

1.3 STREAMLINING APPROACHES

Five streamlining approaches for the regulatory pathway and documentation requirements have been identified as having application to the 200-IS-1 OU and are described below. The first four approaches also are discussed in the Implementation Plan (DOE/RL-98-28). The fifth approach, a graded approach, is a process that ensures that the level of analysis, documentation, and actions are appropriate for decision making associated with the pipelines. These streamlining approaches could be used to meet the requirements for site evaluations and/or for development of the recommended remedy for the 200-IS-1 OU.

1. Contingent or alternate remedy: Developed for cases where uncertainty is associated with the preferred remedy. Use of a contingent or alternate remedy would be included in the ROD in the event that post-ROD confirmation sampling indicates that an alternate remedy is more appropriate for the site. Development of a ROD that permits use of

[2] *Hanford Federal Facility Agreement and Consent Order* (Ecology et al., 1989a).

contingent or alternate remedies may be applicable to some 200-IS-1 OU pipelines, diversion boxes, catch tanks, and related waste sites.

2. Plug-in approach: An approach geared toward implementing remedial actions for new sites identified and/or evaluated after a ROD has been issued. The plug-in approach is built into the ROD through the incorporation of criteria that must be met before a new site can "plug into" the selected remedy(s). Use of the plug-in approach may require additional sampling and evaluation to ensure that the criteria are met. This approach may be applicable to any new waste site identified post-ROD for inclusion in the 200-IS-1 OU. Confirmation sampling results would be used to substantiate that the waste site could "plug in" and be remediated by an approved remedy.

3. Focus package: Used for sites with minimal need for remediation, or where a remedial action would follow the path that already was followed at similar waste sites. The focus package provides evaluation, analyses, and documentation demonstrating that remedial alternatives are not required; provides site-specific information to complete the remedy selection process; and supports issuance of a proposed plan and new or modified ROD.

4. Observational approach: Uses real-time data collection associated with excavation activities. Provides the flexibility necessary to adapt to actual site conditions encountered during remedial actions by scaling the level of effort to the conditions encountered. This method of streamlining is considered to be more cost effective and time effective than traditional approaches that require substantial amounts of preremediation characterization data. The observational approach is expected to be applicable to the 200-IS-1 OU pipelines, diversion boxes, and associated waste sites that are identified for removal.

5. Graded approach: Integrates available data, process knowledge, expert opinion, professional judgment, probabilistic statistical data evaluations, and modeling (risk, fate and transport) to determine/define data requirements for remedial decisions. This integration allows for a graded approach in determination of the data needed for remedy selection and decision making. With this approach, remedial decisions can be made at any point at which criteria established for data sufficiency have been met.

1.4 WORK PLAN CHANGE CONTROL

Following approval of this work plan, the major elements (RI/FS steps) of the work plan are requirements that are not expected to change; therefore, the work plan should not change. Specific workscope elements might require modification or refinement as the work progresses. Changes that do not affect the overall intent of the approved work plan or schedule can be made using a change notice. Alternately, and if agreed to by RL, ORP, and the lead regulatory agency, unit managers' meetings or predecessor primary documents requiring RL and lead regulatory agency approval also can be used to document changes (e.g., the RI report can be used to document refinements to or focus the FS). Changes to the project schedule that affect assigned M-015 interim milestones will require approval through the Tri-Party Agreement (Ecology et al., 1989a) change control process.

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2.0 BACKGROUND AND SETTING

This section includes descriptions of the 200-IS-1 OU waste sites, physical setting, and the general hydrogeologic conditions. The information presented in this section also identifies the waste-generating processes associated with the 241-CX-70 Storage Tank, 241-CX-71 Neutralization Tank, and 241-CX-72 Storage Tank, and the 276-S-141 and 276-S-142 Hexone Storage Tanks (RCRA TSD units) and the process-waste pipeline systems. A general description of each of the 200-IS-1 OU pipeline-system bins and the CX Tank System and Hexone Storage Tanks is provided. Additional site-specific information for 200-IS-1 OU pipeline-system waste sites is provided in Appendix D. Information in this section has been compiled from a number of sources, the most significant of which are as follows:

- D&D-30262
- DOE/RL-98-28
- DOE/RL-96-81
- PNNL-15670, *Hanford Site Groundwater Monitoring for Fiscal Year 2005*
- PNNL-16346, *Hanford Site Groundwater Monitoring for Fiscal Year 2006*
- WIDS
- Hanford Site engineering drawings
- *Tank Waste Information Network System* (TWINS) database.

2.1 SUMMARY OF HYDROGEOLOGIC CONDITIONS

This section summarizes the geology and hydrogeology associated with the 200 Areas inclusive of the 200-IS-1 OU. Additional information on the physical setting of this OU can be found in the Implementation Plan (DOE/RL-98-28) and in other documents as cited in the text. Detailed information on the hydrogeologic setting of the 200 Areas and vicinity can be found in PNNL-12261, *Revised Hydrogeology for the Suprabasalt Aquifer System, 200-East Area and Vicinity, Hanford Site, Washington*, and PNNL-13858, *Revised Hydrogeology for the Suprabasalt Aquifer System, 200-West Area and Vicinity, Hanford Site, Washington.*

2.1.1 Topography

The 200-IS-1 OU is located in the Central Plateau, which is a broad, relatively flat prominent terrace (Cold Creek Bar) that constitutes a local topographic high near the center of the Hanford Site. The Cold Creek Bar was formed about 13,000 years ago during the last cataclysmic flood from glacial Lake Missoula. The Cold Creek Bar trends generally east-west with elevations between 197 and 225 m (646 to 738 ft) above mean sea level (amsl) (NAVD88, *North American Vertical Datum of 1988*). The plateau drops off rather steeply to the north and northwest into a former flood channel with elevation changes of between 15 and 30 m (49 and 98 ft). The plateau gently decreases in elevation to the south into the Cold Creek valley and to the east toward the Columbia River. Most of the 200 West Area and the southern half of the 200 East Area are situated on the Cold Creek Bar, while the northern half of the 200 East Area lies within the former flood channel. A secondary flood channel running south from the main channel bisects

the 200 West Area. The buried former river and flood channels may provide preferential pathways for groundwater and contaminant movement. More detail on the physical setting of the 200 Areas and vicinity is provided in DOE/RL-98-28, Appendix F.

The topography of the Central Plateau at the Hanford Site is shown in Figure 2-1. The 200 West Area occupies a relatively flat area in a secondary flood channel. Surface elevations range from approximately 200 to 220 m (656 to 722 ft) amsl (NAVD88), and the ground surface slopes gently to the southwest. The surface of the 200 East Area slopes gently to the northeast. Surface elevations in the 200 East Area range from approximately 180 m (590 ft) amsl (NAVD88) in the northeast corner of the area to about 230 m (755 ft) amsl (NAVD88) in the southeast corner of the area.

2.1.2 Geology

The 200-IS-1 OU is located in the Pasco Basin, one of several structural and topographic basins of the Columbia Plateau. Basalts of the Columbia River Basalt Group and a sequence of suprabasalt sediments underlie the 200 East and 200 West Areas. From oldest to youngest, the major geologic units present consist of the Elephant Mountain Member, the Ringold Formation, the Cold Creek unit, the Hanford formation, and surficial deposits. Figure 2-2 shows the generalized stratigraphic nomenclature used in the 200 Areas. Descriptions of the geologic units of interest are provided below.

Elephant Mountain Member. The Elephant Mountain Member is part of the Saddle Mountains Basalt, the uppermost formalized formation in the Columbia River Basalt Group. The Elephant Mountain Member is the uppermost basalt unit (i.e., bedrock) in the 200 Areas (DOE/RL-98-28, Appendix F). Except for a small area north of the 200 East Area, where it has been eroded away, exposing basalt of the Pomona Member of the Saddle Mountains Basalt, the Elephant Mountain Member is laterally continuous throughout the 200 Areas.

Ringold Formation. The Ringold Formation consists of an interstratified fluvial-lacustrine sequence of unconsolidated to semiconsolidated clay, silt, sand, and granule-to-cobble gravel deposited by the ancestral Columbia River (PNNL-12261, PNNL-13858). These sediments, shown in Figure 2-2, consist of four major units (from oldest to youngest): the fluvial gravel and sand of unit 9 (basal coarse, Ringold Unit A); the buried soil horizons, overbank, and lake deposits of unit 8 (Ringold Lower Mud); the fluvial sand and gravel of unit 5 (upper coarse, Ringold Unit E); and the lacustrine mud of unit 4 (upper fines, Upper Ringold). Units 9 and 5 consist of a silty-sandy gravel with secondary lenses and interbeds of gravelly sand, sand, and muddy sands to silt and clay.

Unit 8 consists mainly of silt and clay. Unit 4 consists of silty over-bank deposits and fluvial sand. Units 6 and 7 are not present beneath the 200 West and 200 East Areas (PNNL-12261, PNNL-13858).

Figure 2-1. Topographic Map of the Central Plateau at the Hanford Site.

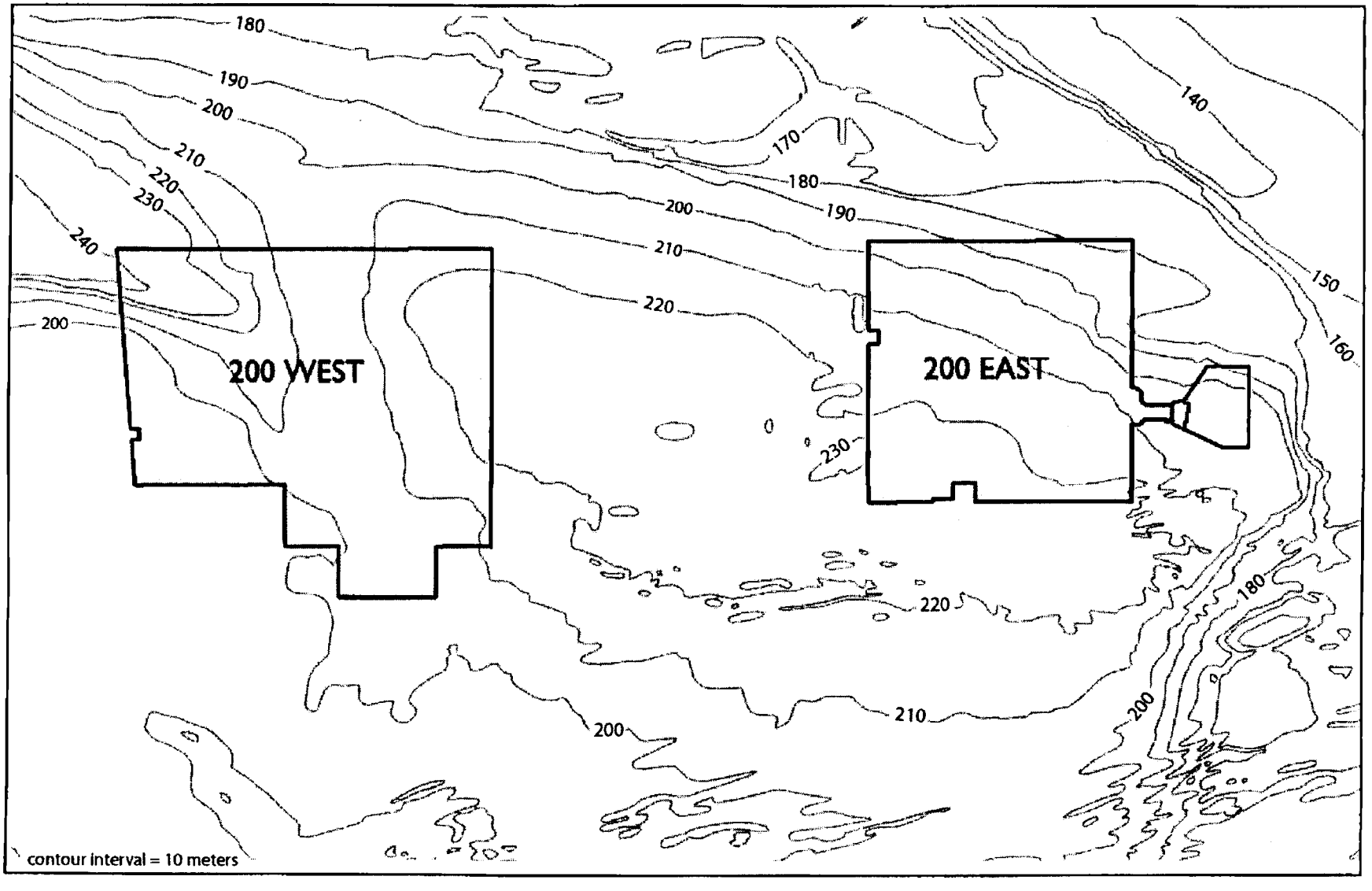
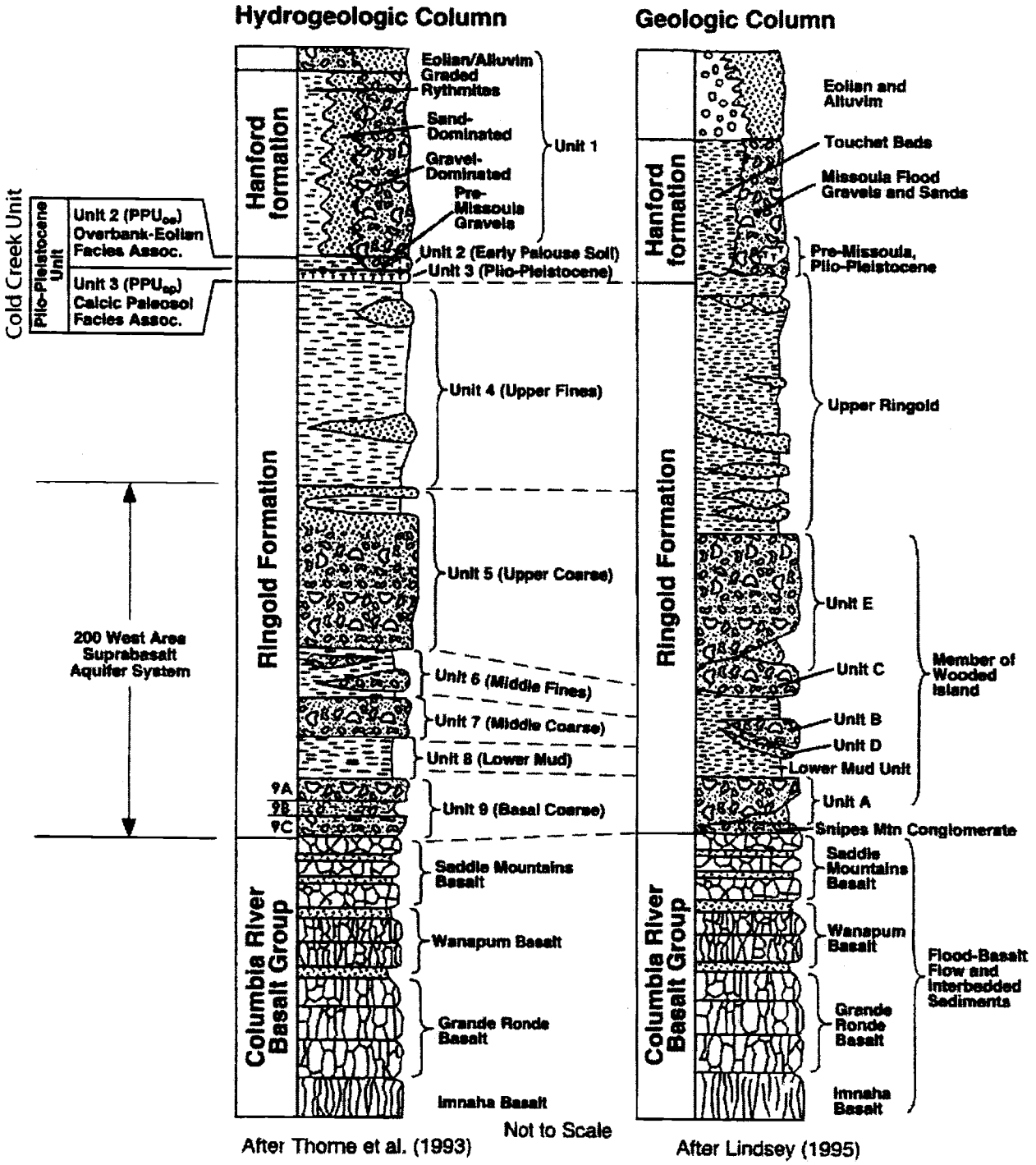


Figure 2-2. Generalized Stratigraphic Columns for the 200 Areas.

(From PNNL-12261, *Revised Hydrogeology for the Suprabasalt Aquifer System, 200-East Area and Vicinity, Hanford Site, Washington*, and PNNL-13858, *Revised Hydrogeology for the Suprabasalt Aquifer System, 200-West Area and Vicinity, Hanford Site, Washington*)



After Bjornstad et al. (2002)

Cold Creek unit. The Cold Creek unit is the recently standardized name applied to several post-Ringold Formation and pre-Hanford formation units present beneath the 200 East and 200 West Areas (DOE/RL-2002-39, *Standardized Stratigraphic Nomenclature for Post-Ringold Formation Sediments Within the Central Pasco Basin*). The Cold Creek unit includes the formations formerly described as the Plio-Pleistocene unit, caliche (unit 3), early Palouse soil (unit 2), 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 [unit 2], formerly called the early Palouse soil); fine- to coarse-grained, calcium-carbonate cemented (calcic paleosol [unit 3], formerly called the caliche); coarse-grained, multilithic (mainstream alluvium, formerly called the Pre-Missoula gravels); coarse-grained, angular, basaltic (colluvium); and coarse-grained, rounded, basaltic (sidestream alluvium, formerly called the sidestream alluvial facies) (DOE/RL-2002-39).

Hanford formation. The Hanford formation (unit 1) is the informal stratigraphic name used to describe the Pleistocene cataclysmic flood deposits in the Pasco Basin (DOE/RL-2002-39). The Hanford formation consists predominantly 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 called the Touchet beds or the slackwater facies); sand-dominated (formerly called the sand-dominated flood facies); and gravel-dominated (formerly called the Pasco gravels), which have been subdivided further into 11 textural-structural lithofacies (DOE/RL-2002-39). Beneath the waste sites of the 200-IS-1 OU, the Hanford formation includes all three facies. The gravel-dominated facies are cross-stratified, coarse-grained sands and granule-to-boulder gravel. The gravel is uncemented and matrix-poor. The sand-dominated facies are 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 are rare in the Ringold Formation (DOE/RL-98-28; DOE/RL-2002-39). They appear as vertical to subvertical sediment-filled structures, especially within sand- and silt-dominated units.

The cataclysmic floodwaters that deposited sediments of the Hanford formation also locally reshaped the topography of the Pasco Basin. The floodwaters deposited a thick sand and gravel bar that constitutes the higher southern portion of the 200 Areas, informally known as the 200 Areas Plateau. In the waning stages of the Ice Age, these floodwaters also eroded a channel north of the 200 Areas in the area currently occupied by Gable Mountain Pond. These floodwaters removed all of the Ringold Formation from this area and deposited Hanford formation sediments directly over 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. Silty deposits less than 1 m (approximately 3 ft) thick also have been documented at waste sites where fine-grained, wind-blown material has settled out through standing water over many years (DOE/RL-98-28, Appendix F).

2.1.3 Vadose Zone

The vadose zone is approximately 104 m (341 ft) thick in the southern section of the 200 East Area and thins to the north to as little as 0.3 m (1 ft) near West Lake, north of the 200 East Area. Vadose-zone hydrostratigraphic units in the 200 Areas include the Ringold Formation, Cold Creek unit, Hanford formation, and surficial deposits (see Figure 2-2).

The Cold Creek unit may be present in a small area immediately above the basalt. Because erosion during cataclysmic flooding removed much of the Ringold Formation north of the central part of the 200 East Area, the vadose zone predominantly is composed of Hanford formation sediments between the northern part of the 200 Areas and Gable Mountain. Basalt projects above the water table north of the 200 East Area (PNNL-12261), and the Ringold Formation unit 8 (Ringold Lower Mud) occurs at or above the water table east of the 200 East Area (PNNL-12261) and northeast of the 200 West Area, west of the 200 East Area (PNNL-13858). In the 200 West Area, the vadose-zone thickness ranges from 40.2 to 102 m (132 to 335 ft). Sediments in the vadose zone are the Ringold Formation, Cold Creek unit, and Hanford formation. Erosion during cataclysmic flooding removed some of the Ringold Formation and the Cold Creek unit.

Perched water historically has been documented above the Cold Creek unit at locations in the 200 West Area. While liquid-waste disposal facilities were operating, localized areas of saturation or near saturation were created in the soil column. With the reduction of artificial recharge in the 200 Areas, downward flux of liquid in the vadose zone beneath these waste sites has been decreasing. However, moisture content in the vadose zone is expected to remain elevated over preoperational conditions for some time. As unsaturated conditions are reached, liquid flux at these disposal sites becomes increasingly less significant as a source of recharge and contaminant movement to groundwater. As part of ongoing facility operations, unanticipated releases (e.g., waterline failures), if of sufficient volume, could results in localized recharge of the unsaturated zone and potentially mobilize contaminants if present in the effected soil zone. In the absence of artificial recharge, recharge from natural precipitation becomes the more dominant driving force for moving contamination remaining in the vadose zone to the groundwater.

2.1.4 Groundwater

The unconfined aquifer in the 200 Areas occurs within the Hanford formation, Cold Creek unit, or Ringold Formation, depending on location. The base of the unconfined aquifer is predominately the top of the Ringold Formation unit 8 (Ringold Lower Mud) in the 200 West Area and is predominately the top of basalt (Elephant Mountain Member) in the 200 East Area.

Regionally, groundwater in the unconfined aquifer flows from recharge areas where the water table is higher (west of the Hanford Site) to areas where it is lower, near the Columbia River (PNNL-13404, *Hanford Site Groundwater Monitoring for Fiscal Year 2000*). Water-table maps for the 200 East and 200 West Areas, showing water-table elevations and general direction of flow, are presented in Figures 2-3 and 2-4, respectively.

Figure 2-3. Water-Table Map of the 200 East Area, July 2005.

(From PNNL-15070, *Hanford Site Groundwater Monitoring for Fiscal Year 2004*)

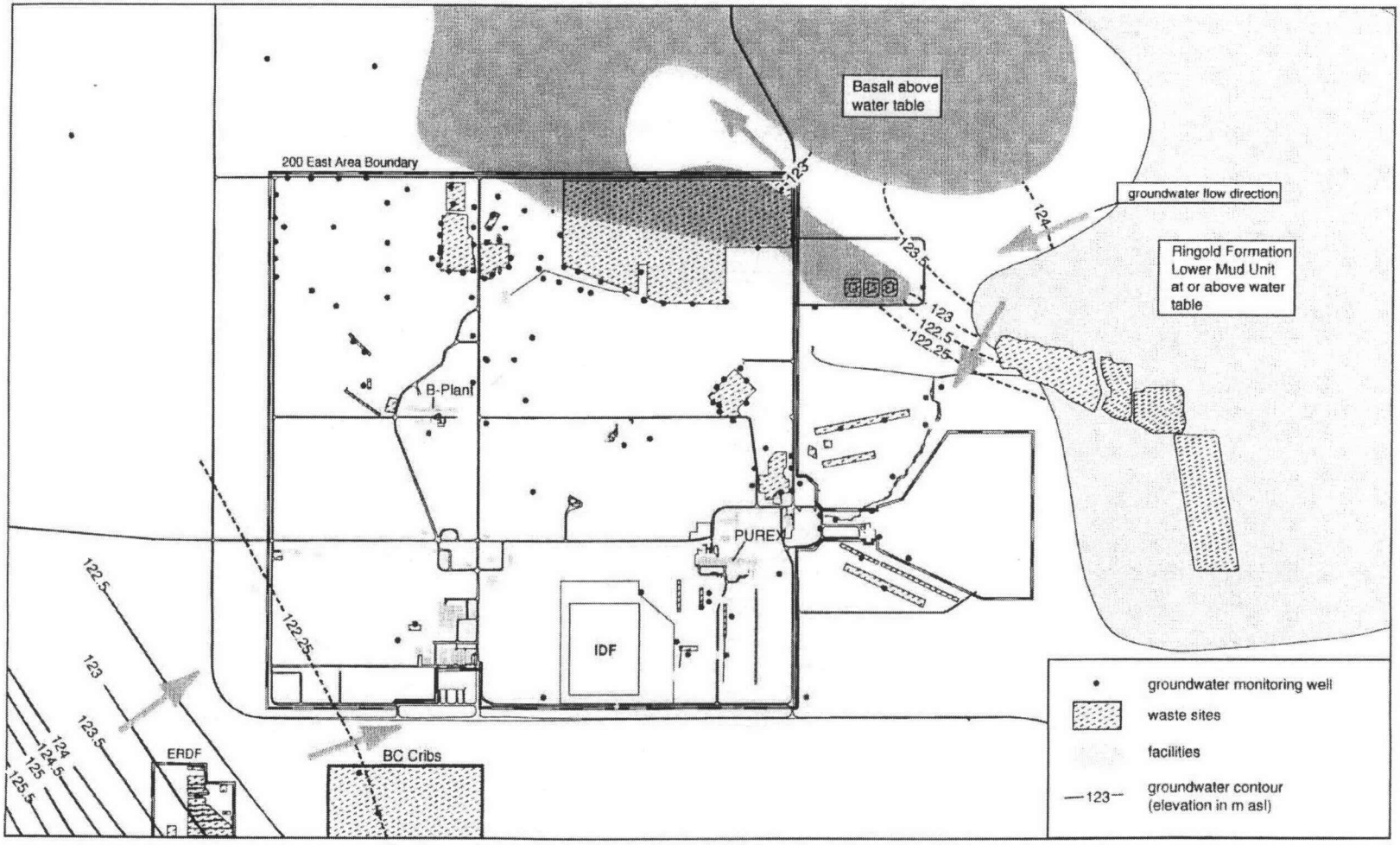
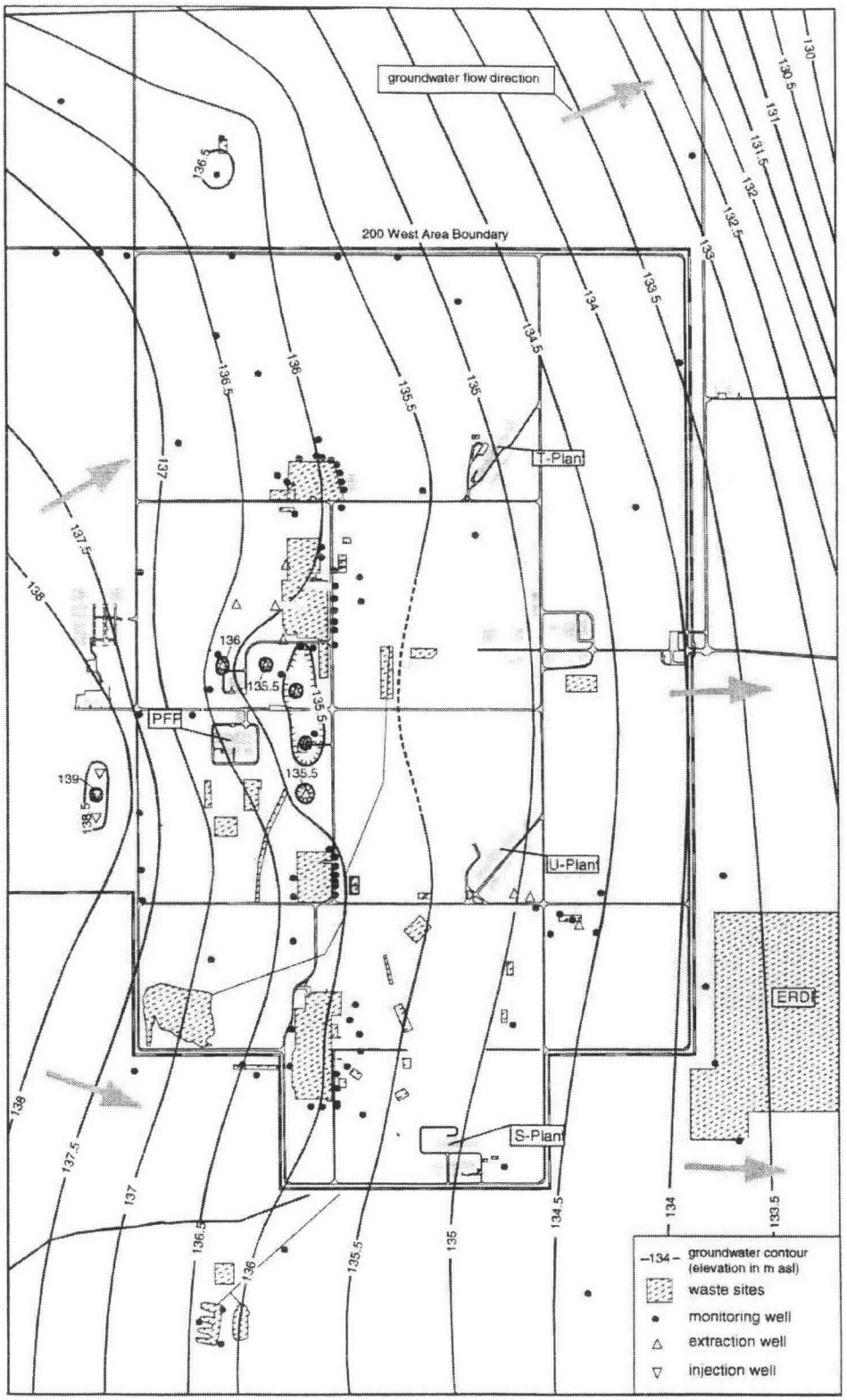


Figure 2-4. Water-Table Map of the 200 West Area, 2005.

(From PNNL-15070, *Hanford Site Groundwater Monitoring for Fiscal Year 2004*)



In the northern half of the 200 East Area, the water table primarily is present in the Hanford formation, except where basalt extends above the water table, resulting in the absence of the uppermost unconfined aquifer (PNNL-12261). In the north-central portion of the 200 West Area, the water table occurs in the Cold Creek unit. Both east and west of the 200 East Area, the Ringold Formation unit 8 (Ringold Lower Mud) occurs at an elevation that results in the absence of the uppermost unconfined aquifer. In the central and southern sections of the 200 East Area, the water table is located near the contact between the Ringold Formation and the Hanford formation.

Depth to groundwater in the 200 East Area and vicinity ranges from about 54 m (177 ft) below ground surface (bgs) near B Pond to about 104 m (341 ft) bgs to the south. The water-table surface across most of the 200 East Area generally is flat (Figure 2-3), making it difficult to determine the groundwater flow direction. The configuration of contaminant plumes, however, indicates that groundwater likely flows to the northwest in the northern half of the 200 East Area and to the east/southeast in the southern half of the 200 East Area (generalized contaminant plume maps are presented in Chapter 3.0). Identifying the specific location of the groundwater divide between the northern and southern sections is hampered by the flat water table. Highly transmissive Hanford formation sediments are the cause of the flat water table in the 200 East Area (PNNL-15670, PNNL-16346). Because of the complex hydrogeologic conditions in the 200 East Area, significant uncertainty exists with respect to the actual groundwater flow directions and gradients (PNNL-15070). Since surface liquid discharges were terminated in the 200 East Area, the water table has been declining rapidly, with a recent rate measured at about 0.13 m/yr (0.43 ft/yr), based on water-level measurements collected between March 2004 and March 2005 (PNNL-15670, PNNL-16346).

Groundwater beneath the 200 West Area occurs primarily in the Ringold Formation. Depth to water varies from about 40.2 m (132 ft) bgs to greater than 102 m (335 ft) bgs. Groundwater flow direction is more definitive in this area and is predominately to the east (Figure 2-4). The surface elevation of the water table beneath the 200 West Area currently is declining at a rate of 0.36 m/yr (1.2 ft/yr) (PNNL-15670). Currently, the water-table elevation is approximately 12 m (approximately 36 ft) above an estimated water-table elevation before the start of Hanford Site operations.

Recharge to the unconfined aquifer within the 200 Areas is primarily from artificial sources and, to a lesser extent, from natural precipitation. Estimates of recharge from precipitation are highly variable and locally range from 0 to a maximum of 10 cm/yr (0 to 4 in/yr) and are largely dependent on soil texture and the type and density of vegetation (PNNL-14702, *Vadose Zone Hydrogeology Data Package for the 2004 Composite Analysis*). PNL-5506, *Hanford Site Water Table Changes 1950 through 1980 – Data Observation and Evaluation*, reports that between 1943 and 1980, 6.33×10^{11} L (1.67×10^{11} gal) of liquid wastes were discharged to the soil column in the 200 East and 200 West Areas. Most sources of artificial recharge were terminated in 1995. The artificial recharge that does continue largely is limited to liquid discharges from sanitary sewers, two state-approved land-disposal structures, and 140 small-volume, uncontaminated miscellaneous liquid-discharge streams. One of the approved land-disposal structures is the Treated Effluent Disposal Facility (TEDF), a liquid-waste disposal facility that receives treated liquid wastes from the 200 East and 200 West Area facilities.

2.2 PROCESS OPERATION DESCRIPTIONS AND HISTORY

The waste streams handled by the 200-IS-1 OU pipeline systems relate directly to the operations conducted at the process facilities located in the 200 East and 200 West Areas. The primary facilities involved in the generation or storage of process wastes and involved use of pipelines include the following:

- B Plant
- T Plant
- U Plant and Uranium Trioxide (UO_3) Plant
- Reduction-Oxidation (REDOX) Plant (S Plant)
- Plutonium-Uranium Extraction (PUREX) Plant (A Plant)
- Z Plant Complex
- Hot Semiworks Facility (C Plant)
- Tank farms, evaporators, and ancillary facilities.

The U Plant and UO_3 Plant are listed here for completeness of information on process-waste operations. Pipelines located within the 200-UW-1 OU that are connected to disposal waste sites (e.g., cribs, trenches) are not part of the 200-IS-1 OU process-waste pipeline systems. Portions of the waste-transfer pipelines that extend outside the 200-UW-1 OU, such as tank farm waste-transfer lines, are addressed by the 200-IS-1 OU.

The pipeline systems received liquid waste from 200 Areas operations, including the following:

- Bismuth phosphate/lanthanum fluoride
- Uranium Recovery Process, UO_3 operations, and scavenging operations
- REDOX process
- PUREX process
- Isotope (strontium/cesium) separations, recovery, and storage operations
- Plutonium Finishing Plant operations, machining, and plutonium/americium scrap recovery processes (i.e., Recovery of Uranium and Plutonium by Extraction process [RECUPLEX], Plutonium Reclamation Facility, and americium recovery)
- Tank-waste evaporation/solidification operations.

The primary process operations that generated the waste streams that were transferred in the 200-IS-1 OU pipeline systems are discussed in the following subsections. This process discussion also links the waste streams generated to the process-waste-type categories that were established and used for the current OU designations within the 200 Areas. A summary of the general characteristics of the waste-stream categories that are encompassed by each of the pipeline bins is presented following the operational processes information.

2.2.1 Primary Processes

The 200 Areas operations included the following five primary processes:

- Fuel processing
- Plutonium isolation
- Uranium recovery
- Cesium/strontium recovery
- Waste storage/treatment.

Each of these processes generated a variety of waste streams. However, specific waste types were isolated at the point of generation and discharged to specific disposal sites. Four of the primary process streams identified above are discussed below. The Uranium Recovery Process was conducted at the U Plant Facility. Pipelines in the 200-UW-1 OU are not included in the scope of this work plan.

2.2.1.1 Fuel Processing

Fuel processing started in the mid-1940s using the batch-operation bismuth phosphate ($BiPO_4$) extraction process at the 221/224-B Plant and 221/224-T Plant. Starting in the late 1940s, technological improvements led to the development of the continuously operating hexone-based solvent-extraction (REDOX) process and, in the mid-1950s, to the tributyl phosphate (TBP) solvent-extraction (PUREX) processes at the 202-S Plant and 202-A Plant facilities, respectively. Solvent-extraction processes also were used to recover cesium and strontium from tank wastes at the 221-B Plant from the mid-1960s to mid-1970s. A number of other shorter term processes were established at various facilities to recover valuable radionuclides.

2.2.1.2 Plutonium Isolation

Plutonium was isolated and prepared for shipment at the 231-Z Plant in the mid- to late 1940s using a peroxide/nitrate-based batch process. New processes were developed to improve plutonium refining, and the 234-5Z Plutonium Finishing Plant Building was constructed to convert plutonium into an oxide or metal. The 234-5Z Plant was modified to recover scrap plutonium via the RECUPLEX process and, later, the Plutonium Reclamation Facility. Americium also was recovered from plant wastes. The TBP/carbon tetrachloride solvent extraction was the basis for the purification processes (DOE/RL-91-58, *Z Plant Source Aggregate Area Management Study Report*).

Plutonium production at the Hanford Site began with the delivery of cylindrical metal uranium billets to the 300 Areas. The metal was heated, forced through an extrusion die, and formed into a cylindrical rod, followed by air quenching and inspection. The rods were machined and cut into slugs. The slugs then were canned inside aluminum jackets and bonded to the material with an aluminum-silicon alloy (DOE/RL-98-28).

The slugs were placed in the reactor pile and irradiated. Following irradiation, the slugs were pushed out from the reactor pile and collected in basins for cooling. Next, the fuel rods were taken to the 200 East Area or the 200 West Area for processing in one of the separations plants (DOE/RL-98-28). The various separations processes are described in more detail in the

Implementation Plan (DOE/RL-98-28, Appendix G). All separations processes required decladding of the fuel slugs by caustic dissolution of the aluminum jacket or by basic dissolutions of the zirconium jacket. During this step, only the jacket was dissolved and lesser quantities of chemical and radiological constituents were generated.

Following that, the uranium fuel rod was dissolved in a bath of nitric acid in preparation for the particular separations process steps. The initial $BiPO_4$ process at the B and T Plants separated and concentrated plutonium from the rest of the dissolved material by multiple precipitations. The $BiPO_4$ preferentially attracted the plutonium from the rest of the solution and, as a precipitate, was physically separated by centrifuging. Repeated dissolution and precipitation, using both $BiPO_4$ and lanthanum fluoride, led to recovery of the plutonium and removal of the uranium and fission products. This process generated large volumes of uranium-rich and fission product-rich wastes (HW-23043, *Flow Sheets & Flow Diagrams of Precipitation Separations Process*). The waste types generated during these processes included those waste streams received at the 200-PW-2, 200-PW-4, and 200-PW-5 OU disposal sites. Most low-level liquid wastes generated as part of this process were sent to ponds. This included those waste streams associated with the 200-CW-1, 200-CW-4, and 200-SC-1 OU disposal sites. The B Plant operations of the $BiPO_4$ process ended in late 1952, and T Plant operations of the $BiPO_4$ process ended in late 1956. High-activity-waste storage was an operational concern for production facility operations throughout the 200 Areas. The $BiPO_4$ process generated large quantities of liquid waste, which necessitated construction of four additional tank farms. An initial approach to declining tank space was to pump the least contaminated low-activity supernatant of the stored-waste streams to nearby cribs (200-TW-1 and 200-TW-2 OU disposal sites). Next, evaporators were built in 1951 at the B and T Tank Farms to reduce the volume of liquids in storage.

The $BiPO_4$ process was a relatively slow stepwise approach to recovering plutonium and generated large volumes of liquid waste. Organic solvent-extraction processes were applied in 1951 with the implementation of the REDOX process at the 202-S Plant. Immediate benefits in production were observed because of the plant's ability to operate continuously. This plant used the organic compound methyl isobutyl ketone (MIBK or hexone) as a solvent to remove both plutonium and uranium from the dissolved fuel-rod solution. The process passed the dissolved-acid fuel-rod solution down tall columns by gravity flow, through a less dense, rising countercurrent of organic liquids. Through mixing, both plutonium and uranium were stripped out of the acid by the hexone, which was pulled off at the top of the column. Next, plutonium was removed from the uranium-rich hexone solution and purified, in this case using inorganic acids to reduce the plutonium to the extractable plutonium (III) valence state in similar countercurrent flow columns. Uranium was recovered using similar extraction processes in a separate set of process columns. Recovery and reuse of the solvent was achieved through this process (HW-18700-DEL, *REDOX Technical Manual*). High-fission-product wastes generated at the REDOX Plant were stored in the tank farms. Because it operated continuously, the plant also generated significant quantities of low-level wastes, which were discharged to ponds and cribs (200-CW-2 OU disposal sites). The REDOX process operated from 1951 to 1967, and the waste concentrators were active during the same time frame (DOE/RL-91-60, *S Plant Source Aggregate Area Management Study Report*).

2.2.1.3 Plutonium/Uranium Recovery

The PUREX process at the 202-A Plant Building was the final large-scale separations process developed. It used the same countercurrent flow principles of solvent extraction that were used at the REDOX Plant, but benefited from significant design and process improvements. Again, as at the REDOX Plant, both plutonium and uranium were recovered and purified, as were the solvents and acids. The plant used a much less flammable two-part organic mix, TBP in a normal paraffin hydrocarbon (NPH or kerosene), to separate plutonium and uranium from the nitric acid-dissolved fuel-rod solution. The TBP process was much more efficient in the rate of processing and was safer and cleaner in operation. The PUREX Plant began operation in late 1955 and ran continuously until 1972. Following an 11-year hiatus, the plant was restarted in 1983 and ran intermittently through 1988. High-fission-product wastes generated at the PUREX Plant were stored in tank farms. The plant also generated significant quantities of low-level wastes, which were discharged to ponds, cribs, and french drains (200-CW-1 and 200-SC-1 OU disposal sites) (BHI-00178, *PUREX Plant Aggregate Area Management Study Technical Baseline Report*).

The recovered, purified plutonium was refined to one of several forms, depending on the era. At the start of Hanford Site operations, plutonium was refined in the 231-Z Plutonium Isolation Facility, where it was converted to a nitrate paste before being shipped off site. Shortly thereafter, however, a more elaborate plant, the Plutonium Finishing Plant, was constructed with the capability to convert plutonium into metal, nitrate, or oxide forms. A number of process lines in the 234-5Z Plutonium Finishing Plant Building were used between 1949 and 1989. Initially, batch inorganic chemical steps were used to refine and convert plutonium to the desired form. Later, more elaborate extraction processes were developed. The Plutonium Finishing Plant also was used for reprocessing scrap plutonium, using solvent-extraction techniques based on TBP mixed with carbon tetrachloride. Processing operations resulted in waste stream discharges to 200-PW-1, 200-PW-3, 200-PW-6, and 200-SC-1 OU disposal sites (DOE/RL-91-58; HNF-EP-0924, *History and Stabilization of the Plutonium Finishing Plant (PFP) Complex, Hanford Site*).

2.2.1.4 Cesium/Strontium Recovery

In 1954, the cesium/strontium recovery process was found to reduce the amount of fission products (especially Sr-90) in the high-activity Uranium Recovery Process and PUREX process wastes by scavenging (precipitation through chemical additions), and the treated liquids were determined to be suitable for discharge to the soil column (200-PW-3 and 200-PW-4 OU waste sites) (ARH-564, *B Plant Recovery of Cesium from Current Acid Wastes by Phosphotungstate Precipitation*). At about the same time, more tank space was freed up in 1954-1955 by discharging another of the less contaminated high-activity waste-stream supernatants to the ground (200-TW-2 OU disposal sites).

Several waste fractionization campaigns were conducted between 1963 and 1983 to recover certain radionuclides, including Cs-137, Sr-90, and certain rare-earth isotopes for which specific uses or applications had been identified. The program was implemented at the 221-B Plant facility and used a variety of chemical processes, including solvent extraction and ion exchange, to recover target isotopes. Resulting waste streams were disposed of at 200-PW-3, 200-PW-4,

and 200-PW-5 OU waste sites. The program was superseded by the Waste Encapsulation and Storage Facility, which concentrated cesium and strontium into dry-salt compounds. The powders then were placed in doubly welded capsules and stored in cooling pools. The waste streams generated were disposed of at 200-PW-4 and 200-PW-5 OU waste sites (DOE/RL-2000-38, *200-TW-1 Scavenged Waste Group Operable Unit and 200-TW-2 Tank Waste Group Operable Unit RI/FS Work Plan*).

Many of the full-scale production processes described above were developed in laboratories at both experimental and bench-scale levels, using small quantities of nonradioactive elements or small quantities of radioactive isotopes. Before full plant implementation, tests were performed in near full-scale vessels and at working concentrations to examine problems in scaling up the chemical principles and processes. This "semiworks" scale of testing was conducted at one of two places. The earliest $BiPO_4$ developmental testing was conducted in the "head-end" section of the 221-T Plant Building. However, much more extensive development work for REDOX, Uranium Recovery Process, PUREX, and the fission-product fractionization processes was undertaken at the 201-C Plant Building, also known as the Hot Semiworks Facility. Wastes generated in these processes were disposed of at the 200-PW-2, 200-PW-3, 200-PW-4, and 200-PW-5 OU liquid-waste disposal sites (DOE/RL-2000-38).

2.2.1.5 Tank Farm Waste Transfers

Radioactive wastes that were generated by the separations plants discussed above were stored in 149 SSTs and 28 DSTs beginning in 1944. The 177 tanks were constructed in 12 SST and 6 DST tank farms. Each tank farm was designated with an alphabetic code (A, B, C, S, T, and U) that indicated the original processing plant from which the tank farm received waste.

The initial processing facilities included B Plant, T Plant, and U Plant. The B, C, T, and U Tank Farms were constructed in 1943 to receive waste from these plants. In 1947, the BX Tank Farm was built for added storage capacity. The operating capacity of these first-generation tank farms was quickly reached, and new second-generation tanks were constructed between 1948 and 1953 in the new BY, S, TX, and TY Tank Farms. Third-generation tanks were built between 1954 and 1963 at the A, AX, and SX Tank Farms.

Between 1966 and 1986, DSTs were constructed at the remaining SY, AN, AP, AW, AY, and AZ Tank Farms. These tanks provided an increased capacity and could handle high-heat loads associated with self-boiling high-level/high-activity wastes generated at the REDOX and PUREX Plants.

Waste transfers from the plants to the tank farms and between tank farms were accomplished using a pipeline system that consisted of a variety of pipelines and diversion boxes. Pipelines used to transfer high-level/high-activity wastes initially were buried directly in trenches, but because failures in these lines occurred in the 1940s, subsequent construction involved placement in concrete encasements. The encasements extended between diversion boxes and were designed so that any liquids lost from leaks or pipeline failure would drain to a drain in the diversion box, which conveyed the release to a catch tank. Pipe-in-pipe transfer lines also were installed in addition to the concrete encasement pipelines. The outer pipeline had a drain to a diversion box or pit.

The following is a summary of the tank farm system and the process wastes that were transferred into the tank farms. The previous discussion on specific facilities described the chemical processes and wastes generated that were transferred through the tank farm waste-transfer system. A more detailed description of the operation of tank farms is presented in the following documents:

- RPP-6072, *Site-Specific SST Phase 1 RFI/CMS Work Plan Addendum for WMA B-BX-BY*
- HNF-4380, *Preliminary Site-Specific SST Phase 1 RFI/CMS Work Plan Addendum for WMA S-SX*
- RPP-16608, *Site-Specific Single Shell Tank Phase 1 RCRA Facility Investigation/Corrective Measures Study Work Plan Addendum for Waste Management Areas C, A-AX, and U*
- RPP-7578, *Site-Specific SST Phase 1 RFI/CMS Work Plan Addendum for WMAs T and TX-TY.*

A Tank Farm System

WMA A-AX is located in the south-central portion of the 200 East Area. WMA A-AX contains the A and AX Tank Farms. The A Tank Farm contains six SSTs that were constructed in 1954, put into service in 1955, and used to store and transfer waste until 1980. The AX Tank Farm contains four tanks that were constructed in 1963, put into service in 1964, and used to store and transfer waste until 1980. The A and AX Tank Farms received waste generated by PUREX Plant operations. The PUREX process produced three major waste streams: PUREX coating waste; PUREX acid waste, which contained about 99 percent of the fission products; and organic wash waste.

During its operational history, there were a number of confirmed or suspected waste-loss events in WMA A-AX. These included suspected tank leaks and known waste losses from piping systems. Currently, the pumpable liquid wastes have been removed from the WMA A-AX tanks, and all tanks have been interim stabilized (HNF-EP-0182, *Waste Tank Summary Report for Month Ending November 30, 2004*).

The current understanding of contaminant occurrences and environmental conditions at WMA A-AX is described in RPP-14430, *Subsurface Conditions Description of the C and A-AX Waste Management Area*. Historical information on soil-surface and vadose-zone contamination in WMA A-AX is provided in RPP-7494, *Historical Vadose Zone Contamination from A, AX, and C Tank Farm Operations*. The primary contamination zones currently identified in WMA A-AX are a localized Cs-137 activity zone near the bottom of the 241-A-104 and 241-A-105 Tanks and three unplanned releases near pipelines and diversion boxes.

B Tank Farm System

WMA B includes the SST B, BX, and BY Tank Farms, the 242-B Evaporator, five inactive miscellaneous underground storage tanks, and associated piping and support systems as well as various cribs, trenches, ponds, pipelines, and diversion boxes.

The B Tank Farm was constructed from 1943 to 1944 and began receiving waste in 1945. Waste sources include B Plant, REDOX Plant, N Reactor, PUREX Plant, and U Plant. The B-200 series SSTs also received waste from the 224-B Concentration Facility from 1946 to 1952. The SSTs stopped receiving waste by 1978. The B Tank Farm also includes the 242-B Evaporator.

The BX Tank Farm was constructed from 1946 to 1947 and began receiving waste in 1948. Waste sources include B Plant, REDOX Plant, N Reactor, U Plant, and PUREX Plant. The SSTs stopped receiving waste by 1980.

The BY Tank Farm was constructed from 1948 to 1949 and began receiving waste in 1950 as an extension of the BX Tank Farm. Waste sources include B Plant, U Plant, and coating waste and organic-wash waste from the PUREX process. The SSTs stopped receiving waste by 1974. The BY Tank Farm also includes In-Tank Solidification units 1 and 2 (ITS-1 and ITS-2), which performed in-tank evaporation of supernate wastes. The ITS-1 unit was located in the 241-BY-101 Tank and was moved to the 241-BY-102 Tank. The ITS-2 unit was located in the 241-BY-112 Tank.

C Tank Farm System

WMA C includes only the SST C Tank Farm, one inactive miscellaneous underground storage tank, and associated piping and support systems as well as various cribs, trenches, ponds, pipelines, diversion boxes, and other ancillary equipment.

The C Tank Farm was constructed from 1943 to 1944 and began receiving waste in 1945. Waste sources include B Plant, U Plant, PUREX Plant, and various experiments and operations conducted at the Hot Semiworks Chemical Engineering Laboratory. The C-100 series SSTs stopped receiving waste by the late 1970s.

S/U Tank Farm Systems

The S/U Tank Farms consist of the SST S, SX, and U Tank Farms, the 242-S Evaporator, the DST SY Tank Farm, eight inactive miscellaneous underground storage tanks, and associated piping and support systems as well as various cribs, trenches, ponds, pipelines, and diversion boxes.

The S Tank Farm was constructed in 1950 and began receiving waste in 1951 from the REDOX chemical separations plant. Some tanks in the S, SX, and U Tank Farms received evaporator bottoms from the 241-S Evaporator from 1973 to 1977. Some tanks in the U Tank Farm received evaporator bottoms from the 242-T Evaporator from 1975 to 1977. The SSTs stopped receiving waste and were filled with solids by the late 1970s.

The SX Tank Farm was constructed in 1953 and began receiving waste in 1954 from the REDOX Plant and the 242-S Evaporator.

The SY Tank Farm was constructed in 1976 and began receiving waste in 1977. Waste sources include the 242-S Evaporator; S, SX, T, and U Tank Farms; 222-S Laboratory; and T Plant. The

three DSTs are still in service, with DST 241-SY-101 receiving waste removed from older SSTs and DST 241-SY-102 receiving waste from saltwell pumping operations in SSTs.

The U Tank Farm was constructed from 1943 to 1944 and began receiving waste in 1946. Waste sources include the REDOX Plant and the 242-S Evaporator. Portions of the U Tank Farm were decommissioned between 1959 and 1995.

T Tank Farm System

The T Tank Farm consists of the SST T, TX, and TY Tank Farms, the 242-T Evaporator, 10 inactive miscellaneous underground storage tanks, and associated piping and support systems as well as various cribs, trenches, ponds, pipelines, and diversion boxes.

The T Tank Farm was constructed from 1943 to 1944 and began receiving waste in December 1944 from T Plant. The T-100-series SSTs stopped receiving waste by 1979, and the T-200-series SSTs stopped receiving waste by 1952. The T-200-series SSTs received waste from the 224-T Process Unit. The TX Tank Farm was constructed from 1947 to 1948 and began receiving waste in 1949 from the T Plant. Other waste sources included PUREX Plant, B Plant, 221-U Uranium Recovery Process Plant, and the 242-T Evaporator. Tank 241-TX-118 received waste from the 234-5 Z Plant from 1973 to 1978 for mixing with caustic waste to neutralize the acidic Z Plant waste. The SSTs stopped receiving waste by the 1970s.

The TY Tank Farm was constructed from 1951 to 1952 and began receiving waste in 1953. Waste sources include T Plant, REDOX Plant, PUREX Plant, B Plant, 221-U Uranium Recovery Process Plant, and the 242-T Evaporator. The SSTs stopped receiving waste by 1979.

2.2.2 Waste Streams

The following subsections provide general information concerning the characteristics of the waste streams associated with each of the pipeline-system bins.

2.2.2.1 Bin 1 Waste Streams (Process Waste, Process Condensate, and Chemical-Laboratory Waste)

Process-waste streams were derived from solvent recovery, ion-exchange regeneration, and ammonia-scrubber distillation. The processing was done off line of a plant's major processing system. The waste stream generated from recovery/regeneration is referred to as process waste. Cold-startup wastes usually were contaminated with uranium, whereas process wastes derived from fuel reprocessing tended to have a much more varied and equally concentrated inventory of contaminants. Process condensates were condensed liquids that became contaminated from direct contact with the process materials. The laboratory-waste group includes laboratory wastes commonly associated with the 222-Laboratory buildings at the B, T, U, and S Plants, where disposal sites received various liquid-waste streams from laboratory operations. Laboratory-waste liquid-disposal sites also are known at the PUREX and Z Plants.

2.2.2.2 Bin 2 Waste Streams (Steam Condensate and Cooling Water)

The steam-condensate and cooling-water streams were intended to be noncontact in character, in that they either came from uncontaminated parts of the plants or were separated from contaminated process solutions by pipe or vessel walls. Large volumes of water were used to regulate the temperature at various stages of the separations and concentration processes. A pipe or vessel failure was necessary to contaminate the steam-condensate or cooling-water streams and sites.

2.2.2.3 Bin 3 Waste Streams (Chemical-Sewer Waste)

Chemical-sewer wastes were generated at many of the separation/concentration processes. Early chemical-sewer wastes were combined with the larger cooling-water and steam-condensate streams at the B, T, and U Plants. With the advent of REDOX, PUREX, and cesium/strontium recovery operations, separate chemical sewers and separate disposal sites were installed. The chemical-sewer system was designed to serve nonradioactive operations in plant areas such as operating galleys, service areas, aqueous-makeup galleries, and maintenance areas. The plants discharged out-of-specification chemical batches, noncontaminated floor-drain-waste liquids, nonradiological process wastes, nonprocess steam condensates, noncontaminated vessel-coil waste, and other miscellaneous waste streams into the chemical sewers.

2.2.2.4 Bin 4 Waste Streams (Miscellaneous Waste)

Miscellaneous waste consists of the remaining radioactive waste streams not encompassed by the major process operations. Miscellaneous-waste streams covers a combination of moderate-volume equipment-decontamination and ventilation-system wastes, plus small-volume waste streams commonly disposed to french drains. These waste streams are varied in terms of sources. No organic contaminants are documented in available inventory data, and only small quantities of inorganics are noted in the inventories.

2.2.2.5 Bin 5 Waste Streams (Tank/Scavenged Waste)

Tank and scavenged wastes generally are defined as liquids discharged directly from the high-activity, SST tank farms or as treated high-activity tank wastes. These waste types generally are characterized as relatively small when compared to the cooling-water volumes of liquid that have more highly concentrated contaminants than other waste streams.

2.2.2.6 Bin 6 Waste Streams (Tank Farm Waste Transfers)

Tank-waste transfer lines received radioactive waste from the majority of the 200 Areas processing and support facilities. While some transfer lines received discreet waste types, the majority have had extensive transfer and commingling of waste types from the processing facilities and from tank-to-tank transfers. The bulk of the constituents in tank-waste transfer lines (if residual waste is present) likely are sodium hydroxide; sodium salts of nitrate, nitrite, carbonate, aluminate, oxalate, sulfate and phosphate; and hydrous oxides of metals such as aluminum, iron, bismuth, lanthanum, and manganese. Heavy metals, including mercury, chromium, and lead, also likely are present in tank-waste transfer lines. Key radioactive

components may include strontium, cesium, uranium, plutonium, thorium, technetium, iodine, and americium.

2.3 WASTE-SITE DESCRIPTIONS

A general description of the waste sites addressed by this work plan is provided in this section. For the pipeline systems, the association with a waste-stream bin is carried forward through the remainder of the work plan. Specific information pertaining to individual pipelines being evaluated in each waste stream bin as part of the Phase 1 investigation is provided in the SAP for facility-process-waste pipeline systems (Appendix A). Summary information for the CX Tank System and the Hexone Storage Tanks also is provided in this section.

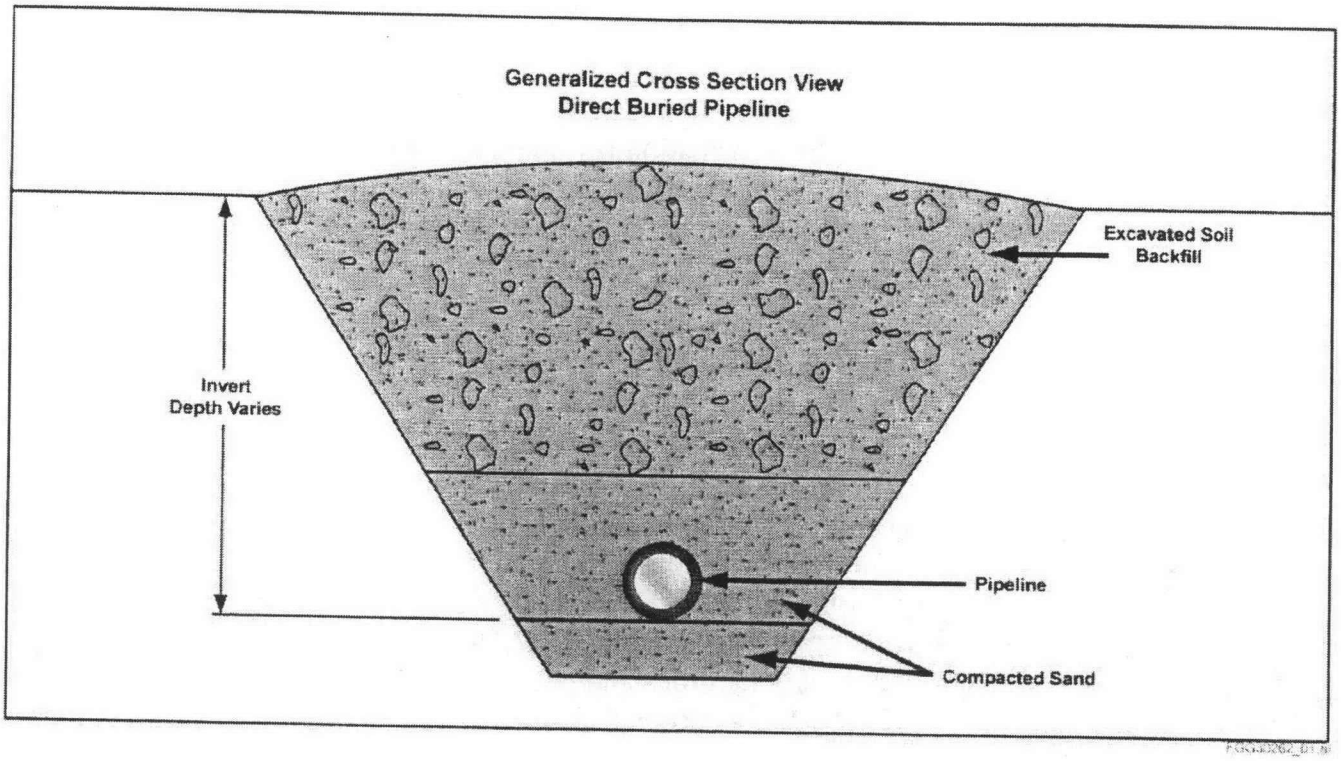
2.3.1 Pipeline Systems

Numerous pipelines and ancillary equipment were used in conjunction with processing operations and waste transfers in the 200 Areas. A complex network of pipelines was required to handle the different waste streams. The combined length of all of the pipelines in service is conservatively estimated to be more than 161 km (100 mi). WIDS has designated waste-site identification numbers for some of the pipelines outside the WMAs, but not for the complete pipeline network. The task of compiling, evaluating, and recording complete pipeline routing paths from points of inception (process facilities and/or tank farms) to disposal locations (e.g., trenches, cribs, ponds) or storage locations (tank farm WMAs) currently is proceeding but has not been completed. A database is being constructed that will delineate the mapped locations of the pipeline network. The complete mapped locations of the process-waste pipeline systems and assignment of waste-sites codes will support this work plan and provide information needed to update Appendix C of the Tri-Party Agreement (Ecology et al., 1989a).

In association with the processes performed by the plants in the Central Plateau area, the extensive network of pipelines, diversion boxes, catch tanks, valve pits, retention basins, vaults, and other related structures transferred liquid process wastes from the separations facilities to the SSTs and DSTs, evaporators, and effluent-discharge waste sites. During historical plant operations, the disposal or storage destination for a particular liquid-waste stream most often was determined by chemical characteristics and radiological activity levels. Waste-stream characteristics (e.g., corrosiveness, acidity, radiological activity) were considered during design of the pipeline network that was constructed at the Hanford Site. The waste stream's storage or disposal destination (e.g., tanks, cribs, trenches) determined whether the effluent needed to be transferred through the lines under pressure or could flow by gravity. Materials selected for constructing the pipelines depended on the anticipated waste stream's composition and characteristics. Although a number of materials were used for construction of the lines, all pipelines in process-waste stream Bins 1-5 were direct buried in the ground without use of additional exterior encasements. The initial tank farm waste-transfer pipelines installed in 1944-1945 were direct-buried pipelines, with some on concrete slabs. After 1947, all pipelines installed in the tank farms either were concrete encased or pipe-in-pipe encased. A generalized cross-sectional view of the burial characteristics of a single direct-buried pipeline is shown in Figure 2-5. Depth of burial of the pipelines varied with surface topographic conditions in the area. For the gravity flow lines, the burial depth along the pipe run was sufficient that the

gradient permitted liquids to free flow. In general, burial depths averaged from 4.6 to 6.1 m (15 to 20 ft) bgs.

Figure 2-5. Generalized Cross-Sectional View of a Direct-Buried Single Pipeline.



The following discussion presents the general attributes of the pipelines and waste-stream constituents that are encompassed by Bins 1-6. Characteristics of the pipelines are provided for each bin. Table 2-1 summarizes the general physical attributes of the pipelines in each bin.

2.3.1.1 Bin 1 (Process Condensate, Process Waste, and Chemical-Laboratory Waste) Attributes

Pipelines included in Bin 1 are located throughout the 200 East and 200 West Areas and are associated with of all the processing-facilities operations. Waste fluids carried by these pipelines include process condensate, process waste, and chemical-laboratory waste.

Table 2-1. General Attributes of Pipelines in Each Bin.

Bin	Process-Waste Operable Units	Process-Waste Streams	Physical Attributes		200 Areas Facilities Where the Process-Waste Pipeline Bin Applies
			Pipe Material Types Included[a]	Pipe Diameters (in.)[a]	
1	200-PW-1/2/3/4/5/6, 200-LW-1/2	Process Condensate, Process Waste, and Chemical-Laboratory Waste	Vitrified clay, stainless steel, corrugated galvanized steel, carbon steel, and fiberglass-reinforced epoxy	1, 1.5, 2, 3, 3.5, 4, 5, 6, 8, 10, 14, and 16	All
2	200-CW-1/2/3/4/5, 200-SC-1	Steam Condensate and Cooling Water	Vitrified clay, stainless steel, carbon steel, reinforced concrete, corrugated metal, and cast iron	4, 6, 8, 10, 12, 15, 16, 18, 24, 30, 36, and 42	All
3	200-CS-1	Chemical-Sewer Waste	Vitrified clay, stainless steel, carbon steel, and corrugated metal	3, 8, 10, 12, 14, 15, 16, 36, 42, and 48	A Plant (PUREX), B Plant, and S Plant (REDOX)
4	200-MW-1	Miscellaneous Waste	Vitrified clay and black steel.	4, 6, and 8	All
5	200-TW-1/2	Tank/Scavenged Waste	Stainless steel and carbon steel	2, 3, 3.5, 4, 10, and 14	B Plant, Hot Semiworks, T Plant, and U Plant
6	Tank Farms	Tank Farm Waste Transfers	Carbon steel, stainless steel, vitrified clay,[b] and fiberglass-reinforced thermosetting resin[b]	1, 2, 3, 3.5, 4, 6, 10 (NOTE: The A, AX, AY, AZ, and SX Tank Farms also contain 20- and 24-in.-diameter carbon steel pipelines used for vapor headers.)	All

[a] The pipe materials and diameters listed are based on the current level of review of engineering drawings. This list may be revised as additional information is compiled and evaluated.

[b] These pipeline material types transferred lower concentrations of radionuclides than typically were transferred in tank farms carbon or stainless steel pipelines.

PUREX = Plutonium-Uranium Extraction (Plant or process).
REDOX = Reduction-Oxidation (Plant or process).

Process condensate generally is water that was condensed from the closed-process system and was in direct contact with radioactive and chemical materials. Process waste is low-level and/or hazardous waste that directly contacted radioactive material and may contain organic components that could enhance mobility. The condensates formed from heating of the process chemistry and were removed in the vapor space of a dissolver or concentrator vessel, condensed off line in a cooling vessel, treated as necessary, and disposed to the ground. The vaporized material mostly was water, but volatile chemicals and trace quantities of radionuclides were removed as well. Common contaminants included tritium, I-129, Cs-137, Sr-90, Ru-106, Tc-99, U-238, U-239/240, organics, nitrates, and a number of other inorganic components.

Each separations and concentration process in the 200 Areas had an associated laboratory designed to monitor the processes. Laboratory-waste streams generally are low in all radionuclides, although some have significant inventories of plutonium, uranium, and fission products. Sodium dichromate also is reported at several of the waste sites. Liquid volumes for the 200-LW-1 and 200-LW-2 waste streams typically are smaller than the other waste streams. Laboratory wastes differ from the process wastes only in the quantity of waste disposal.

These waste streams were routed from facilities to various liquid-waste disposal sites, including cribs, trenches, tile fields, french drains, and injection wells. Pipeline materials used to transfer the waste streams varied, and include carbon steel, stainless steel, fiberglass-reinforced epoxy, vitrified clay, and corrugated galvanized steel (corrugated metal). Available information indicates that pipeline diameters range from approximately 2.54 to 41 cm (1 to 16 in.). Waste streams were transferred by nonpressurized gravity flow in the pipelines included in Bin 1.

2.3.1.2 Bin 2 (Steam-Condensate and Cooling-Water) Attributes

Pipelines included in Bin 2 occur throughout the 200 Areas and were used with all of the primary 200 Areas processing facilities. Process fluids carried by these pipelines consisted of cooling water and steam condensate.

Both the steam-condensate and the cooling-water waste streams have been subdivided into a number of OU disposal sites, primarily based on geography and, to a lesser extent, on the potential differences in contaminants. Both of these two waste streams consisted predominately of water. The water would flow through a heat exchanger and then flow to a disposal site. Cooling-water pipelines conveyed significant inventories of contaminants because of the large volumes of slightly contaminated wastes discharged.

These waste streams generally were routed from facilities to ditches, ponds, trenches, and cribs. Steam-condensate waste streams from the solvent-extraction-process plants were recognized as having a greater potential for becoming contaminated and were discharged to cribs instead of ditches and ponds. Pipeline composition varies and includes carbon steel, stainless steel, vitrified clay, reinforced concrete, corrugated metal, and cast iron. The sizes of the pipelines associated with these waste streams are larger because of the need to handle larger volume flows, and they range from 10 to 107 cm (4 to 42 in.) in diameter. These pipelines transferred fluids using nonpressurized gravity flow.

2.3.1.3 Bin 3 (Chemical-Sewer Waste) Attributes

Pipelines comprising Bin 3 are located in both the 200 East and the 200 West Areas and are associated with the A Plant (PUREX), B Plant, and S Plant (REDOX) facilities. Process fluids carried by these lines consisted of chemical-sewer waste. This waste stream generally was routed from facilities to cribs, ditches, and ponds.

These chemical wastes received a quantity of raw water to dilute the chemical additions to the waste stream. These waste streams became contaminated with low levels of radionuclides at some unspecified time and by an unknown process. No reports of chemical contaminants in the chemical sewer have been found in the aggregate area management study reports, but the ditches and ponds receiving this category of waste have been designated as RCRA TSD units. Chemical-sewer contamination resulted from some form of process upset such as liquid draining back into an aqueous-makeup area. The waste compounds discharged by these pipelines are acidic in nature. Pipeline compositions include carbon steel, stainless steel, vitrified clay, and corrugated metal. Large pipelines often were used for this waste stream, to handle high-volume flows. Pipe diameters range from 7.6 to 122 cm (3 to 48 in.). These pipelines handled nonpressurized gravity-flow liquids.

2.3.1.4 Bin 4 (Miscellaneous-Waste) Attributes

These pipelines occur throughout the 200 Areas. Process fluids transferred in these pipelines consisted of miscellaneous waste streams. The liquid waste generally was routed a relatively short distance from the facilities to cribs, trenches, french drains, and injection wells.

Most miscellaneous-waste streams are low in radionuclides and chemicals, except for higher inventories of uranium, plutonium, fission products, and occasional reports of sodium dichromate attributed to the PUREX Plant ventilation system. Equipment decontamination wastes are associated with the decontamination mission of T Plant. There is one equipment decontamination site each at the 202-S Plant Building and the U Tank Farm. Decontamination wastes are lightly contaminated, high-volume streams, but are expected to be accompanied by detergents or cleaning agents that may have mobilized the contaminants. Miscellaneous wastes include a host of potentially contaminated small-volume waste streams, such as vacuum-pump seal-water wastes, fan-bearing cooling-water wastes, stack drainage, floor drainage from stack control rooms, and stack-condensate drainage. Pipeline composition currently is known to include only vitrified clay and black steel, with pipeline diameters ranging from approximately 10 to 20 cm (4 to 8 in.). These pipelines generally were operated as nonpressurized, gravity-flow lines.

2.3.1.5 Bin 5 (Tank/Scavenged-Waste) Attributes

Pipelines that are part of Bin 5 are located in both the 200 East and the 200 West Areas and are associated with the B Plant, Hot Semiworks, T Plant, and U Plant facilities (pipelines in the 200-UW-1 OU area are not addressed by this work plan). Process fluids carried by these pipelines consisted of tank waste and scavenged waste. These waste streams generally were routed between tank farms, between facilities and tank farms, or from tank farms to cribs, trenches, french drains, and injection wells. Pipeline materials currently are known to include only carbon steel and stainless steel, with available information on pipeline diameters indicating

a range from approximately 5.1 to 35.6 cm (2 to 14 in.). Waste streams in Bin 5 were either transferred by gravitational flow or pumped under pressure.

2.3.1.6 Bin 6 (Tank Farm Waste Transfers) Attributes

The tank-farm pipeline system consisted of a variety of pipelines and diversions boxes. Pipelines in the system include slurry lines, supernatant lines, cross-site lines, and jet-pump transfer lines. Approximately 350 transfer pipelines are associated with the 200-IS-1 OU, and there are more than 100 diversion boxes and associated catch tanks. Pipelines often are buried anywhere from 2.4 to 4.6 m (8 to 15 ft) bgs. Generally, the pipelines are carbon steel, which was joined by butt welding. The original pipelines installed in 1944-1945 were stainless steel (Cb 18-8) tubing. Pipelines used to transfer high-level/high-activity wastes initially were buried directly in trenches. As failures in these lines occurred in the 1940s, subsequent construction involved placement in concrete or pipe-in-pipe encasements. The encasements extended between diversion boxes or concrete pits on top of the SSTs (occasionally drywells) and were designed so that any liquids lost because of leaks or pipeline failure would drain to a drain in the bottom of a diversion box (or to the SST if from a concrete pit), which conveyed the release to a catch tank.

2.3.2 Pipeline Appurtenances

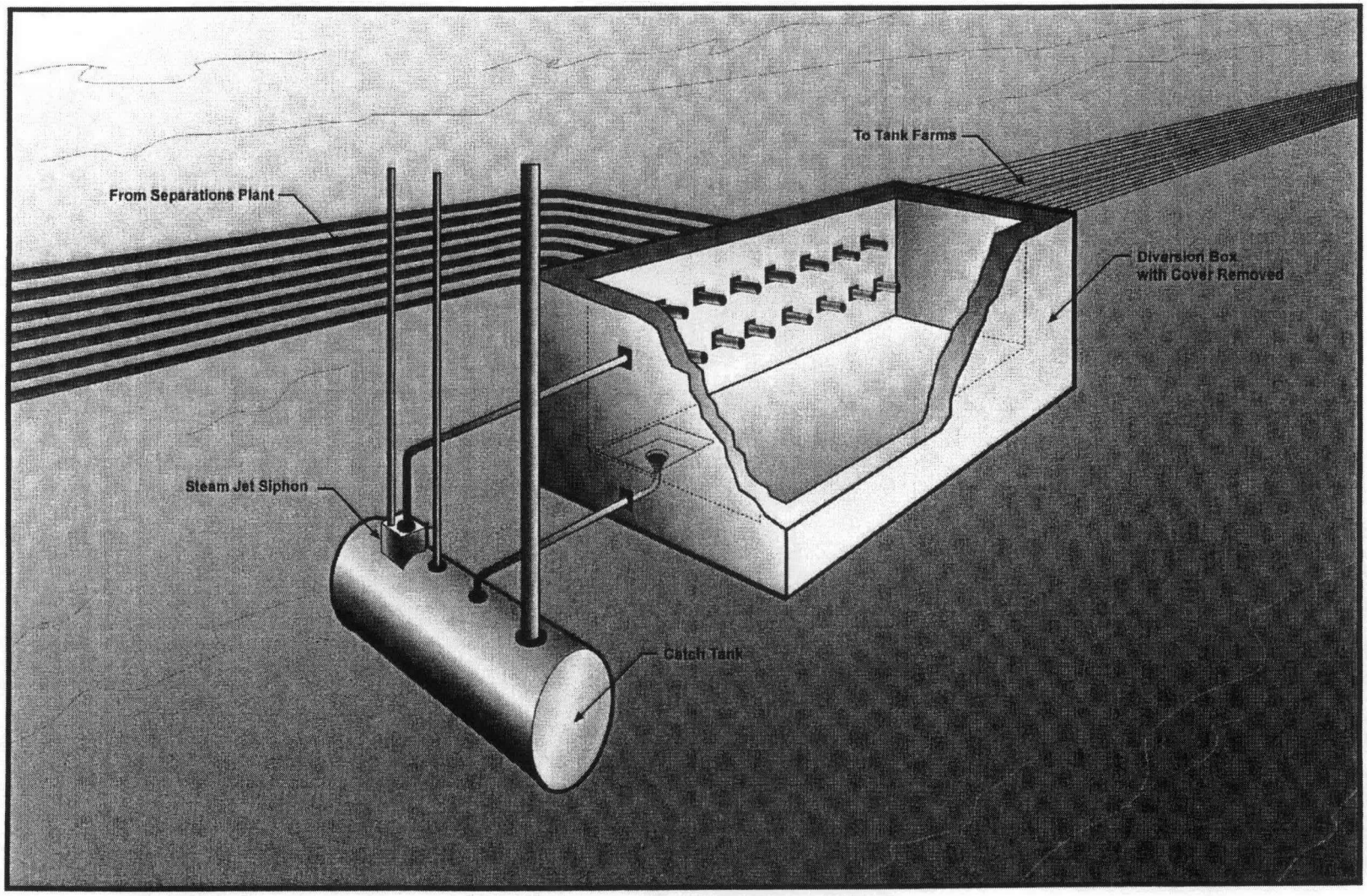
A general description of the major pipeline-system appurtenance structures is provided below. Another appurtenance type not described here is the diverter stations/diversion boxes and catch tanks (241-AX-151 and 241-AX-152). A description of these appurtenances can be found in RL-SEP-9, *PUREX AX Tank Farm and Waste Routing System Information Manual*, pages 8-10.

2.3.2.1 Diversion Boxes

Diversion boxes are reinforced-concrete structures that generally were constructed below grade. Waste-transfer lines are connected inside the diversion box by installing a jumper between connecting nozzles. Diversion boxes provided a flexible method of redirecting the liquid-waste flow path to various locations in the 200 East and 200 West Areas. They also provided containment for leaks in transfer pipes (which drain back to the boxes via concrete or pipe-in-pipe encasements) and leaks at jumper-nozzle connections. The boxes are large, covered, underground reinforced-concrete structures that received at least two (and up to four) sets of pipelines. The general configuration of a diversion box is shown in Figure 2-6. The pipe sets entered the diversion box at different levels through one wall. Each pipe had a special end fitting that permitted the secure attachment of either flexible or solid pipes, also known as jumpers.

All connections were made manually using remote equipment. Each jumper was fabricated to custom fit to the desired pair of incoming and outgoing pipes. To assist with gravity flow, pipelines coming in from the facility were located on the higher level of pipes, while lines leading to tank farms were on the lower level. Connections could be routed for flow in either direction, because several of the separations processes retrieved wastes from the tank farms and transferred the material to the facility.

Figure 2-6. Generalized Configuration of a Typical Diversion Box and Catch Tank.



Diversion boxes varied in size but typically were constructed 5.2 to 6.1 m (17 to 20 ft) deep, by 1.8 to 3.0 m (6 to 10 ft) wide, by 7.6 to 12.2 m (25 to 40 ft) long. All but the uppermost portion of a diversion box is below ground. Each diversion box is covered with a series of thick-stepped cover blocks, 30.5 to 35.6 cm (12 to 14 in.) in thickness that prevented ready migration of contaminants out of the box. Cover blocks were removed when a routing change was required.

Connecting pipelines either were direct buried or were encased up to the outside wall of the diversion box. There they mated with preinstalled pipe that penetrated the box wall. Catch tanks were built at a level below that of the floor of the diversion box and collected liquid wastes that spilled in the box when routings were changed, thereby containing the release. The jumpers are thought to have been allowed to drain onto the floor when the connection was broken, leading to internal contamination of the box.

2.3.2.2 Catch Tanks

Catch tanks were built in conjunction with diversion boxes to contain high-activity wastes spilled during changes in pipeline routings. The tanks are direct-buried, underground-storage tanks, generally constructed of carbon steel (Figure 2-6). Sump pits in the diversion box collected the liquid and were connected by piping to the catch tank. With the advent of encased pipelines, leaks were anticipated, and a provision was made to collect the liquid released into the nearest downgradient catch tank. In some cases, a catch tank served more than one diversion box, particularly around tank farms. The catch tanks usually were located within 15.2 m (50 ft) of the diversion box. Catch tanks could be empted to diversion boxes through an underground pump-out line. Each catch tank is equipped with a liquid-level sensor and a pump-pit leak indicator. Activation of the leak-detection alarm causes a shutdown of transfer operations. Only a few of the catch tanks have liquid-level monitoring devices that are connected to the surveillance automated control system. Some of the catch tanks and miscellaneous underground storage tanks are not monitored.

Catch tanks range between 2.1 and 2.7 m (7 and 9 ft) in diameter and 7.6 to 10.7 m (25 to 35 ft) long, with storage capacities of 30,283 to 45,425 L (8,000 to 12,000 gal). Catch-tank designs changed as new diversion boxes were added to manage waste streams. Catch tanks were located at depths of 7.6 to 10.7 m (25 to 35 ft), considerably deeper than the floor of the diversion box, to provide complete drainage of a leak or spill. A series of risers extended to above the ground surface and were used to monitor liquid levels, collect samples, pump out tank contents, and permit chemical additions. Steam jets or in-tank pumps were added later with piping that led back to the diversion box for ready transfer to the facility or tank farm. Some catch tanks have been replaced because of leaks or vessel failure.

2.3.2.3 Valve Pits

A valve pit or box is a belowground reinforced-concrete structure used to route wastes between pipelines leading to two waste sites. For a very long crib (up to 427 m [1,400 ft]), valve pits also were used to more evenly distribute flow over both halves of the crib. These structures most commonly were associated with pipelines that relied on gravity flow of waste streams that discharged to cribs, ponds, or ditches. Valve pits have been used to direct process liquids encompassing waste streams included in pipeline Bins 1-6.

For some pits/boxes, pipelines passed through the structure with no open flow. Intersecting pipes were connected at tee or union fittings. Valves were built into the pipeline and were opened or closed to change flow routings. Other valve pits/boxes were designed to allow open wastewater flow within the pit. The incoming pipe terminated at the edge of the pit/box, and water then flowed through the box before exiting at another pipeline. Changes in routing were through a series of moveable dams, or stop logs, as well as slide gates that covered the opening of the receiving pipe. Valve and gate handles were extended through the pit/box cover to permit remote operation.

Valve pits generally were smaller structures than diversion boxes. Sizes ranged up to 4.6 by 3.0 m (15 by 10 ft) at the surface, and they were constructed to depths up to 3.7 to 4.6 m (12 to 15 ft), depending on the depth of the buried pipeline. These structures usually carried a "216-" series prefix and a designation that was associated with the waste site to which the flow was directed. The interiors of the valve pits could be accessed through hatches in the cover.

2.3.3 CX Tank System

The CX Tank System is located at the former Hot Semiworks Facility east of B Plant in the 200 East Area (Figure 2-7). The CX Tank System consists of three tanks: 241-CX-70 Storage Tank, 241-CX-71 Neutralization Tank, and 241-CX-72 Storage Tank. Although the Dangerous Waste Permit Application (Form 3) (WA7890008967) calls it the "241-CX tank system," these three tanks operated independently and served separate functions. These tanks no longer receive waste, and all three have been decommissioned. The 241-CX-70 Storage Tank, 241-CX-71 Neutralization Tank, and 241-CX-72 Storage Tank were evaluated (BHI-01018, *Environmental Restoration Contractor Management Plan for Inactive Miscellaneous Underground Storage Tanks [IMUSTS]*) and determined to be safely managed as inactive waste sites under existing surveillance and maintenance programs. Prior process uses and the status of each of these three tanks are summarized in the following discussion. A summary of the inventory information that has been complied for each tank is presented in Table 2-2.

2.3.3.1 241-CX-70 Storage Tank

This tank (Figure 2-8) was used from approximately early 1952 through 1957 to store high-level liquid-process waste from the REDOX Plant pilot studies (BHI-01018; BHI-01173, *Auditable Safety Analysis for Surveillance and Maintenance of the 214-CX Tank System*). The term "REDOX" was used for the reduction-oxidation chemical process used to separate plutonium and uranium from irradiated reactor fuel. The design capacity of the tank is 114,000 L (30,000 gal) (BHI-01173). Waste-removal activities for the contents of the 241-CX-70 Storage Tank were initiated in the summer of 1987 with the construction of a sluicing/pumping system. The sluicing/pumping system used large volumes of water to sluice the solid waste mixed from the bottom of the 241-CX-70 Storage Tank and pump it to the DST system.

Figure 2-7. CX Tank Farm System Area Plan View.

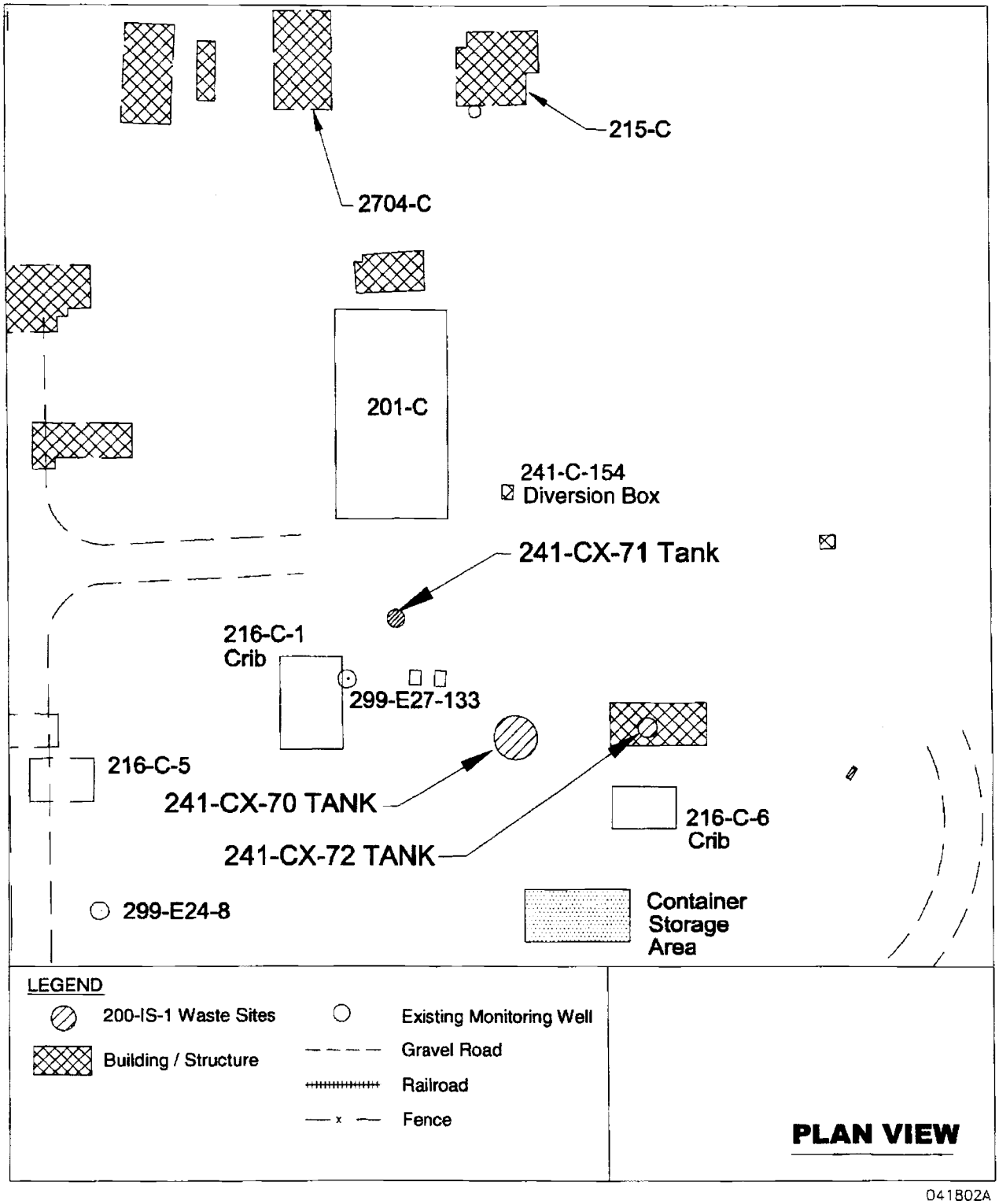


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Table 2-2. Summary Information for the CX Tank Farm System and Hexone Storage and Treatment Facility Tanks. (2 Pages)

Tank Identification	Facility Served	Tank Volume and Type	Tank Construction	Function	Tank Inventory (Based on Process Knowledge)			Tank Inventory (Based on Samples or Radiological Logging)		Status
					Nonradiological Constituents	Radiological Constituents	Volume Handled	Nonradiological Constituents	Radiological Constituents	
241-CX-70 Storage Tank	201-C Process Building, A cell	30,000-gal waste-handling underground storage tank[1]	1-ft concrete shell and top (bottom concrete 2 ft thick at edges, 9 in. thick at center) with 0.25-in. stainless steel liner; tank 20-ft inner diameter by 15 ft high. Top of tank is 11 ft bgs; bottom is 26 ft bgs.[1,7]	Designed, constructed, and used for high-level REDOX process waste[1,2] discharged from scrubber, oxidizer, dissolver, feed makeup, waste-receiver tanks, and waste-concentrator tank centrifuge.[1,24,25,26]	Negligible[4]	287 Ci Sr-90, 134 Ci Cs-137, 0.034 Ci Am-241, 0.116 Ci Pu-239[5]	106,000 L (28,000 gal)[6]	During sludge removal (1988): pH 13 in liquid phase;[7] 0.0009 wt% halogenated hydrocarbons (aliphatic amines or aliphatic alcohol[8])	Tank sludge remaining (1976): 4300 Ci Sr-90; 870 Ci Cs-137; 3.4 Ci transuranic content[9] During sludge removal (1988): alpha readings from 390 to 690 nCi/g of filtered solids; transuranic content ~50 nCi/g[10] 1992 interior dose readings ranged from 5 mrad/h beta at top to 15,000 mrad/h on the bottom[10]	Empty[1]
241-CX-71 Neutralization Tank	201-C Process Building, hot shop	Approximately 3,800-gal neutralization underground tank[1]	Stainless steel; reported tank size is 9-ft diameter by 9 ft high. Top of tank is 3.5 ft bgs; bottom is 12.5 ft bgs.[1]	Designed, constructed, and used for neutralization (with limestone) of acidic REDOX hot-shop sink and process/condensate cooling-coil wastes containing low-level radioactive waste before discharging to 216-C-1 and 216-C-5 Cribs.[1,2,14,27,28,29]	Minor chemical residues in sludge/ aggregate[4]	(1990 estimate) 1,600 nCi/L of Cs-137, 2.46 E-8 g/L Pu; 43,000 nCi/L of Sr-89/90,[12] 6 Ci transuranic content, and 6,000 Ci beta.[9]	33 million L (8.8 Mgal)[6]	Sludge samples (1990): extremely low concentration of methyl ethyl ketone, xylene, toluene (7 to 54 parts per billion), and cyanide (21 parts per million)[11]	No sample results available	Capped with grout; 930 gal of limestone and sludge in bottom[2,13]
241-CX-72 Storage Tank	201-C Process Building, A and C cells	2,000- to 2,300-gal experimental underground concentration tank[1,2]	Tank is vertically oriented; 40-in. diameter by 35.8 ft high; 0.38-in. stainless steel plating with five stiffening rings around perimeter, connected by three rows of vertical guides; resting on concrete pad inside 6-ft-diameter steel caisson; cylindrical heater located just above each stiffening ring; top of tank sealed with plate that extends over and seals the caisson; bottom of caisson sealed with 12-in.-thick reinforced-grout plug that provides base for tank. Top of tank is 14 ft bgs; bottom is about 50 ft bgs.[12]	Designed, constructed, and used for terminal storage of waste associated with pilot PUREX waste-concentration studies performed in Cells A and C; tank also may have been used for fluids from decontamination of semiworks after separations projects; investigations of bumping phenomenon were conducted in the tank.[1,14,15,24-28,29]	Chemical residues in sludge/ aggregate; minor compared to radiological source term[4]	Upperbound estimate: 200 g Pu, 10,000 Ci Cs-137[12,15,16]	8,700 L (2,300 gal)[17]	Nondestructive assay (1989): fluorine compounds (see information in radiological constituents column)[15]	In-tank samples (1974): Pu (total), 1.13 E-8 g/gal; U (total) 2.43 E-3 g/gal; Sr-89/90 4.33 mCi/g; Cs-137 undetected;[6] (1988) 2,000 to 8,000 d/min alpha; 2640 to 5810 pCi gamma; beta/gamma ratio of 25:1; estimated 9,000 to 10,000 Ci Cs-137[6] 1989 nondestructive assay (gamma spectroscopic, relative axial-neutron flux, neutron flux, axial-temperature profile, and axial dose-rate profile measurements) taken from periphery drywell (not direct samples): ~11 ft sediment layer consisting of fission products and transuranic isotopes at bottom of tank; suggested uniform distribution of activity in sludge layer, with likely higher concentration in bottom 2 to 3 ft of tank; activity layer is dry and does not contain hydrogenous materials to thermalize the neutrons generated within contents of the tank; axial temperature profile measurements of 60 to 72 °F indicated presence of heat-generating wastes; dose rates vary from 4 rem/h at 10 ft above sludge layer to 265 R/h at top of sludge layer, increasing to ~491 R/h at bottom of sludge layer; transuranic content likely is present in fluorides; plutonium content of sludge is between 150 and 200 g.[15]	Capped with grout; 650 gal of dried sludge in bottom[2,13]
276-S-141 Hexone Storage Tank	276-S Solvent Handling Facility	21,500-gal underground recovery/ storage tank[2]	Horizontal tank ~28 ft long by 12 ft diameter; 0.38-in. carbon steel, single shell. Top of tank is 2.5 to 3 ft bgs; bottom is 14.5 to 15 ft bgs.[2]	Designed, constructed, and used to store clean reagent-grade hexone for use in the REDOX Plant. Later received waste during REDOX Plant decontamination.[2]	(1992) Estimated to contain TBP, hexone, and total petroleum hydrocarbons[18]	Not applicable	~605,600 L (160,000 gal)[19]	In-tank samples (1976 and 1988): 98.4% hexone, 1.6% water[20, 21] Tank sludge (2001): NPH, TBP, hexone, iron oxide[18]	In-tank samples (1976 and 1988): 5460 pCi/L I-129, 7,470,000 pCi/L H-3 (estimated), <31 pCi/L total alpha, 4910 pCi/L total beta[20, 21] Tank sludge (2001): Am-241, Pu, Sr-90, Cs-137. The sludge in the 276-S-142 Hexone Storage Tank contains about four times the amount of radioactive material in the sludge in the 276-S-141 Hexone Storage Tank.[18]	Grout fill with 132 gal tarry sludge heel in bottom[22]
276-S-142 Hexone Storage Tank	276-S Solvent Handling Facility	21,500-gal underground recovery/ storage tank[2]	Horizontal tank ~28 ft long by 12 ft diameter; 0.38-in. carbon steel, single shell. Top of tank is 2.5 to 3 ft bgs; bottom is 14.5 to 15 ft bgs.[2]	Designed, constructed, and used to store clean reagent-grade hexone for use in the REDOX Plant. Later received waste during REDOX Plant decontamination. Tank also was used to store kerosene and TBP during a one-time campaign to separate americium, curium, and promethium from Shippingport reactor blanket fuel.[2]	(1992) Estimated to contain TBP, hexone, and total petroleum hydrocarbons[18]	Not applicable	~980,000 L (256,000 gal)[23]	In-tank samples (1976 and 1988): 60% hexone, 25.2% NPH, 12.6% TBP, 1.7% water, 380 L (100 gal) sludge[20, 21] Tank sludge (2001): NPH, TBP, hexone, iron oxide[18]	In-tank samples (1976 and 1988): 34,500 pCi/L I-129, 3,162,000 pCi/L H-3, 2,070,000 pCi/L total alpha, 871,000 pCi/L total beta[20, 21] Tank sludge (2001): Am-241, Pu, Sr-90, Cs-137. The sludge in the 276-S-142 Hexone Storage Tank contains about four times the amount of radioactive material in the sludge in the 276-S-141 Hexone Storage Tank.[18]	Grout fill with 132 gal tarry sludge heel in bottom[22]

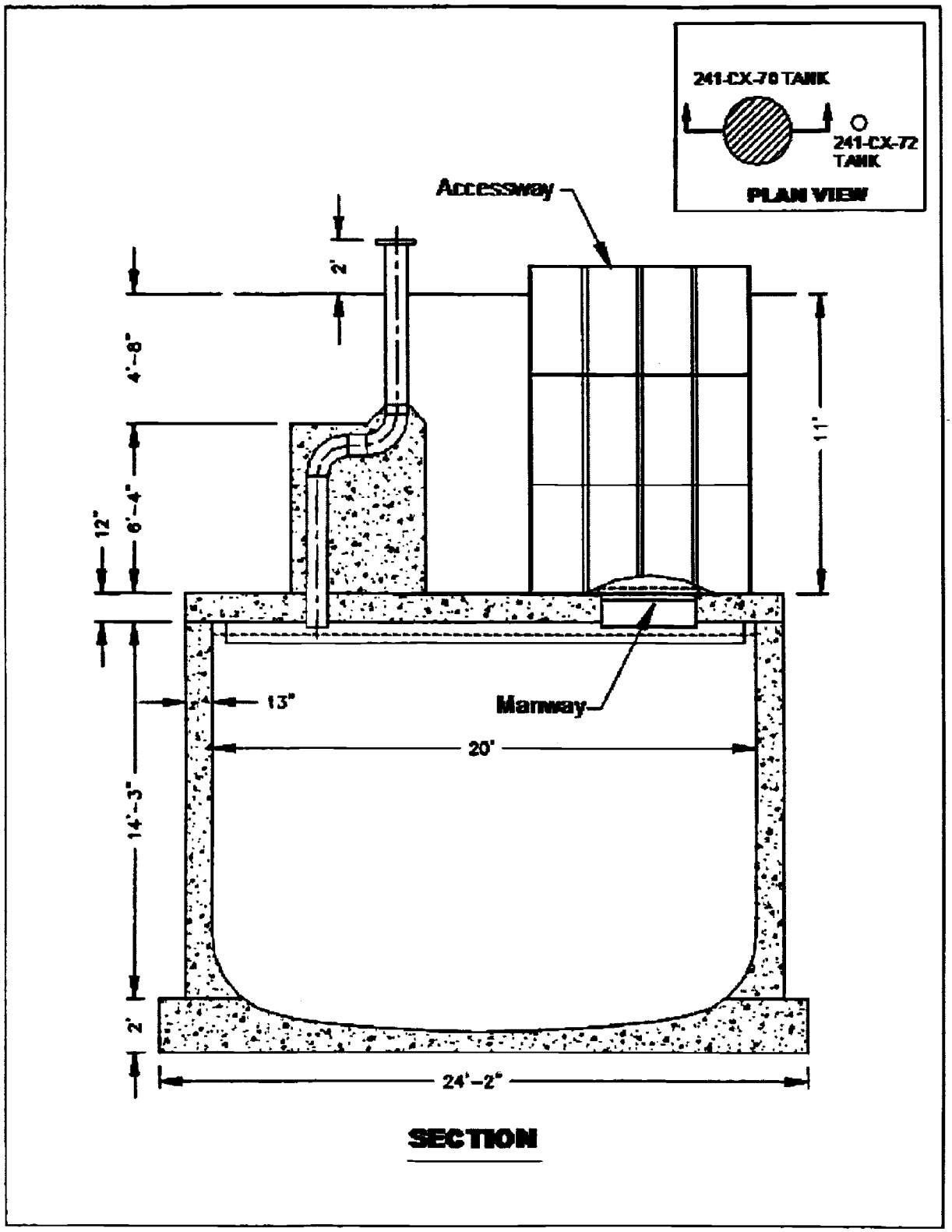
Table 2-2. Summary Information for the CX Tank Farm System and Hexone Storage and Treatment Facility Tanks. (2 Pages)

Tank Identification	Facility Served	Tank Volume and Type	Tank Construction	Function	Tank Inventory (Based on Process Knowledge)			Tank Inventory (Based on Samples or Radiological Logging)		Status
					Nonradiological Constituents	Radiological Constituents	Volume Handled	Nonradiological Constituents	Radiological Constituents	

[1]BHI-01173, *Auditable Safety Analysis for Surveillance and Maintenance of the 241-CX Tank System.*
[2]BHI-01018, *Environmental Restoration Contractor Management Plan for Inactive Miscellaneous Underground Storage Tanks (IMUSTS).*
[3]HW-31373, *PUREX Chemical Flowsheet HW Number 3 Chemical Development Unit Separations Technology Subsection Technical Sec Engineering Department.*
[4]DOE-RL-92-18, *Semiworks Plant Source Aggregate Area Management Study Report.*
[5]BHI-01087, *Preliminary Hazard Classification for the 241-CX Tank System.*
[6]AR00227, "Disposition and Isolation of Tanks 270-E-1, 270-W, 241-CX-70, 241-CX-71, and 241-CX-72."
[7]WHC-SD-DD-TI-034, *Tank 241-CX-70 Waste Removal Assessment.*
[8]12712-PCL88-019, *Analysis of Sludge Samples from Hot Semiworks Tank CX-70.*
[9]SD-WM-SAR-003, *Safety Analysis Report for the Decontamination and Decommissioning of the Strontium Semiworks Complex.*
[10]WHC-SD-DD-TI-071, *Facility Decommissioning Report for Tank 241-CX-70.*
[11]WHC-SD-DD-TI-058, *Tank 241-CX-71 Waste Characterization.*
[12]WHC-SD-DD-SAD-001, *Safety Evaluation for interim Waste Management Activities in Tank 241-CX-70, Tank 241-CX-71, and Tank 241-CX-72.*
[13]WHC-MR-0144, *Plan and Approach for Completion of Decommissioning of Strontium Semiworks Plant.*
[14]WHC-SD-DD-TI-040, *Tank 241-CX-72 Preliminary Waste Characterization.*
[15]WHC-SD-CP-TI-148, *Radiological Evaluation of Hot Semiworks Tank 241-CX-72.*
[16]WHC-SD-DD-TI-051, *An Estimation of the Radionuclide Content of Tank 241-CX-72.*
[17]HW-52860, *Standby Status Report Hot Semiworks Facility.*
[18]BHI-01521, *Evaluation of Alternatives for the Interim Stabilization of the Hexone Tanks.*
[19]CCN 100786, "276-S-141/142 Hexone Storage Tank Sludge Sampling Results."
[20]ARH-CD-685, *Characterization of the Contents of Organic Waste Storage Tanks 276-S-141 and 276-S-142.*
[21]WHC-SP-0350, *Hexone Remediation Demonstration Plan for Tanks 276-S-141 and 276-S-142.*
[22]BHI-01142, *REDOX Facility Safety Analysis Report.*
[23]DOE/RL-96-82, *Hanford Facility Dangerous Waste Closure Plan, 241-Z Treatment and Storage Tanks.*
[24]H-2-4093, *Hot Semiworks Process Piping Plan A Cell.*
[25]H-2-4105, *Hot Semiworks Engineering Flow Sketch.*
[26]H-2-4335, *Hot Semiworks Waste Line Bldg 201-C to TK-70.*
[27]H-2-4010, *Strontium Semiworks & Vicinity Outside Lines Key Map.*
[28]H-2-4420, *Plot Plan Hot Semiworks Waste Self-Concentrator.*
[29]H-2-4535, *Site Plan & Underground Piping Strontium Facilities, Hot Semiworks.*

bgs = below ground surface.
NPH = normal paraffin hydrocarbon.
PUREX = Plutonium-Uranium Extraction (Plant or process).
REDOX = Reduction-Oxidation (Plant or process).
TBP = tributyl phosphate.

Figure 2-8. 241-CX-70 Storage Tank Construction Diagram.



Approximately 530,000 L (140,000 gal) of water were used to reduce the original waste volume of 38,986 L (10,300 gal) to 2,800 L (750 gal). This volume of waste remained in the 241-CX-70 Storage Tank until December 20, 1991, at which time the waste was placed in approved containers and transferred to the 224-T Transuranic Assay Facility. As part of the 1991 waste-removal activity, excavation to the top of the tank occurred. Plywood was used to shore up the excavation and was left in place following waste-removal activities. The shoring has collapsed and obscures the view of the tank. The tank currently is empty (BHI-01173) and is being managed under interim status.

2.3.3.2 241-CX-71 Neutralization Tank

This tank (Figure 2-9) was used from 1952 thorough 1957 for neutralizing 201-C Hot Semiworks process condensate, hot-shop sink, and condenser cooling water. The 241-CX-71 Neutralization Tank received process condensate from REDOX process operations and may have received decontamination flushed following the completion of PUREX process operations. The waste remaining in the 241-CX-71 Neutralization Tank contains process effluents that were passed through the tank to be neutralized by contact with a bed of limestone aggregate placed in the tank for this purpose. After the June 1957 decontamination flushes, the 241-CX-71 Neutralization Tank was taken out of service. The design capacity of the 241-CX-71 Neutralization Tank is 14,000 L (3,800 gal) (BHI-01173). Grout currently caps the limestone aggregate (BHI-01018; WHC-MR-0144, *Plan and Approach for Completion of Decommissioning of Strontium Semiworks Plant*). This RCRA unit is being managed under interim status.

2.3.3.3 241-CX-72 Storage Tank

This tank (Figure 2-10) was used to study the concentration of waste generated from the Hot Semiworks Facility pilot studies. This tank was used for approximately 1 year in 1956, when 8,725 L (2,305 gal) of waste was transferred into the tank. Decontamination flushes from the Hot Semiworks Facility also might have been sent to the 241-CX-72 Storage Tank. The waste in the tank then was heated until enough liquid evaporated that it was nearly dry. The 241-CX-72 Storage Tank remained idle from 1960 until it was taken out of service in 1967. In 1986, the 241-CX-72 Storage Tank was filled with 7.3 m (24 ft) of grout over a 3.4 m (11-ft) heel consisting of nonliquid mixed waste (BHI-01018, WHC-MR-0144) and decommissioned. Gamma spectroscopic, relative-axial neutron-flux profile, axial temperature profile, and axial dose-rate profile measurements were taken from a periphery drywell (see Table 2-2) to estimate the remaining radionuclide content (WHC-SD-CP-TI-148, *Radiological Evaluation of Hot Semi-Works Tank 214-CX-72*). The design capacity of the 241-CX-72 Storage Tank is between 7,600 and 8,700 L (2,000 and 2,300 gal) (BHI-01018, BHI-01173). This RCRA unit is being managed under interim status.

The RCRA Part A Permit Application (Form 3) was revised in 1994 and submitted to Ecology as Revision 3 (WA7890008967). The CX Tank System tanks are classified as dangerous-waste tank TSD units with the following waste codes:

- <u>241-CX-70 Storage Tank</u>: "D002" (corrosive) because of sodium hydroxide, and "D007" and "WT02" (dangerous toxic) because of chromium

Figure 2-9. 241-CX-71 Neutralization Tank Construction Diagram.

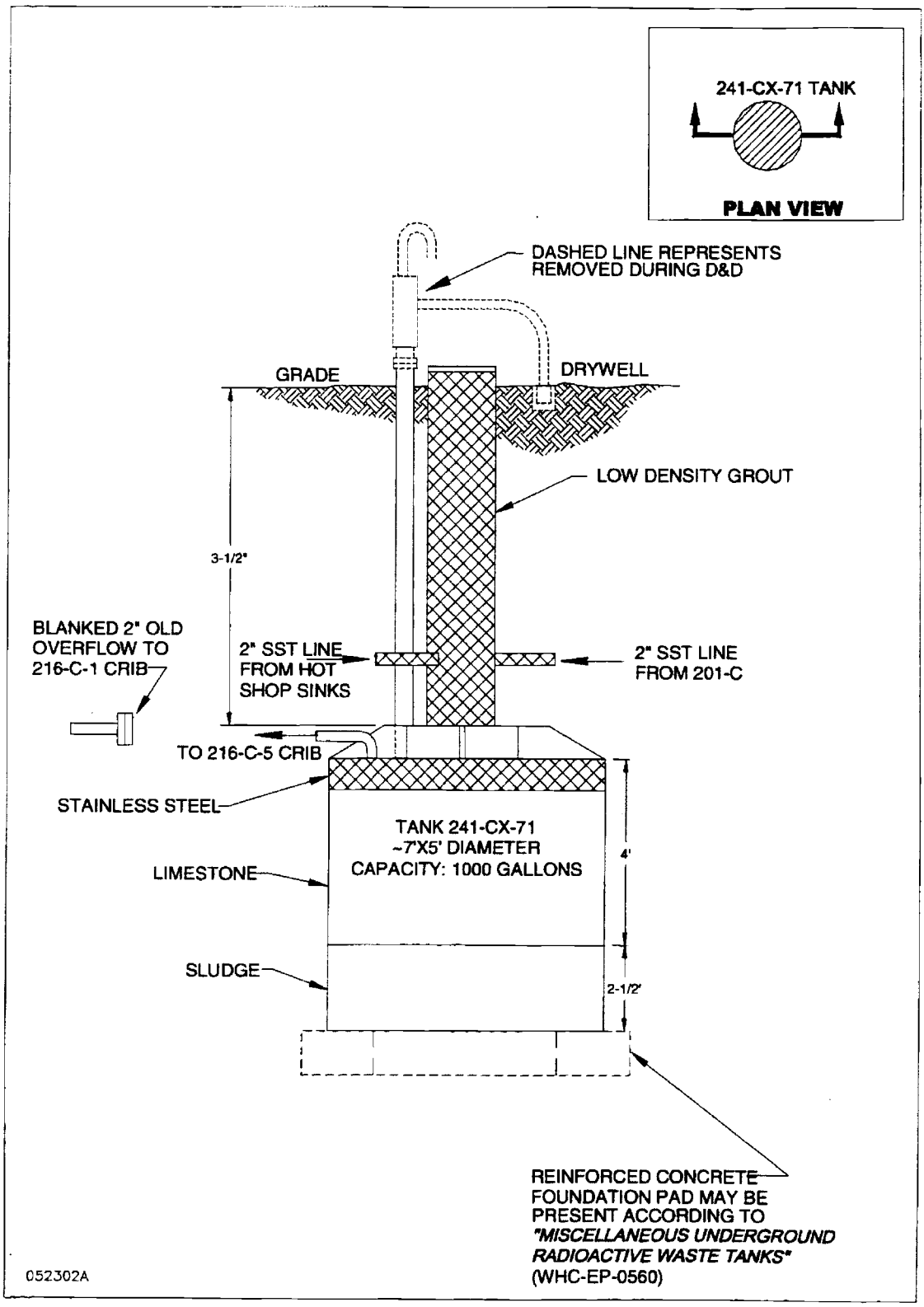
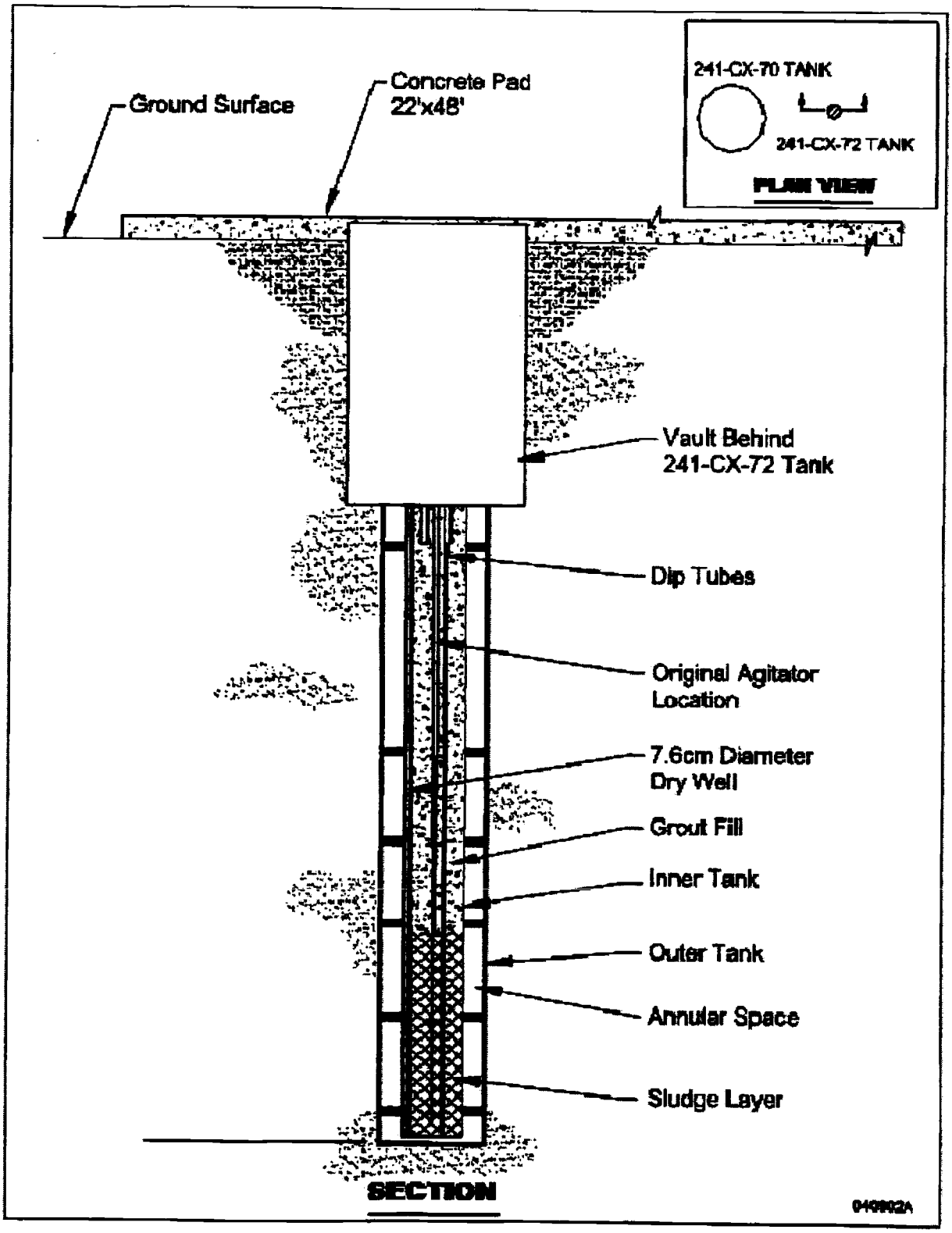


Figure 2-10. 241-CX-72 Storage Tank Construction Diagram.



- 241-CX-71 Neutralization Tank: "WT-02" (dangerous toxic – state only) because of cyanides and nitrates

- 241-CX-72 Storage Tank: "D002" (corrosive), "D004" (arsenic), "D005" (barium), "D006" (cadmium), "D007" (chromium), "D008" (lead), "D009" (mercury), "D010" (selenium), "D011" (silver), "WC02" and "WT01" (extremely hazardous toxic), and "WT02" (dangerous toxic – state only) because of cyanides and nitrates.

2.3.4 Hexone Storage and Treatment Facility

The HSTF is located in the southeast corner of the Hanford Site 200 West Area (Figure 2-11). The HSTF consisted of two 81,400 L (21,500-gal) belowgrade carbon-steel tanks (276-S-141 and 276-S-142 Hexone Storage Tanks) (Figure 2-12), a distillation system, and railroad tank cars. The HSTF received liquid mixed waste from the REDOX Plant and possibly the Hot Semiworks Facility. The HSTF was used from 1951 through 1967 to store reagent-grade MIBK for makeup as solvent for the REDOX Plant. After 1967, the HSTF contained distilled hexone, part or all of which had been used in the REDOX Plant. The 276-S-142 Hexone Storage Tank also contained NPH and TBP from a one-time campaign to separate americium, curium, and promethium from Shippingport reactor blanket fuel in 1966. Approximately 760 L (200 gal) of water were added to the 276-S-141 Hexone Storage Tank in 1988 (BHI-01018).

The 276-S-142 Hexone Storage Tank received approximately 5,000 L (1,300 gal) of water in 1967; 1,900 L (500 gal) in the mid-1970s; and 760 L (200 gal) in the mid-1980s. The combined storage design capacity of the 276-S-141 and 276-S-142 Hexone Storage Tanks is 163,000 L (43,000 gal) (BHI-01018). The treatment design capacity of the distillation system was 11,400 L (3,000 gal) of waste per day.

The mixed waste was pumped from the 276-S-141 and 276-S-142 Hexone Storage Tanks through a distillation system to decrease the radioactivity of the waste. The distilled waste was sent to temporary storage in railroad tank cars (located within the HSTF) until transfers to an offsite incinerator were completed in June 1992. The storage design capacity of the railroad tank cars was 152,000 L (40,000 gal). The railroad tank cars have been emptied, cleaned, and moved to another location. Three distillation vessels containing process residue have been sampled and are stored at the Hanford Site as mixed waste.

Grout has been added to the tanks over a heel of tarry sludge (see Table 2-2). The tank was grouted in two pours in March 2002, with a colored grout layer containing the heel in the bottom layer and uncolored grout completely filling the remainder of the void space in each tank (BHI-01142, *REDOX Facility Safety Analysis Report*).

Figure 2-11. 276-S-141 and 276-S-142 Hexone Storage Tanks Location Map.

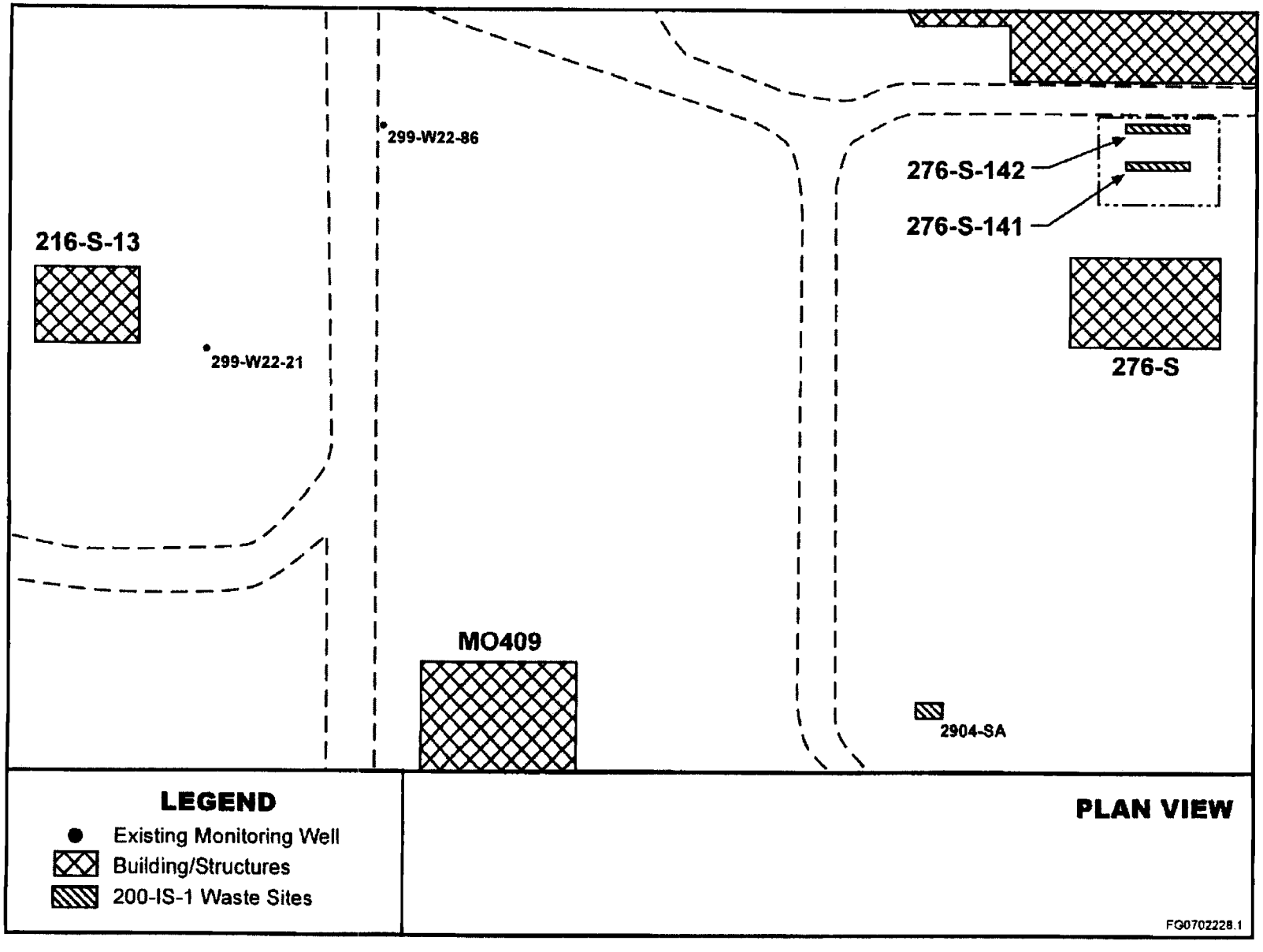
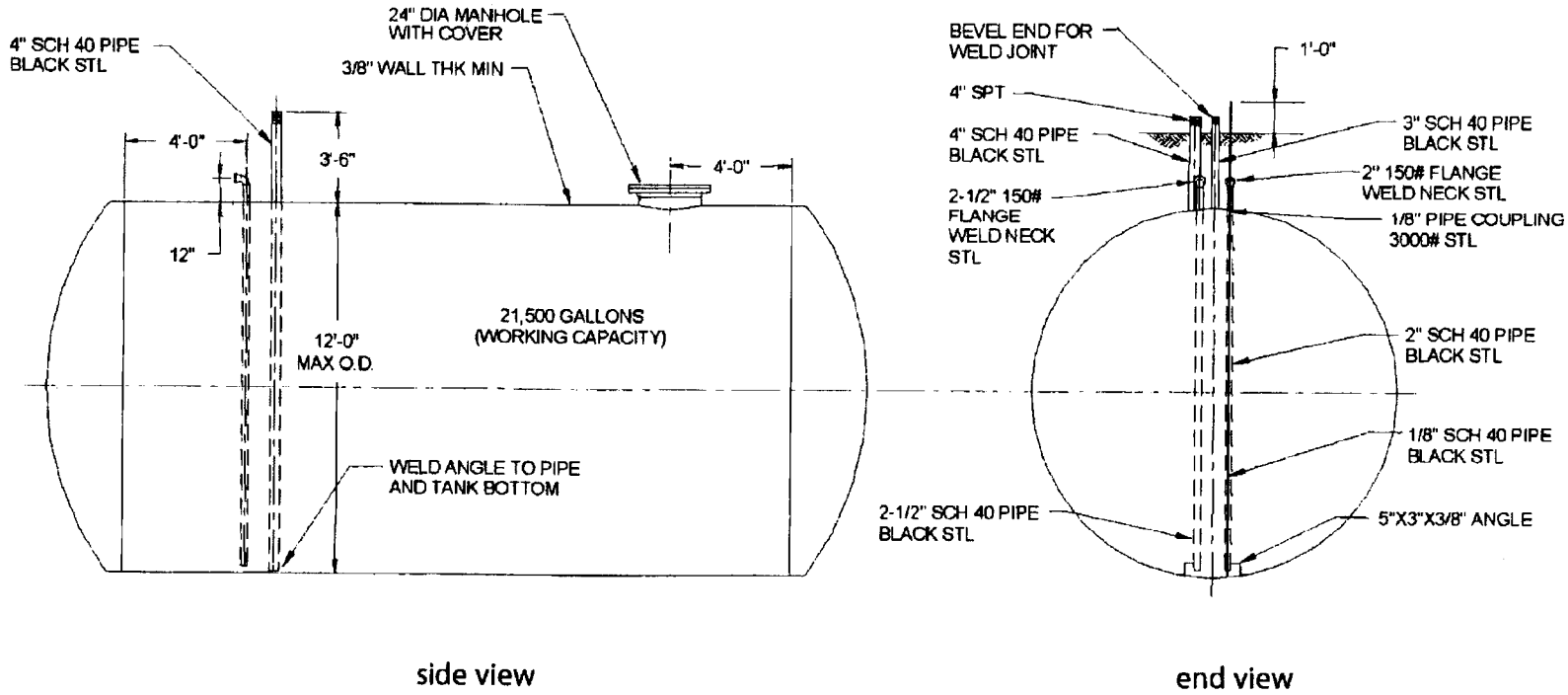


Figure 2-12. 276-S-141 and 276-S-142 Hexone Storage Tanks Construction Diagram.



side view

end view

A RCRA Dangerous Waste Permit Application (Form 3) for the hexone tanks was submitted to Ecology in December 1987 (WA7890008967). A RCRA closure plan for the tanks was submitted in November 1992 (DOE/RL-92-40). The tanks are regulated as dangerous-waste tank TSD units with waste codes "D001" (ignitability), "F003" (listed spent hexone solvent), and "WT02" (toxicity criteria).

In April 2000, Ecology inspected the TSD unit encompassing the tanks. In May 2000, Ecology issued CCN 079387, "Notice of Correction for Stabilization of Hexone Storage and Treatment Facility," regarding their findings. The letter required that the hexone tanks be stabilized by removing all of the potential safety hazards posed to employees by no later than December 2001. It also required that the stabilization include removal or deactivation of the waste. If the tanks remain in place, provisions must be made for monitoring the tanks for oxygen and organic vapors and for intrusion of liquids.

In May 2001, Ecology issued CCN 089928, "Notice of Correction for Stabilization of the Hexone Storage and Treatment Facility," which revised the deadline for stabilizing the hexone tanks to the end of February 2002.

On December 13, 2001, Ecology approved grouting as the stabilization method for interim closure of the hexone storage tanks (CCN 095038, "Approval for Stabilization of the Hexone Storage and Treatment Facility"). Ecology stipulated that each tank be grouted in two pours. In March 2002, the tanks were filled with cement grout using the method authorized by Ecology for stabilization and to reduce flammability concerns associated with hexone vapors. In each tank, the first-pour grout covers the heel of waste with a distinctly colored grout. The first grout layer was allowed to solidify enough to introduce a cold joint between pours. After the first-pour grout solidified, the second layer of grout was poured into the tank. The second grout layer completely filled the tank's void space. The second pour consisted of uncolored grout that, in concert with the cold joint created between layers, provides a clear demarcation between the grout layers. The coloring and two-stage grouting processes facilitate closure of the tanks by separating the mixed-waste contents (tank bottom containing the heel and colored grout) from nonmixed-waste debris (upper tank and uncolored grout). The area is fenced off as a controlled access zone.

Ecology also requested that a revised closure plan for the hexone storage tanks be prepared for inclusion in future modifications to the Hanford Site's RCRA Sitewide Permit (WA7890008967).

3.0 INITIAL EVALUATION

This chapter presents the results of previous characterization activities conducted for the 200-IS-1 OU. Limited characterization of the pipeline systems has been completed to date. The information collected usually was obtained as part of previous investigations that focused on liquid-waste disposal sites. Current contaminant distribution in groundwater underlying the pipeline systems in the 200 Areas also is provided.

For the CX Tank System and the Hexone Storage Tanks, information on contaminant inventory, effluent volume, and available sampling data is presented. This chapter contains information that will be used for portions of the RCRA TSD closure plans, including the nature and extent of contamination, facility description, and current RCRA interim-status groundwater-monitoring requirements.

3.1 KNOWN AND SUSPECTED CONTAMINATION

The estimated composition of the primary radionuclides and nonradiological constituents that potentially may have been released to the vadose zone at waste sites in the 200-IS-1 OU was obtained from numerous sources. The process operations and waste streams generated at the 200 Areas facilities and handled by the structures associated with the 200-IS-1 OU are discussed in Chapter 2.0. Waste-source and inventory data for the process-waste pipeline systems are available from a number of sources, including the following:

- WIDS
- Aggregate area management study reports for the 200 Areas:
  - DOE/RL-92-05, *B Plant Source Aggregate Area Management Study Report*
  - DOE/RL-91-52, *U Plant Source Aggregate Area Management Study Report*
  - DOE/RL-92-04, *PUREX Plant Source Aggregate Area Management Study Report*
  - DOE/RL-91-60
  - DOE/RL-92-18
- DOE/RL-98-28
- DOE/RL-96-81
- RPP-26744
- TWINS database.

The radionuclide and nonradiological waste inventory transferred or stored during active operations associated with the 200-IS-1 OU was not fully documented in historical records. However, rough-order-of-magnitude estimates are provided in RPP-26744, DOE/RL-98-28, and WIDS, based on existing documentation. Additional sources of data regarding the composition of contaminants that were transferred through pipelines were obtained by reviewing analytical

results for samples collected at the disposal sites (e.g., cribs, trenches, french drains, injection wells, ponds) that received the waste streams. Analytical results from disposal waste sites and inventory information, where available, indicate that primary constituents in many of the waste streams include Cs-137, Sr-90, uranium, plutonium, and nitrate (DOE/RL-96-81).

3.2 MONITORING

3.2.1 Environmental Monitoring

Current activities at the Hanford Site focus on environmental cleanup. Before the recent cleanup efforts began, monitoring was performed across the Hanford Site to measure and evaluate long-term trends in the environmental accumulation of radioactive contamination. Risks associated with unacceptable levels of contamination typically were addressed by stabilizing the waste sites with soil, concrete, and/or gravel backfill to minimize impact on human health and the environment.

Typically, the accumulation of radioactivity at liquid-waste disposal sites was evaluated through gathering and analyzing soil samples. Scintillation logging was commonly performed in boreholes adjacent to the liquid-waste disposal sites. The logs were used to determine the extent of radiological contamination in the subsurface; however, these logs are not quantitative and only generally indicate the presence of radiological contamination. Groundwater is monitored based on RCRA requirements and the objectives of the Hanford Site-wide groundwater-monitoring program.

Currently, environmental monitoring at the Hanford Site consists of effluent monitoring, groundwater and vadose-zone monitoring, and environmental surveillance. The environmental surveillance is conducted for the following media:

- Air
- Surface water and sediments
- Drinking water
- Farm and farm products
- Soil and vegetation
- External radiation.

Air, external radiation, soil, and vegetation are evaluated routinely in the 200 Areas as part of the Hanford Site Near-Facility and Environmental Monitoring Programs. Results of the Near-Facility and Environmental Monitoring Programs are presented in annual reports. The annual reports (e.g., PNNL-13230, *Hanford Site Environmental Report for Calendar Year 1999*; PNNL-13230, Appendix 2, *Hanford Site Near-Facility Environmental Monitoring Data Report for Calendar Year 1999*; PNNL-14687, Appendix 2, *Hanford Site Near-Facility Environmental Monitoring Data Report for Calendar Year 2003*; PNNL-15222, *Hanford Site Environmental Report for Calendar Year 2004*) contain some data applicable to the 200-IS-1 OU. PNNL-14687, Appendix 2; PNNL-13230, Appendix 2; and PNNL-15892, Appendix 2, *Hanford Site Near-Facility Environmental Monitoring Data Report for Calendar Year 2005*, focus on monitoring activities near facilities that have the potential to, or have, discharged, stored, or

disposed of radioactive or hazardous materials, including those facilities in the 200 Areas. PNNL-13230, PNNL-15222, and PNNL-15892, *Hanford Site Environmental Report for Calendar Year 2005*, cover the entire Hanford Site, including those areas not associated with operations (e.g., the 600 Area). These annual reports examine the resources associated with the Hanford Site, including the media listed in the previous paragraph. Results of monitoring pertinent to the 200-IS-1 OU waste sites are presented in this chapter. The potential impacts of 200-IS-1 OU waste-site contamination on human health and the environment also are discussed.

Groundwater routinely is monitored site wide. More than 600 monitoring wells are sampled annually to characterize groundwater flow; groundwater contamination by metals, radionuclides, and nonradiological constituents; and the extent of contamination. Contaminated groundwater, ingestion risk, and dose also are assessed. Results of groundwater monitoring and remediation are presented in annual reports (e.g., PNNL-15670, PNNL-16346). The groundwater-monitoring reports also summarize vadose-zone characterization activities conducted on the Hanford Site as part of other projects.

3.2.2 Groundwater-Monitoring Results

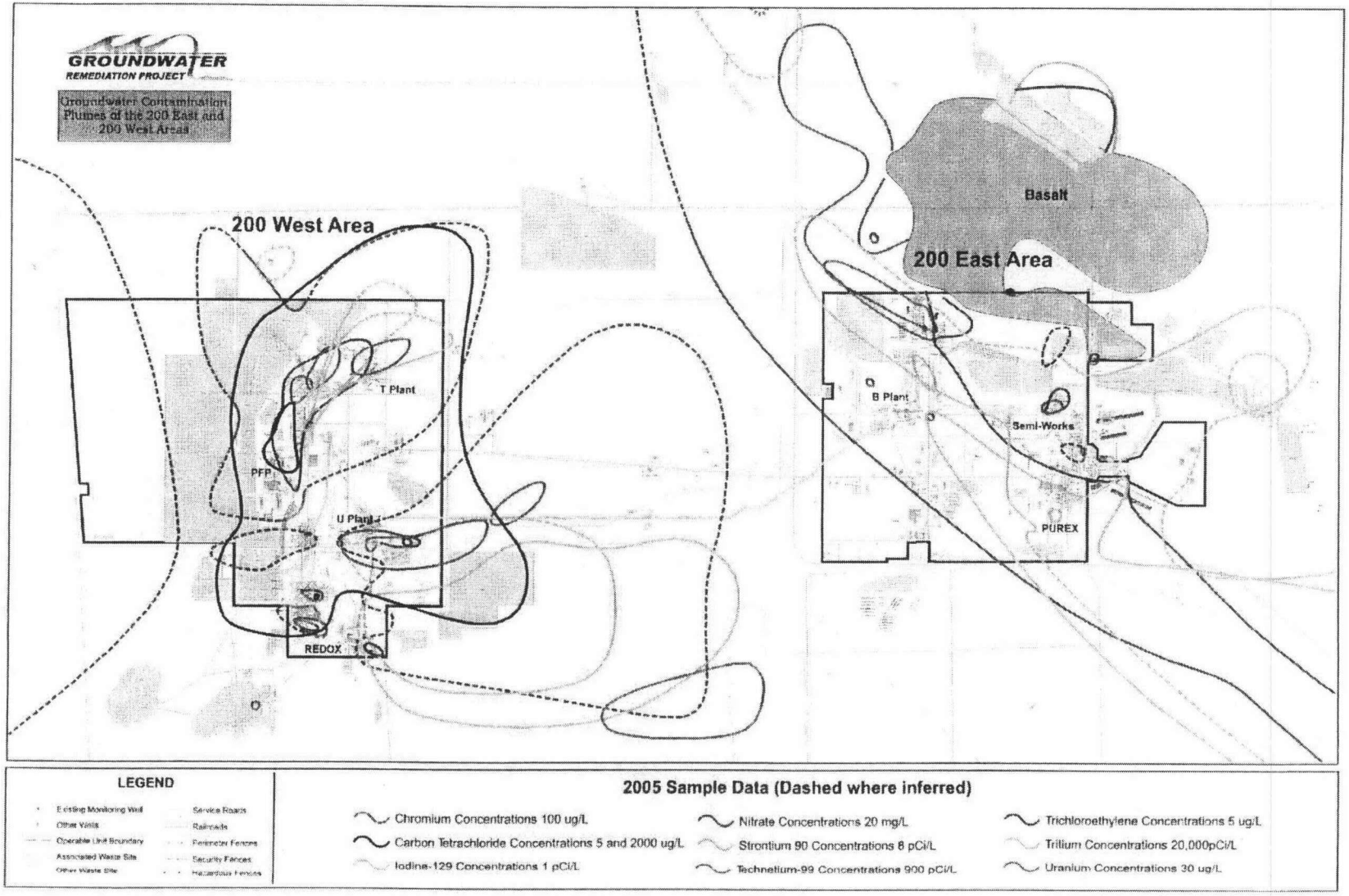
The process-waste pipeline systems extend across a large portion of the 200 East and 200 West Areas. This section summarizes the groundwater-contaminant conditions associated with the 200 Areas and vicinity underlying the 200-IS-1 OU pipeline systems, the CX Tank System and Hexone Storage Tanks. The information presented here primarily was taken from PNNL-15670 and PNNL-16346. The major radiological and nonradiological groundwater-contaminant plumes in the 200 Areas and vicinity are shown on Figure 3-1.

Some of the source areas for these groundwater plumes have been identified as a result of the RIs completed for the soil-waste sites in the 200 Areas and the tank farms investigations. Characterization studies completed in conjunction with the groundwater OUs also have resulted in determination of additional sources for some plumes. The groundwater OUs have the primary responsibility for characterization of groundwater conditions and the identification and delineation of the contaminant plumes.

The information presented in the following discussion provides an overview of the current delineation of primary-contaminant plumes in areas where the 200-IS-1 OU pipeline systems will be investigated and the impacts to groundwater assessed. This overview of groundwater conditions underlying the pipeline systems is provided to show the configuration of the primary plumes that have been identified beneath the Central Plateau. At this time, no relationship between the pipeline systems and any of the groundwater plumes has been identified. The information presented in this section will be used during the assessment of the potential impact to groundwater, if release locations in the soil are identified during the RI.

Figure 3-1. Groundwater Contaminant Plume in the 200 East and 200 West Areas.

(After PNNL-15670, *Hanford Site Groundwater Monitoring for Fiscal Year 2005*)



In the northern part of the 200 East Area and vicinity, contaminants identified in groundwater include tritium, uranium, I-129, Tc-99, Co-60, cyanide, Sr-90, Cs-137, Pu-239/240, and nitrate (PNNL-15670; PNNL-16346; and PNNL-14049, *Data Quality Objectives Summary Report – Designing a Groundwater Monitoring Network for the 200-BP-5 and 200-PO-1 Operable Units*). In the southern portion of the 200 East Area and to the south, contaminant plumes containing tritium, nitrate, I-129, Sr-90, and Tc-99 have been identified. Other contaminants detected include arsenic, chromium, manganese, vanadium, Co-60, and cyanide (PNNL-14049; PNNL-15670; and DOE/RL-2003-04, *Sampling and Analysis Plan for the 200-PO-1 Groundwater Operable Unit*).

In the northern and central parts of the 200 West Area, contaminant groundwater plumes containing carbon tetrachloride, chloroform, trichloroethene, nitrate, chromium, fluoride, tritium, I-129, Tc-99, and uranium are present (PNNL-15670, PNNL-16346). In the southern portion of the 200 West Area, plumes containing Tc-99, uranium, tritium, I-129, nitrate, and carbon tetrachloride have been delineated (PNNL-15670, PNNL-16346). Groundwater that exceeds drinking-water standards for Sr-90, trichloroethene, chloroform, chromium, cadmium, and arsenic also has been identified (PNNL-15670; PNNL-16346; and DOE/RL-92-76, *Remedial Investigation/Feasibility Study Work Plan for the 200-UP-1 Groundwater Operable Unit*). Groundwater sampling results have shown the presence of volatile organic compounds, metals, anions, ammonium ion, ammonia, cyanide, sulfide, cresols, phenols, total petroleum hydrocarbons (TPH, kerosene range), beta emitters (C-14 and Se-79), alpha emitters (Np-237 and Pa-231), and gamma emitters (Cs-137 and Co-60) in the 200 West Area (PNNL-15670, PNNL-16346, and DOE/RL-92-76).

3.2.2.1 Primary Radiological Groundwater Contaminant Plumes

Iodine-129

Iodine contamination in groundwater is present in the 200 East Area and vicinity and has been delineated as a large continuous plume. The portion of this plume that is above the I-129 drinking-water standard of 1 pCi/L extends to the northwest toward Gable Gap and to the southeast through the 200 East Area and into the 600 Area. The northeastern limit of this plume has not passed beyond Gable Gap (PNNL-15670, PNNL-16346). The southeastern limit of this plume extends beyond the boundary of the map presented in Figure 3-1.

Three major I-129 plumes exist in the 200 West Area and vicinity. One plume originates from the U Plant area (near the 216-U-1/216-U-2 Cribs), and another plume originates from the REDOX Plant area in the southern part of the 200 West Area. These plumes merge downgradient (generally to the east) and become indistinguishable. The portion of this combined plume exceeding an iodine concentration of 1 pCi/L extends to the east and northeast a total distance of ~3.5 km. The third plume is in the vicinity of the Tank Farm WMA TX-TY and extends to the northeast. The portion of this plume that exceeds 1 pCi/L concentration now appears to extend to the 200 West Area boundary (PNNL-16346).

Strontium-90

Three major, although fairly localized, Sr-90 groundwater plumes exist in the 200 East Area and vicinity that have resulted from unique discharges settings within the vadose zone (PNNL-15670, PNNL-16346). One very localized plume occurs near the 216-B-5 Injection Well in the central part of the 200 East Area, and another plume is located along the northeastern edge of Gable Mountain Pond, north of the 200 East Area. Both of these plumes have levels of Sr-90 well above the drinking-water standard of 8.0 pCi/L. A third, small, plume has been identified near the 216-A-10 and 216-A-36B Cribs (south of the PUREX Plant) in the southeastern part of the 200 East Area. Only one monitoring well is located in this area with a Sr-90 level exceeding 8.0 pCi/L (PNNL-15670, PNNL-16346).

A fourth, very small, plume of Sr-90 is present in the 200 West Area, located south of the 216-S-1/216-S-2 Cribs. The very small size of this plume again is based on only one monitoring well located in this area with a Sr-90 level exceeding 8.0 pCi/L (PNNL-15670, PNNL-16346).

The localized distribution of Sr-90 is related to its low mobility. Mechanisms by which this radionuclide has reached groundwater are unique and include an unplanned release at Gable Mountain Pond, direct discharge of liquid waste streams to an injection well, and migration from a disposal site to an adjacent monitoring well and preferential vertical transport along the well casing.

Technetium-99

Technetium-99 plumes have been identified in two portions of the 200 East Area. A major plume extends from the vicinity of WMA B-BX-BY and the BY Cribs (located in the northern part of the 200 East Area) to the northwest toward Gable Gap. A significant portion of the plume that exceeds the drinking-water standard of 900 pCi/L is located north of the 200 East Area boundary. Technetium-99 has been detected at levels lower than 900 pCi/L north of Gable Gap, indicating that Tc-99 has moved north into, and through, Gable Gap (PNNL-15670, PNNL-16346). Along the eastern margin of the 200 East Area, two distinct small plumes occur in the vicinity of the A-AX WMA. One plume is located in the northern portion of the WMA and the other is situated near the southeast corner.

Seven Tc-99 plumes with concentrations exceeding 900 pCi/L exist in the 200 West Area and vicinity. One large plume is present downgradient from the 216-U-1/216-U-2 Cribs, with two small plumes near WMA S-SX and one plume at WMA U. The plume located downgradient from the 216-U-1/216-U-2 Cribs extends ~1.5 to 2 km east into the 600 Area. The two small plumes at WMA S-SX consist of a northern plume, originating from the S Tank Farm, and a southeastern plume, originating from the SX Tank Farm. The plume at the WMA U originates from the U Tank Farm, and the downgradient extent of the plume is not known. The remaining three plumes in the 200 West Area consist of one plume located downgradient of WMA T and two small plumes located downgradient of WMA TX-TY. The plume at WMA T extends from the east side of the WMA downgradient to the northeast. At WMA TX-TY, one very localized plume is present on the east side of the WMA, and one very localized plume is present at the south side of the WMA (PNNL-15670, PNNL-16346).

Tritium

A large tritium groundwater plume emanates to the southeast from the 200 East Area at concentrations exceeding the drinking-water standard of 20,000 pCi/L (Figure 3-1).

Another tritium plume extends from the southern part of the 200 West Area, near the REDOX Plant cribs, and extends ~5 km to the east and northeast into the 600 Area, approaching the 200 East Area. Two primary portions of this plume currently exceed the drinking-water standard of 20,000 pCi/L. One of these exists over a small area extending ~550 m to the east-southeast from near the 216-S-25 Crib.

Tritium contamination at levels exceeding 20,000 pCi/L are found in two plumes in the northern portion of the 200 West Area. One is a large plume extending northeast from waste-disposal facilities near WMAs T and TX-TY. Another small plume is located in the area immediately surrounding the State-Approved Land Disposal Site north of the 200 West Area (PNNL-15670, PNNL-16346).

Uranium

Four uranium plumes that exceed the drinking-water standard of 30 µg/L exist in the 200 East Area. One plume occurs as a narrow northwest-southeast band extending from WMA B-BX-BY to the northwest out of the 200 East Area. A small plume is located in the area immediately surrounding the southeastern end of the 216-B-62 Crib. The remaining two small plumes are located near the 216-B-5 Injection Well. One of these two plumes is located south of the 216-B-5 Injection Well, immediately surrounding well 299-E28-6. The other plume is located in the area immediately surrounding the 216-B-5 Injection Well (PNNL-15670, PNNL-16346).

Only one major uranium plume exists in the 200 West Area and vicinity that exceeds the drinking-water standard of 30 µg/L. This extensive plume is located downgradient from the 216-U-1/216-U-2 Cribs and extends ~1.5 km to the east and northeast into the 600 Area. A few wells in the 200 West Area have, at times, had uranium levels that have exceeded 30 µg/L. One well (299-W23-4) is located downgradient from the 216-S-21 Crib. Another well (299-W18-21), located near the southwest corner of Low-Level Waste Management Area 4, had uranium levels just above the drinking-water standard in the past, although these levels have dropped below 30 µg/L in recent sampling events. Well 299-W11-37, located in the northeast part of the 200 West Area, shows uranium levels exceeding 30 µg/L (PNNL-15670, PNNL-16346).

3.2.2.2 Nonradiological Groundwater Contaminant Plumes

Carbon Tetrachloride

Carbon tetrachloride groundwater contamination is found at levels exceeding the drinking-water standard of 5 µg/L in most of the 200 West Area, extending as far as ~1 km east into the 600 Area (Figure 3-1). The plume originated from waste-disposal sites associated with the Plutonium Finishing Plant, including the 216-Z Cribs and Trenches that received waste from the Plutonium Finishing Plant (PNNL-15670, PNNL-16346).

Trichloroethene

Trichloroethene is found in a plume in the 200 West Area exceeding the drinking-water standard of 5 μg/L in the vicinity of the 200-UP-1 OU pump-and-treat system. The distribution of trichloroethene is different from that of carbon tetrachloride and is thought to have a local source near the U Plant. The main trichloroethene plume extends north and northeast from the vicinity of the 216-Z Cribs and Trenches, with the 216-Z-9 Trench likely being a primary origination source (PNNL-15670, PNNL-16346).

Chromium

Chromium is found in the southern and eastern portions of the 200 West Area in four regions where chromium has been detected at levels exceeding the drinking-water standard of 100 μg/L. One plume emanates from the southern part of WMA S-SX, with the SX Tank Farm as the source, and extends locally to the east-southeast of the WMA. Chromium concentrations in this plume are increasing, and the extent of the plume has been increasing. Another, small, plume is located at the 216-S-10 Pond and Ditch, based on results from one well (299-W26-7) where chromium concentrations exceed 100 μg/L. The well has since gone dry, so no further sampling is possible. The extent of the plume appears to be small and stable, because chromium concentrations in downgradient and side-gradient wells are low to nondetectable. A third, small, plume occurs in the vicinity of the 216-S-20 Crib, based on chromium concentrations that exceed 100 μg/L in one well (299-W22-20) adjacent to the crib. The extent of this plume is not known, because no other downgradient monitoring wells are present in the immediate area. The fourth plume is located in the 600 Area, east and southeast of the 200 West Area, based on chromium concentrations that exceed 100 μg/L in one well (699-32-62) in this area. Chromium concentrations have declined slowly since this constituent was first analyzed at this well, and the sources and extent of this contamination are uncertain.

In the northern part of the 200 West Area, chromium contamination is found at levels exceeding 100 μg/L in the immediate vicinity of WMAs T and TX-TY. The chromium plume present at WMA T extends from the west and southwest part of the WMA to the area east of the WMA. Chromium was detected at levels above 100 μg/L in only two wells (299-W14-11 and 299-W14-13) at WMA TX-TY, indicating that the chromium contamination is limited to the immediate area surrounding the two wells. Chromium at lower levels extends downgradient toward or past the perimeter of the 200 West Area (PNNL-15670, PNNL-16346).

Nitrate

A nitrate plume exceeding the drinking-water standard of 45 mg/L (maximum contaminant level expressed as the concentration of NO_3 anion) originates in the 200 East Area and extends to the northwest toward Gable Gap and to the southeastern part of the 200 East Area (Figure 3-1). A second, small plume exceeding 45 mg/L is located along the northeastern edge of Gable Mountain Pond, north of the 200 East Area (PNNL-15670, PNNL-16346).

Nitrate plumes are widespread throughout the 200 West Area and are thought to have originated from both the U Plant and the REDOX Plant disposal sites. One large plume exceeding 45 mg/L, merged primarily from sources at the 216-U-1/216-U-2, 216-U-8, and 216-U-12 Cribs, extends to the east and northeast of the 200 West Area a total distance of ~4 km. Multiple small

plumes exceeding 45 mg/L also are present. One plume is located in the immediate area surrounding well 299-W19-43 in the 200-UP-1 OU pump-and-treat area. Another plume extends from the west and southwest of Low-Level Waste Management Area 4 to the eastern side (downgradient) of WMA U. Nitrate levels exceeding 45 mg/L occur in two small plumes associated with REDOX Plant disposal facilities, with one near the 216-S-20 Crib and another near the 216-S-25 Crib. The plume from the 216-S-25 Crib merges with another plume emanating from WMA S-SX (PNNL-15670, PNNL-16346).

3.3 ECOLOGICAL INFORMATION

This section discusses DOE/RL-2001-54, *Central Plateau Ecological Evaluation*, and the ongoing Central Plateau ecological risk assessment (SGW-32847, *Reference Sites for the Central Plateau Ecological Risk Assessment*, in work), which serve as the basis for ecological evaluation activities in the Central Plateau. It also summarizes existing 200-IS-1 OU-specific ecological sampling and analysis information. Results from the current ecological evaluations and existing data are considered in the analysis of impacts to human health and the environment for the 200-IS-1 OU.

3.3.1 Central Plateau Ecological Evaluation and Central Plateau Terrestrial Ecological Risk Assessment

DOE/RL-2001-54 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 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 presented in DOE/RL-2001-54.

The document contains a compilation and evaluation of ecological sampling data that have been collected over many years from undisturbed and disturbed habitats in the Central Plateau. The ecological evaluation document helps answer questions about the ecological resources in the Central Plateau 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.

DOE/RL-2001-54 contains descriptions of the habitats in the Central Plateau, including sensitive habitats and the plants and animals that inhabit them. The document identifies potential species of concern, including threatened and endangered species and new-to-science species. A detailed survey of the Central Plateau was conducted in 2000 and 2001, and the results are incorporated into the ecological evaluation document. The information from the survey provides a detailed description of the ecological setting of the Central Plateau and augments the ecological information presented in this work plan.

Ecological evaluation of the Central Plateau has continued since the preparation and issue of DOE/RL-2001-54. An evaluation of the ecological risk and assessment of additional data-collection needs is presented in WMP-29253, *Central Plateau Terrestrial Ecological Risk Assessment Data Quality Objects Summary Report – Phase III*. The ecological-risk assessment, supported by the Central Plateau ecological DQO documents, is one of several being performed on the Hanford Site to ensure that ecological risks have been properly evaluated in support of remedial-action decision-making (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*). The sampling and analysis requirements developed for the evaluation of ecological risk are specified in DOE/RL-2004-42, *Central Plateau Terrestrial Ecological Sampling and Analysis Plan – Phase I*; DOE/RL-2005-30, *Central Plateau Terrestrial Ecological Sampling and Analysis Plan – Phase II*; and DOE/RL-2006-27, *Central Plateau Terrestrial Ecological Sampling and Analysis Plan – Phase III*.

3.3.2 200-IS-1 Operable Unit Specific Ecological Data

Existing information pertaining to sampling of vegetation and biota in those areas associated with the pipeline systems is presented in this section. The available ecological data are considered in the discussion on potential impacts to human health and the environment, presented in Section 3.6.

A 1994 field investigation of the 200-UP-2 OU (BHI-00033, *Surface and Near Surface Field Investigation Data Summary Report for the 200-UP-2 Operable Unit*), which was conducted in conjunction with the 200-UP-2 OU limited field investigation (DOE/RL-95-13, *Limited Field Investigation for the 200-UP-2 Operable Unit*), examined surface-soil contamination and uptake of radionuclides and metals by vegetation near a vitrified clay pipeline (now officially known as waste site 200-W-42 in the WIDS database) leading to the 216-U-8 Crib. Although this pipeline is not a 200-IS-1 OU waste site, the ecological data gathered from this investigation can be applied to other pipelines in the 200-IS-1 OU that exhibit the same or similar attributes.

Vegetation samples were taken at the 216-U-8 Crib vitrified clay pipeline and analyzed for a series of metals and radionuclides. Analytical results for the radionuclides detected are listed in Table 3-1 can be found in BHI-00033, Appendix B. Radionuclides detected in vegetation samples near the 216-U-8 Crib vitrified clay pipeline included Cs-137, Pu-239/240, Tc-99, Th-232, total strontium, U-234, and U-238.

In a 1999 sampling activity described in the Hanford Site environmental report (PNNL-13230), 48 vegetation samples were collected in the 200 and 600 Areas. Vegetation samples were collected from one 200-IS-1 OU waste site, the 200-W-59 Diversion Box, under the Hanford Site Near-Facility Monitoring Program (e.g., PNNL-13230, Appendix 2). The vegetation samples were collected from station V021, located inside the 200-W-59 Diversion Box boundary. Vegetation concentrations of radionuclides for the V021 monitoring site are listed in Table 3-2. All vegetation samples contained radionuclide concentrations of less than 1.0 pCi/g.

Investigative wildlife sampling has been conducted to monitor and track the effectiveness of measures designed to deter animal intrusion. Wildlife-related materials, including nests,

carcasses, and feces, have been 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. 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 West Area. Contaminants included Sr-89/90, Cs-137, Eu-154, Pu-238, and Pu-239/240 (PNNL-13910, *Hanford Site Environmental Report for Calendar Year 2001*). 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).

Table 3-1. Detectable Radionuclide Concentrations in Vegetation at the 216-U-8 Vitrified Clay Pipeline.

Sample ID	Radionuclides (pCi/g)																		
	Ac-228	Be-7	Beta	Cs-137*	K-40	Pb-212	Pb-214	Pu-239/240*	Ra-224	Se-79	Tc-99*	Th-232*	Th-234	Tl-208	Total Sr*	U-234*	U-238*	U-238G	Total U
BOBFL8	(U)	1.89	817	0.158	9.28	0.024	NA	(U)	NA	NA	296	NA	NA	NA	328	0.0554	0.0474	NA	0.209
BOBFL9	NA	2.7	4,220	0.974	5.37	0.219	0.193	0.0708	0.234	2.66	117	0.185	NA	0.0425	1,380	0.198	0.189	0.193	0.752
BOBFM0	NA	2.3	879	17.2	3.67	0.0643	NA	0.0228	0.0686	1.44	49.5	0.152	NA	NA	492(J)	0.324	0.299	NA	0.782
BOBFM1	NA	2.21	614	6.32	3.43	0.0463	NA	(U)	0.0494	1.85	46.8	0.118	NA	0.037	426(J)	0.186	0.145	NA	0.613
BOBFM2	0.0414	2.02	24.8	0.579	5.29	0.0451	0.134	0.0239	0.0423	(U)	29.4	NA	NA	NA	10.4	(U)	(U)	0.134	0.126
BOBFM3	(U)	2.61	35.4	0.611	3.58	0.0448	NA	(U)	0.0479	(U)	28.7	NA	2.63	0.00774	10(J)	0.08	(U)	NA	0.106
Maximum	0.0414	2.7	4,220	17.2	9.28	0.219	0.193	0.0708	0.234	2.66	296	0.185	2.63	0.0425	1,380	0.324	0.299	0.193	0.782
Minimum	0.0414	1.89	24.8	0.158	3.43	0.024	0.134	0.0228	0.0423	1.44	28.7	0.118	2.63	0.0077	10	0.0554	0.0474	0.134	0.106
Avg. detectable concentration	0.0414	2.3	1,098.4	4.307	5.1	0.0739	0.1635	0.0392	0.0884	2.0	94.6	0.1517	2.63	0.0291	441.1	0.1687	0.1701	0.1635	0.4313

*Contaminants of concern for 200-PW-2 Operable Unit (BHI-00033, *Surface and Near-Surface Field Investigation Data Summary Report for the 200-UP-2 Operable Unit*).
Qualifiers: (U) = undetected, (J) = concentration is estimated, NA = not analyzed.
Undetected radionuclides: Cm-242, Cm-244, Cs-134, Co-60, Eu-152, Eu-154, Eu-155, I-129, Na-22, Np-237, Pu-238, Ru-106, and U-235.

Table 3-2. Vegetation Concentrations of Radionuclides for the V021 Monitoring Site Near the 200-W-59 Diversion Box.

Isotope	Vegetation (V021 Monitoring Site) (pCi/g)
Antimony-125	1.5 E-02
Cerium-144	5.9 E-02
Cobalt-60	1.8 E-02
Cesium-134	-1.3 E-02
Cesium-137	9.2 E-03
Europium-152	3.7 E-02
Europium-154	-1.7 E-02
Europium-155	7.1 E-03
Plutonium-238	6.4 E-03
Plutonium-239/240	3.7 E-03
Ruthenium-103	1.9 E-02
Ruthenium-106	4.2 E-03
Strontium-90	4.7 E-01
Tin-113	-5.3 E-02
Uranium-234	2.0 E-02
Uranium-235	3.8 E-03
Uranium-238	1.3 E-02
Zinc-65	7.0 E-02

Source: PNNL-13230, Appendix 2, *Hanford Site Near-Facility Environmental Monitoring Data Report for Calendar Year 1999.*

Biological transport of contamination by deep rooting plants and burrowing animals is also a concern on the Hanford Site. Contaminated soil and anthills were identified both north and south of 7th Street and around the 241-ER-151 Diversion Box (part of the 200-IS-1 OU) in September 1998.

3.4 NATURE AND EXTENT OF CONTAMINATION

The following section describes the current assessment of the nature and extent of contamination associated with the 200-IS-1 OU pipeline systems and the CX Tank System and Hexone Storage Tanks. A summary of the historical characterization data, indicating contaminant distribution, is presented.

3.4.1 Process-Waste Pipeline Systems

A compilation and review of previously collected characterization data that was directed specifically to evaluating process-waste pipeline systems was undertaken for this work plan. Previous investigations primarily were focused on characterization of waste-disposal sites, but several of the studies included evaluations of the pipelines that connected to the waste sites. A listing of the documents that were reviewed and the characterization data found in the reports is summarized in tabular format and provided in Appendix D. This section provides additional details concerning the information presented in Appendix D and other data that were obtained from WIDS.

3.4.2 Historical Sampling and Analysis of Pipelines

The information presented in the following sections is organized and presented with reference to the process-waste pipeline bins. Discussions are differentiated between pipelines associated with the process facilities and those that are part of the tank-farm waste-transfer system.

3.4.2.1 Process-Facility Pipeline Systems

Limited existing characterization data were identified for the facility process-waste pipelines that are being evaluated under this work plan (pipelines in the 200-UW-1 OU are not included). At locations where unplanned releases or soil contamination zones (CZ) have been identified along a pipeline and are known or believed to be associated with a pipeline leak, no surface (soil or vegetation) samples have been collected and analyzed. No subsurface sampling or subsurface radiological-logging results were found to be directly related to any of the facility pipelines. Pipe interiors have not been radiologically surveyed, sampled, or viewed with remote video cameras (other than in the one instance, discussed in Section 3.4.3).

No prior sampling and analysis information is available for the pipelines in two of the five facility process-waste-stream bins: Bin 1, the Process-Condensate, Process-Waste, and Chemical-Laboratory-Waste streams; and Bin 4, the Miscellaneous-Waste streams (see Appendix D, Table D-1). For the other three facility pipeline bins: Bin 2, Steam Condensate and Cooling Water; Bin 3, Chemical-Sewer Waste; and Bin 5, Tank/Scavenged Waste), available information is summarized below.

At some locations where unplanned releases or soil CZs have been identified on the surface along a pipeline, and the release was known or believed to be caused by a pipeline leak, limited investigations have been conducted. Characterization activities generally have been restricted to surface radiological surveys, noting the maximum radiological-instrument counts and observations concerning the media contaminated (i.e., vegetation or soil). Soil CZs are contamination areas in which radioactive material exists within the top 15 cm (5.9 in.) of soil. To be designated a CZ, a direct radiological survey instrument reading has indicated contamination levels exceeded the appropriate "total" contamination levels identified in 10 CFR 835, "Occupational Radiation Protection," Appendix D. The transferable contamination in the CZs do not exceed the appropriate removable levels defined in 10 CFR 835, Appendix D, In some cases, an estimate also is available concerning the volume of effluent or quantity of radiological material that may have been released into the soil.

The following sections summarize the existing characterization data identified for the pipeline structures and associated UPRs and/or CZs. Appendix A provides the sampling approach for process facility pipelines (UPRs and CZs) identified for Phase 1 characterization.

3.4.2.1.1 Characterization Information for Bin 2 Stream Condensate and Cooling Water Pipelines

Six pipelines in Bin 2, Steam Condensate and Cooling Water, have associated unplanned releases or CZs that have been identified along their paths and that are known or believed to be caused by leakage.

Three small soil CZs are located above the 200-E-127-PL Pipeline that extends from the PUREX Plant to the 216-A-25 (Gable Mountain Pond) waste site. In the areas of the CZs, the pipeline consists of 91 or 107 cm (36- or 42-in.)-diameter corrugated metal. The depth below ground surface to bottom of the pipeline (i.e., invert depth) ranges from approximately 1.8 to 2.3 m (6 to 7.5 ft) in the vicinity of the CZs. Little information is available about these CZs, except that records in WIDS indicate that radiologically contaminated tumbleweeds were present in these areas at one time. The three areas are outside and to the north of the 810 Gate. Currently they are surface stabilized. Two areas are posted as Contamination Areas, and the third is posted as an underground radioactive material area.

Two CZs are located along the 200-E-113-PL Pipeline from the PUREX Plant to the 216-A-6 and 216-A-30 Cribs. In the areas of the CZs, the pipeline consists of 41 cm (16-in.)-diameter steel. Depth of the pipeline below ground surface is uncertain. The larger CZ occupies an area of approximately 21 m^2 (230 ft^2) and is located further from the 216-A-30 Crib. The smaller CZ is only a few meters square and is next to the 216-A-42C Valve Box near the 216-A-30 Crib. Both areas are surface stabilized and posted as Contamination Areas. The wooden fence surrounding the area by the valve box is in disrepair. The maximum surface radiological survey count obtained for these two zones was 1,050 c/min beta/gamma in October 2000, measured on a tumbleweed growing in the CZ (Radiation Survey Report SS256115, *Vegetation Growth Above Posted Pipeline Associated with 216-A-42C and 216-A-30 Crib*).

Three CZs are located along the 200-W-79-PL Pipeline from the 241-T-151 Diversion Box to the 216-T-36 Crib. In the areas of the CZs, this pipeline consists of 10 cm (4-in.)-diameter vitrified clay. The depth below ground surface to the bottom of the pipeline ranges from approximately 2.4 to 3 m (8 to 9.5) ft in the vicinity of the CZs. The two CZ areas nearest the crib are roughly rectangular, while the third area is further from the crib and is irregular in shape. A portion of this third CZ is the result of contaminated vegetation built up along a fence, and this area is not considered related to the pipeline. The area of these CZs, including the unrelated lower portion, is approximately 1,600 m^2 (17,000 ft^2). All three CZs are surface stabilized and posted as underground radioactive material areas. The maximum surface radiological survey count measured in these CZs was 80,100 c/min beta/gamma in August 1998, obtained from rabbitbrush. The ground surface and several anthills also were surveyed along portions of the pipeline in these CZs (Radiation Survey Report SS248978, *Survey of Underground Transfer Lines*). The instrument counts for the anthills were at background. The maximum ground surface reading was 4,100 c/min beta/gamma.

An approximately 460 m^2 (5,000 ft^2), CZ (UPR-200-E-79) is located along the pipeline that extends from the 242-B Evaporator to the 207-B Retention Basin. In this area, the pipeline consists of 10 cm (4-in.)-diameter cast iron. Depth of the pipeline below ground surface is uncertain. The CZ was created when five leaks were detected in the pipeline in June 1953. The maximum surface radiological survey count for this CZ was 2,500 c/min (WIDS). It was estimated that approximately 10 Ci of mixed fission products were discharged into the soil in this CZ (RHO-CD-673, *Handbook 200 Areas Waste Sites*). The area is surface stabilized and posted as a high-contamination area.

Two unplanned release waste sites (UPR-200-E-80 and UPR-200-E-1) are located along the 200-E-112-PL Pipeline. This pipeline extends from the 221-B Plant Canyon Building through the 241-B-154 Diversion Box to the 207-B Retention Basin. Both unplanned release waste sites are near the 221-B Canyon Building. In this area, the pipeline consists of 61 cm (24-in.)-diameter cast iron. Depth below ground surface to the bottom of the pipeline is estimated to be approximately 3 m (10 ft). According to WIDS, the first release, associated with UPR-200-E-80, occurred in June 1946 when the line failed. A portion of the ground surface above the line caved in and the dose rate measured at the surface was 400 rad/h. It was estimated that about 10 Ci of fission products were released into the soil. A second release site, UPR-200-E-1, was identified in September 1946, located approximately 24 m (80 ft) from the 1946 leak, and was assumed to have resulted from liquid migration from the June leak. Surface radiation survey results are not reported for this second leak, but WIDS indicates that the area was covered with enough soil to reduce surface contamination readings to 2 mrad/h. The area is posted with radiation warning signs.

One CZ is has been identified along the 200-W-88-PL Pipeline between the 221-T Canyon Building and the 207-T Retention Basin. The CZ has an area of approximately 56 m^2 (600 ft^2). In the area of this CZ, the pipeline consists of 61 cm (24-in.)-diameter vitrified clay. Depth of the pipeline below ground surface is uncertain. Although tumbleweeds have been known to grow in this CZ, WIDS indicates that no radiological survey data could be found to describe the conditions inside the posted area or when it was posted. The zone is adjacent to a manhole associated with the pipeline and is posted with an Underground Radioactive Material Area sign.

3.4.2.1.2 Characterization Information for Bin 3 Chemical-Sewer-Waste Pipelines

One pipeline in the Chemical-Sewer Waste bin has associated CZs along its length that are known to be caused by leaks. Three CZs are located along the 200-E-188-PL Pipeline that extends from B Plant to the 216-B-2 Ditches and the 216-B-63 Ditch. The pipeline consists of 38 cm (15-in.)-diameter vitrified clay. The burial depth to the bottom of the pipeline varies along its length and is estimated to range from approximately 0.6 to 6 m (2 to 6.5 ft). All three CZs are surface stabilized and posted as Underground Radioactive Material Areas. The maximum surface radiological survey count for these CZs was 1,200 c/min beta/gamma in August 2000, obtained for a tumbleweed fragment (Radiation Survey Report SS255613, *Survey of Transfer Line Northeast of B Plant to 207-B*).

According to RHO-CD-1010, *B Plant Chemical Sewer System Upgrade*, and WHC-EP-0342, Addendum 6, *B Plant Chemical Sewer Stream-Specific Report*, pipeline leakage was documented in the 1970s and 1980s related to the 200-E-188-PL Pipeline and associated lines.

The leakage was discovered while excavating in the area. Based on subsequent leak testing, it was estimated that approximately 1.1 million L/day (300,000 gal/day) may have been leaking into the soil. The releases were assumed to be occurring primarily along the feeder and collector pipelines. Major portions of chemical-sewer-system pipelines were relined in 1985.

3.4.2.1.3 Characterization Information for Bin 5 Tank/Scavenged-Waste Pipelines

Two pipelines in the Tank/Scavenged-Waste bin have associated unplanned releases or CZs along them that are suspected to be caused by leaks.

Two CZs are located along bends near the north end of the 200-E-114-PL Pipeline. This line extends from the BY Tank Farm to the BC Cribs and Trenches Area and to the 216-B-51 French Drain. In the area of the CZs, two 10 cm (4-in.)-diameter steel pipes comprise the line. The depth from ground surface to the bottom of the pipe is approximately 0.6 to 0.9 m (2 to 3 ft). The larger CZ is approximately 420 m^2 (4,500 ft^2) and is located near the connection from the main line to the 216-B-51 French Drain. The second CZ is at the next bend to the south along the line and is approximately 260 m^2 (2,800 ft^2) in area. The maximum radiological survey count for these two zones was 8,050 c/min beta/gamma in October 2000, obtained for a tumbleweed (Radiation Survey Reports SS253960, *Survey of B Plant Transfer Line*; SS256142, *Vegetation Growth in Posted CA Associated with UPR-200-E-144*). A later survey in May 2002 reported 72,500 c/min from an area in the second CZ (Radiation Survey Report SS261107, *Assessment Survey in a Posted CA South of 12th Street*). Both CZs are surface stabilized and posted as Underground Radioactive Material Areas.

Another CZ (UPR-200-E-7) is located along the 200-E-195-PL Pipeline that extends from B Plant to the 216-B-9 Crib. WIDS indicates that this CZ was created when leakage in the pipeline led to a cave-in in 1954. The pipeline consists of 9 cm (3.5-in.)-diameter stainless steel. Depth of burial to the bottom of the pipe ranges from approximately 0.8 to 1.4 m (2.7 to 4.7 ft) bgs. An estimated 19,000 L (5,000 gal) of liquid leaked into the soil. The maximum surface dose rate observed was 1.7 rad/h within a 2.8 m^2 (30 ft^2) area. While the cave-in was filled in and once was marked, its exact location no longer can be determined, according to WIDS.

3.4.2.2 Characterization Information for Bin 6 Tank Farm Waste-Transfer Pipelines

Pipeline failures both outside and inside of the tank farms have resulted in the release of high-activity waste streams into the soil. Many of these failures in the 200-IS-1 OU were reported in the period from 1945 through 1950, when direct-buried pipelines were used to transfer tank-farm waste. In most cases, the site was stabilized with gravel, asphalt, or shotcrete cover, and little characterization was undertaken.

While there is little history of pipeline sampling and analysis, known releases of liquid wastes from pipelines and appurtenances are documented through unplanned-release reports. Each unplanned release has a formal report associated with it that is retrievable from WIDS. This electronic database can be accessed over the Internet.

The unplanned-release descriptions indicate that ground subsidence usually occurred over a failed line and that liquids were observed pooling or moving over the ground surface. With the

conversion to encasing transfer pipelines in covered concrete troughs, leaks to the soil column became less common. This design collected any liquid releases inside the encasement and drained the liquid to a downgradient diversion box and catch tank.

A review of the WIDS database for 200-IS-1 OU unplanned releases associated with tank farms indicates that although extensive surface contamination has occurred, with the exception of a few unplanned releases (located inside the C and B-BX-BY Tank Farms and not associated with 200-IS-1 OU), the volume of waste that has been released from the 200-IS-1 OU tank farm pipelines is a small fraction of the total volume of releases that have occurred in the tank farm system.

In a few cases, follow-up site-characterization activities of unplanned releases were conducted and provide some idea of contamination and waste distribution. In addition, a few pipelines have been studied as part of the RI process in other OUs. Other than the information presented in the WIDS database and a few select studies, there has been little effort to further characterize unplanned releases or to understand pipeline contamination and releases.

The following is a summary of unplanned releases that have had characterization work to better define the nature and extent of pipeline releases.

- UPR-200-E-86 represents a 1969 pipeline leak assumed to be associated with a joint in the pipeline. Drilling in 1970 (ARH-1945, *B Plant Ion Exchange Feed Line Leak*) was conducted to determine the nature and extent of contaminant distribution following failure of a high-activity waste line. In 1971 and 1972, 14 shallow wells were drilled to assess the soils adjacent to and beneath UPR-200-E-86. Contamination was reported for three of these wells according to Metz, 1972, "PSS Line Leak (Line No. 812)," and RHO-CD-673. Elevated readings for cesium in the soil were reported from 0.3 to 5.5 m (1 to 18 ft) bgs. One of the wells was terminated at 1.8 m (6 ft), because the driller encountered radiation. The leak was approximately 66,000 L (17,000 gal), containing 25,000 Ci of Cs-137 and contaminating approximately 36 m^3 (1,300 ft^3) of soil. The 1972 study to define the extent of contamination found no contamination below 6 m (20 ft). The site is marked by concrete AC-540 marker posts at each corner. The WIDS database states that the surface has been covered with grout and is posted with Underground Radioactive Material Area signs.

The unplanned releases have been identified that are associated with encased pipelines but that seem to result from root penetration into the encasement (UPR-600-20) or from test or swab risers.

- Characterization activities were conducted around the 241-EW-151 Vent Station in 1988 when a routine quarterly survey detected contamination outside of an established contamination zone (80322-88-090, "Surface Contamination Investigation Report, Cross-Country Waste Transfer Line"). Laboratory analyses revealed 1,000 to 230,000 pCi/g of Cs-137, while field instruments indicated 100 to 27,000 pCi/g of Sr-90 in soil samples. Sagebrush samples contained 32 to 53 pCi/g of Cs-137 and 2,700 to 37,000 pCi/g of Sr-90. A drilling program was undertaken to determine if the encasement had leaked. Field investigations included two auger borings at each of four

selected sites. One of the boring pairs was drilled along the centerline to the top of the encasement. A second hole was offset to miss the encasement and was drilled to a depth below the encasement. Continuous split-spoon soil samples were taken and analyzed for radionuclides, but none were found. It was concluded that the encasement had not leaked, and that the roots of sagebrush growing next to the encasement had penetrated to the interior of the encasement.

3.4.2.3 Characterization Information for Other Pipelines

Other pipelines that were not included within the bin structure being used in this work plan have had investigations conducted. In particular, there are pipelines being addressed as part of the 200-UW-1 OU that have had previous characterization activities conducted. UPR-200-W-163 was identified in 1995 as a zone of contaminated vegetation growing along the vitrified clay pipeline connecting the 221-U Plant to the 216-U-8 Crib. Characterization activities above and next to the pipeline were undertaken as part of the 200-UP-2 OU. The field investigation was conducted in conjunction with the 200-UP-2 OU limited field investigation (DOE/RL-95-13) and examined the surface-soil contamination and uptake of radionuclides and metals by vegetation at the 216-U-8 Crib. As part of the limited field investigation, an integrity investigation was conducted to determine the potential for the vitrified clay pipeline to have leaked, causing the soil contamination. The investigation consisted of surveying sections of pipeline with an in-line video camera and collecting 23 surface and near-surface soil samples to depths of 2 to 4 m (7 to 12 ft) (these depths represent the approximate location of the top of the pipeline). The samples were collected between Beloit Avenue and the 216-U-8 Crib. The pipeline-integrity investigation showed that in the vitrified-clay section of the pipeline many of the joints were dislodged, allowing silty, sandy material to enter the pipeline. The degree of dislodgment varied from minor to very serious. The stainless-steel sections of the pipe were shown to be in excellent condition and the joints were sound. Surface-soil samples collected during the pipeline investigation typically showed background levels of activity for analyzed-for constituents. The highest levels of contamination were detected in the subsurface near the vitrified clay pipeline. However, many constituents were distributed throughout the 4 m (12-ft) depth being investigated. The data also indicated that minor lateral spreading had occurred (no more than 1 to 2 m [3 to 5 ft]). The maximum concentrations detected were Am-241, 426 pCi/g; Cs-137, 49,100 pCi/g; Pu-239/240, 70.6 pCi/g; and Sr-90, 1,380 pCi/g. The highest strontium activity was detected in a vegetation sample.

To date only one pipeline has been removed within the Central Plateau industrial area under CERCLA authority. This action involved removing approximately 305 linear m (1,000 ft) of 15 cm (6-in.) vitrified clay pipe that comprises the 200-W-42 Pipeline. This pipeline carried process waste (Bin 1 waste stream) from the facility to the disposal cribs. The excavation of the pipeline was performed in two phases. Phase 1 included removal of the line from the 216-U-12 Crib to the 216-U-8 Crib. In Phase 2, excavation proceeded from the 216-U-8 Crib to the 221-U Building. The removal of the 200-W-42 Pipeline commenced in January 2006 and stopped in September 2006. Results of the pipeline removal action included the following.

- Little to no contamination was encountered during Phase 1. Contaminants detected included Cs-137 and uranium metal.

- Heavily contaminated areas from the 216-U-8 Crib to south of 16th Street were encountered in Phase 2.
- Minor areas of contamination were encountered from north of 16th Street to the U Plant termination point.
- One area along the pipeline showed extensive lateral contamination, with cesium, uranium, and nitrate being the major constituents present.
- It was determined that sloping the excavation has two benefits. First, it allows personnel access, if needed, and second, it minimizes side-slope sloughing.
- It was concluded that sampling should be performed as the project progresses.

Experience gained during this removal action will be used in the field planning for Phase 1 of the 200-IS-1 OU field work.

3.4.3 Historical Sampling and Analysis for Pipeline Appurtenances

The following sections summarize the historical characterization data that have been identified for pipeline-system appurtenances. Information for those appurtenances associated with process-facilities pipeline systems and data obtained for the tank-farm waste-transfer pipelines are differentiated and provided in separate sections.

3.4.3.1 Characterization Information for Process-Facility Pipeline-System Appurtenances

Historical sampling and analytical data for the process-facility pipeline-system appurtenances are limited. No prior sampling and analysis results were identified for appurtenances associated with three of the facilities-pipeline waste-stream bins: Bin 3, Chemical-Sewer Waste; Bin 4 Miscellaneous Waste; and Bin 5, Tank/Scavenged Waste (see Appendix D, Table D-1).

Characterization activities performed for Bin 1, Process Condensate, Process Waste, and Chemical-Laboratory Waste, waste-stream appurtenances consist of an evaluation conducted at the 200-W-59 Diversion Box in 1976. This structure directed the flow of process waste via the 241-Z-361 Settling Tank to the 216-Z-12 Crib. Four shallow wells (299-W-18-151, 299-W-18-154, 299-W-18-155, and 299-W-18-156) were drilled in 1976 between the 216-Z-12 Crib and the 200-W-59 Diversion Box to evaluate the near-surface soils. All of the wells showed plutonium contamination activity at approximately 5 m. The source of the contamination is thought to be unsealed joints of vitrified clay pipeline that extend from the south side of the diversion box to the crib. RHO-ST-21, *Report on Plutonium Mining Activities at 216-Z-9 Enclosed Trench*, states that engineering drawings did not specify seals to be used for the butted vitrified clay pipeline connections between the diversion box and the crib. The report also indicates that the vitrified clay pipeline sections were 3 m (10 ft) long. The log for well 299-W18-156 reported contamination at 5.3 to 5.5 m (17.5 to 18 ft) bgs. This well is approximately 3.7 m (12 ft) to the west of the 200-W-59 Diversion Box and is the closest of the four wells drilled.

Available information for Bin 2, Steam Condensate and Cooling Water, waste-stream appurtenances was obtained from DOE/RL-2003-11, *Remedial Investigation for the 200-CW-5 U Pond/Z Ditches Cooling Water Group, the 200-CW-2 S Pond and Ditches Cooling Water Group, the 200-CW-4 T Pond and Ditches Cooling Water Group, and the 200-CS-1 Steam Condensate Group Operable Units*. Interior sampling and analysis was performed for two pipelines that emptied into the Z Ditches, one pipeline from the 231-Z Plutonium Isolation Facility (200-W-125-PL Pipeline) and the other from the 234-5 Plutonium Finishing Plant (no WIDS pipeline site code defined at this time). As part of the investigation, in situ gamma measurements and smear samples were collected. The gamma measurements were collected by lowering a sodium-iodide gamma detector within 15 cm (6 in.) of the bottom of the selected manholes. The smear samples were obtained by affixing two smear pads on either side of a foam paintbrush that was attached to the end of an extendable metal pole. Swipes were made in both directions across the bottom of the pipe and manhole. The condition of each pipe was documented with a video camera. Air sampling and volatile-organic-compound and radiation monitoring were performed for the entire length of the investigation.

The smear samples were analyzed for 17 radionuclides. In both instances, 14 radionuclides were undetected. For the pipeline from the 231-Z Plutonium Isolation Facility to the Z Ditches, 23.5 pCi of Pu-238, 1,210 pCi of Pu-239, and 226 and 813 pCi of Am-241 were detected. For the pipeline from the 234-5 Plutonium Finishing Plant to the Z Ditches, 2.45 pCi of Pu-238, 94.6 pCi of Pu-239, and 19.5 and 23.5 pCi of Am-241 were detected.

3.4.3.2 Characterization Information for Tank-Farm Pipeline Appurtenances

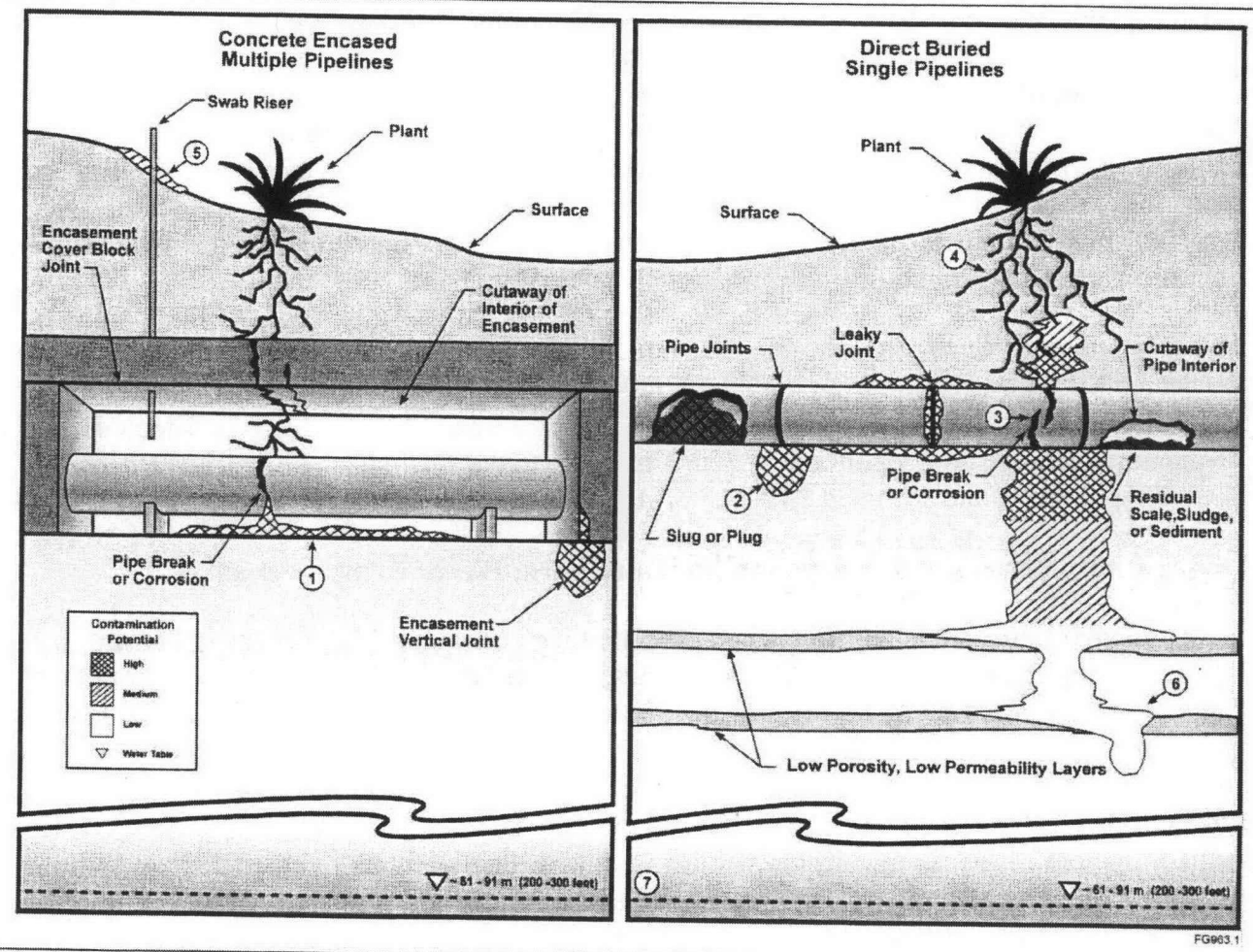
Diversion boxes and catch tanks also are associated with a number of unplanned releases. Significant opportunities exist for releases at these sites because of the operations required to change routings inside the box. Most of the unplanned releases actually are releases that occur when cover blocks are removed, which exposes the interior to winds and the atmosphere. Speck contamination is blown out and deposited on the ground surface. In some cases, equipment removed from a diversion box or catch tank spreads contamination to the ground. In a few cases, a failed jumper or misrouting of a jumper has flooded a diversion box or catch tank and resulted in a spill to the ground surface. In at least one instance a pipeline connection at the exterior of a diversion box failed (UPR-200-W-113), resulting in a spill to the subsurface. Several catch tanks have been replaced because of unspecified failures. As with pipeline releases, there has been limited characterization of unplanned releases associated with tank-farm appurtenances. The available information concerning those unplanned releases that have been identified and associated with tank farm diversion boxes and catch tanks is presented in Appendix D (Table D-2).

3.4.4 Conceptual Contaminant-Distribution Models for Pipelines and Appurtenances

Information pertaining to contaminant sources, release mechanisms, and transport media was considered during development of the conceptual contaminant-distribution models for pipelines and appurtenances. A conceptual contaminant-distribution model for encased and single-buried pipelines is provided in Figure 3-2. The conceptual contaminant distribution model for a

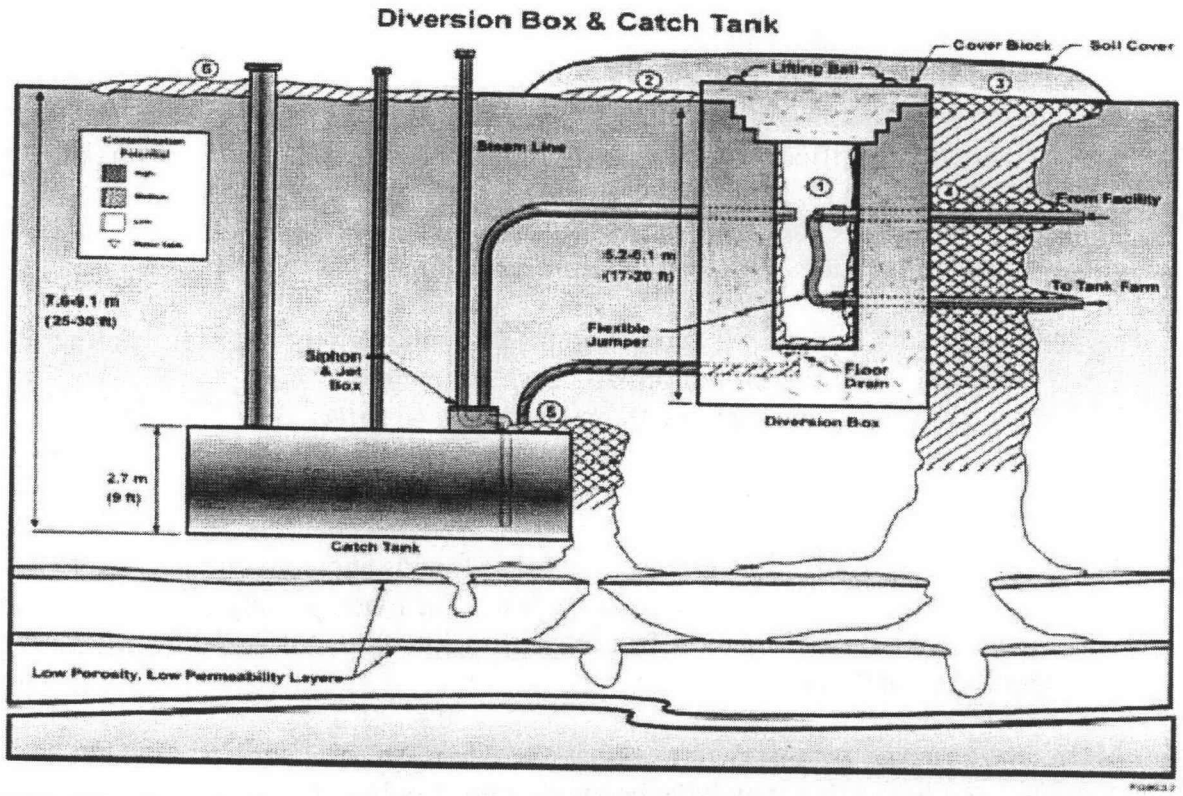
waste-transfer diversion box and catch tank is provided in Figure 3-3. These models will support an evaluation of the potential risk to human health and the environment. The conceptual exposure-pathway model that indicates potential exposure routes and receptors is included with the discussion concerning potential impacts to human health and the environment in Section 3.6.

Figure 3-2. Conceptual Contaminant-Distribution Model for Buried Process-Waste Pipelines.



1. Pipeline leaks have occurred within some concrete encasements. Process liquids that are released may accumulate and pool in the bottom of the encasement.
2. Pipe connection locations such as joints and fittings are susceptible to leakage. The releases are characterized as low-volume leaks and most likely are attributed to faulty or degraded seals, joints, or fittings. The effluent and contaminants move according to the permeability of surrounding soils at various points of release. Low-mobility contaminants such as cesium and plutonium sorb near points of release, and concentrations decrease with depth.
3. Fractures, cracks, and breaks are more prevalent in some pipelines such as those constructed of vitrified clay. Pipe breakage may have occurred in some cases as the result of loading and differential settling of surrounding soils. Larger breaks where flow was under pressure may have resulted in releases that extend both above and below the pipe into surrounding soil.
4. Contamination extends above the pipeline to the surface in some places because of uptake by vegetation (or possible animal intrusion).
5. Surficial dispersion of contaminants may occur around some swab risers, caused by vent releases or sampling activities.
6. Mobile contaminants such as nitrate and tritium migrate with the moisture front to greater depths.
7. Process fluids and contaminants may or may not impact groundwater, depending on the volume of releases.

Figure 3-3. Conceptual Contaminant-Distribution Model for a Diversion Box and Catch Tank.



1. Leaks into the interior of the diversion box occur when jumper connections are changed or during a misrouting. Although most of the spill drains to the catch tank, some contamination remains on the interior floor or sides of the box.
2. During routing change outs or maintenance activities, cover blocks are removed, exposing the diversion box interior to the environment. Winds, remote-handling activities, and removal of equipment generate unplanned releases on the ground surface around the structure. This is the most common type of unplanned release at these structures and usually is stabilized with a cover of clean soil. Vegetation uptake or animal activities may remobilize the contamination.
3. During a misrouting, in some cases, waste liquids fill the diversion box and flow onto the ground around the structure. The liquid drains into the soil, and contaminants are distributed according to respective distribution coefficient (K_d) values, chemistry of the solution, volume of the release, and soil characteristics. Relatively immobile contaminants such as plutonium and cesium remain close to the point of release; mobile contaminants such as technetium-99 and nitrate migrate with the moisture front. This type of unplanned release is very rare for these structures. The contaminated soil is covered with clean soil, shotcrete, or asphalt.
4. Pipe connections may fail at the diversion box exterior wall. Liquid is released to the soil column below ground and flows away from the break. Depending on the volume of the release, liquid flow may induce localized ground subsidence, with contaminated liquids emerging at the ground surface or in the depression (not shown). Contaminants are retained in the soil column according to respective K_d values, chemistry of the solution, and soil characteristics. Immobile contaminants such as plutonium and cesium generally remain close to the point of release; mobile contaminants such as technetium-99 and nitrate migrate with the moisture front. The area of surface contamination is covered with clean soil, shotcrete, asphalt, or other material.
5. Failure at a pipe fitting, or failure of the tank itself, leads to a loss of waste to the subsurface. The volume of waste lost is assumed to be low, because most releases to catch tanks are assumed to be the sum of multiple jumper contents lost when routings were broken. Liquids move down through the soil column, while contaminants are retained in the soil according to respective K_d values, chemistry of the solution, and soil characteristics. Relatively immobile contaminants such as plutonium and cesium remain close to the point of release; mobile contaminants such as technetium-99 and nitrate migrate with the moisture front. This type of failure is rare, but several replacement catch tanks have been installed at diversion boxes.
6. Surface releases around catch tank risers occur primarily when access to the tank is required for liquid-level measurement, sampling, or pumping. Opening the system to the environment allows vapors to escape or wind to mobilize contaminants in the riser. Sampling devices and pumps lowered into the tank to remove liquids entrain contaminants to the surface when removed, and contaminants are scattered by leaks, drips, or wind. Rarely, overflows at diversion box/catch tank pairs lead to releases through catch tank risers. Liquids move down through the soil column, while contaminants are retained in the soil according to respective K_d values and soil characteristics. Relatively immobile contaminants such as plutonium and cesium remain close to the point of release; mobile contaminants such as technetium-99 and nitrate migrate with the moisture front. Releases are covered with clean soil to prevent spread of the radionuclides.

The following assumptions are included with the conceptual contaminant-distribution models for the process-waste pipelines and appurtenances.

- Residual waste material inside pipelines and appurtenances, if present, may occur as scale, corrosion products, sludge, and/or sediment. Residual levels of contamination are expected to be related to the waste-stream characteristics and pipeline materials. Pipeline materials such as vitrified clay may have more readily sorbed waste-stream constituents.

- The major COPCs are the radionuclides Cs-137, Sr-90, Pu-239/240, Tc-99, and tritium, and the nonradionuclides nitrate and uranium metal.

- Contaminants such as Cs-137, Sr-90, and the plutonium isotopes have high distribution coefficients (K_ds) and therefore normally sorb strongly onto shallow-zone Hanford Site sediments. These less mobile contaminants should be detected near points of release in the vadose zone. Contaminants with low K_d values (e.g., nitrate, Tc-99, and tritium) are not readily adsorbed on soil particles and migrate to greater depth within the vadose zone.

- Both vertical migration and lateral spreading of liquids and contaminants may have occurred into surrounding soil at release points. The extent of migration or spreading will be dependent on a number of factors, including volume of liquid released and local hydrogeologic conditions.

- Mobile contaminants may or may not have reached groundwater. The volume of contaminated liquid that may have been released at points of leakage generally is unknown. For pipelines and appurtenances where inadvertent liquid releases to the surrounding soil have occurred, the contaminant distribution may be limited to the shallow-zone soil interval (i.e., the interval from the ground surface to a depth of 4.6 m [15 ft]) and could extend to a deeper depth. Liquid releases at pipeline-failure locations may display simple or complex concentration distributions within the impacted soil area, depending on the characteristics of the waste stream and physical composition and chemistry of the soil.

3.4.5 CX Tank System

Information is presented here that was compiled relating to sources of the waste managed in the CX Tanks, volume of waste managed, and available sampling and analyses results indicating contaminant distribution outside the tanks. Historical sampling results for the waste contained in the tanks is presented here and also summarized in Table 2-2.

3.4.5.1 241-CX-70 Storage Tank Sources of Waste Contributions

The 201-C Process Building, A cell, was reported as discharging waste to the 241-CX-70 Storage Tank. According to HW-31373, *PUREX Chemical Flowsheet HW Number 3 Chemical Development Unit Separations Technology Subsection Technical Sec Engineering Department*, Figure 2, and Hanford Site drawings (i.e., H-2-4093, *Hot Semiworks Process Piping Plan A Cell*; H-2-4105, *Hot Semiworks Engineering Flow Sketch*; and H-2-4335, *Hot Semiworks Waste Line Bldg 201-C to TK-70*), the following equipment discharged waste

from A cell to the 241-CX-70 Storage Tank: steam transfer jets and piping that connected the scrubber, oxidizer, dissolver, feed makeup, waste-receiver tanks, and waste-concentrator centrifuge.

3.4.5.1.1 Volume of Waste Managed

According to HW-52860, *Standby Status Report Hot Semiworks Facility*, the total estimated effluent volume received was 95,000 L (25,000 gal) of non-neutralized REDOX process waste. However, in May 1974, the material-level measurements indicated that 4.3 m (14 ft) of liquid and sludge remained in the tank (AR00227, "Disposition and Isolation of Tanks 270-E-1, 270-W, 241-CX-70, 241-CX-71, and 241-CX-72"). Based on the 1974 material level reported, the 241-CX-70 Storage Tank contained approximately 11,000 L (2,900 gal) more volume than it reportedly received in 1957, for a total of 106,000 L (28,000 gal).

3.4.5.1.2 Historical Sampling and Analysis

Limited information is available to evaluate the nature and extent of potential contamination in the soil surrounding the 241-CX-70 Storage Tank. No information was identified regarding soil samples or radiological surveys for the vadose zone in the CX Tank area. Whether liquid might have been released into the soil column is unknown, but comparing liquid-level data in the tank from July 1974 to the data from a later date (not specified) indicated that the tank had not leaked.

The 241-CX-70 Storage Tank was designed and constructed specifically for storing high-level process waste in support of the Hot Semiworks processes. In April 1976, analysis of the remaining sludge in the 241-CX-70 Storage Tank reported that fission products totaled approximately 4,300 Ci of Sr-90, 870 Ci of Cs-137, and 3.4 Ci transuranic content (SD-WM-SAR-003, *Safety Analysis Report for the Decontamination and Decommissioning of the Strontium Semiworks Complex*).

Sludge-removal activities began in the summer of 1987 with the construction of a sluicing/pumping system. Grab samples collected on August 17, 1988, showed alpha readings ranging from 390 to 690 nCi/g of filtered solids. The transuranic content of the sludge was approximately 50 nCi/g, with a pH of 13 in the liquid phase. Halogenated hydrocarbons were recorded at 0.0009 wt%. In addition, as reported in 12712-PCL88-019, *Analysis of Sludge Samples from Hot Semiworks Tank CX-70*, qualitative identification classified the organics as aliphatic amines or possibly aliphatic alcohol. The waste was removed later, and the tank is now empty.

The groundwater gradient is indeterminate in most of the 200 East Area (see Figure 2-3), including the region surrounding the 241-CX-70 Storage Tank. Well 299-E27-5, located approximately 77 m (253 ft) east of the 241-CX-70 Storage Tank, reported a depth to groundwater for March 2002 at 87 m (284 ft) bgs. The status of groundwater contamination near the 241-CX-70 Storage Tank is illustrated in Figure 3-1 (tank is not shown on figure). A groundwater plume containing I-129 at concentrations exceeding groundwater protection standards occupies a large portion of the 200 East Area and encompasses the waste site. Groundwater wells in the immediate area are sparse and provide limited analytical information. No historical analytical information is available for the nearest well, 299-E27-133 (see Figure 2-7), located 22 m (72 ft) from the tank. The 2004 groundwater-sampling records for

well 299-E24-8, located 63 m (210 ft) from the 241-CX-70 Storage Tank, reported 2.28 pCi/L gross alpha and 14.8 pCi/L gross beta.

3.4.5.2 241-CX-71 Neutralization Tank Sources of Waste Contributions

The 201-C Process Building hot shop routed condensate, coil, and condenser cooling waters containing low-level radioactivity waste from the hot sinks to the 241-CX-71 Neutralization Tank before discharging the waste to the 216-C-1 and 216-C-5 Cribs, according to WHC-SD-DD-TI-040, *Tank 241-CX-72 Preliminary Waste Characterization*, and Hanford Site Drawings H-2-4010, *Strontium Semiworks & Vicinity Outside Lines Key Map*; H-2-4420, *Plot Plan Hot Semiworks Waste Self-Concentrator*; and H-2-4535, *Site Plan & Underground Piping Strontium Facilities, Hot Semiworks.*

3.4.5.2.1 Volume of Waste Managed

The total estimated effluent volume received was approximately 33 million L (8.8 Mgal) of waste (AR00227).

3.4.5.2.2 Historical Sampling and Analysis

Limited information is available to evaluate the nature and extent of potential contamination in soil surrounding the 241-CX-71 Neutralization Tank. No information was available regarding soil samples or radiological surveys in the vadose zone in the CX Tank area. No leaks from the tank or connecting piping have been documented.

The 241-CX-71 Neutralization Tank was designed and constructed for the neutralization of acidic low-level radioactive waste. This stainless-steel tank was in operation for less than 3 years. Approximately "8.8 million gallons" of decontamination wastes may have passed through the tank (WHC, 1990, *201-C Strontium Semiworks Project Rebaseline, UE-003-90*). As reported in WHC-SD-DD-SAD-001, *Safety Evaluation for Interim Waste Management Activities in Tank 241-CX-70, Tank 241-CX-71, and Tank 241-CX-72*, it is estimated that waste discharged to the 241-CX-71 Neutralization Tank contained 2.46×10^{-8} g/L of plutonium; 43,000 nCi/L of Sr-89/90; and 1,600 nCi/L of Cs-137. Several estimates have been made concerning the radionuclide inventory retained in the tank and the values have varied widely. The maximum inventory estimated included 6 Ci of plutonium and 6,000 Ci beta (BHI-01173).

During October 1990, gas, liquid, and sludge samples were collected from the 241-CX-71 Neutralization Tank. Extremely low concentrations of methyl ethyl ketone, xylene, and toluene ranging from 7 to 54 ppb were measured. Cyanide was measured in the sludge at 21 ppm.

The groundwater gradient is indeterminate in most of the 200 East Area (see Figure 2-10), including the region surrounding the 241-CX-71 Neutralization Tank. Well 299-E27-5, located approximately 95 m (311 ft) east of the 241-CX-71 Neutralization Tank, reported groundwater depth for March 2002 at 87 m (284 ft) bgs. The status of groundwater contamination near the 241-CX-71 Neutralization Tank is illustrated in Figure 3-1 (tank is not shown on figure). A groundwater plume containing I-129 that exceeds groundwater-protection standards occupies a large portion of the 200 East Area and encompasses the waste site. Groundwater wells in the

area are sparse and provide limited analytical information. No analytical information is available for the nearest well, 299-E27-133, located approximately 10 m (33 ft) from the 241-CX-71 Neutralization Tank (Figure 2-3). Well 299-E24-8, located 62 m (203 ft) from the tank, reported 2.28 pCi/L gross alpha and 14.8 pCi/L gross beta for samples collected in 2004.

3.4.5.3 241-CX-72 Storage Tank Sources of Waste Contributions

According to WHC-SD-DD-TI-040 and Hanford Site Drawings H-2-4093, H-2-4420, and H-2-4535, only the A and C cells in the 201-C Process Building discharged waste to the 241-CX-72 Storage Tank. According to WHC-SD-CP-TI-148, the tank also may have been used for fluids from the decontamination of the Hot Semiworks after separations projects. Investigations of bumping phenomena were conducted in the tank (WHC-SD-CP-TI-148).

3.4.5.3.1 Volume of Waste Managed

According to HW-52860, the estimated effluent volume received was 8,700 L (2,300 gal) of liquid waste.

3.4.5.3.2 Historical Sampling and Analysis

Limited information is available to evaluate the nature and extent of potential contamination in the soil surrounding the 241-CX-72 Storage Tank. No information was identified regarding soil samples or radiological surveys for the vadose zone in the area of the tank. Whether any effluent has leaked from the tank to the soil column is unknown, but the probability of contamination spread from this site is estimated to be zero to very low. The assumption that contaminant distribution outside the tank would be none to limited is consistent with the fact that the tank has double-wall construction (refer to Figure 2-10), only a relatively small volume of liquid waste originally was present in the tank for a short period of time, and the waste that was handled consisted of radionuclides that have low mobility in the soil. The tank received only 8,700 L (2,300 gal) of liquid waste (HW-52860) during its one year in use. Material-level measurements indicated that 188.0 cm (74 in.) of sludge and 2.5 cm (1 in.) of liquid were present in the tank in July 1974, and 193.0 cm (76 in.) of sludge and 2.5 cm (1 in.) of liquid were present in November 1974.

The 241-CX-72 Storage Tank was designed and constructed specifically for the concentration and terminal storage of waste from the pilot PUREX Plant studies. In the 1974 letter AR00227, sampling results for a clear, light-brown solution with a pH of 9.5 and a trace of solids were reported as follows:

- Total plutonium: 1.13×10^{-8} g/gal
- Total uranium: 2.43×10^{-3} g/gal
- Sr-89/90: 4.33 mCi/g
- Cs-137: analysis performed, but not detected.

In 1989, nondestructive assays were performed to evaluate the radiological content of the 241-CX-72 Storage Tank. Three smears were collected from an agitator rod that was inadvertently removed from the tank. WHC-SD-CP-TI-148 reported alpha activity between 2,000 and 8,000 d/min, gamma activity between 2.64×10^3 and 5.81×10^3 pCi, and a

beta-to-gamma ratio of 25:1. The report concluded that the residual waste material contains 150 to 200 g of plutonium. WHC-SD-DD-TI-051, *An Estimation of the Radionuclide Content of Tank 241-CX-72*, estimated that between 9,000 and 10,000 Ci of Cs-137 would be present, based on data presented in WHC-SD-CP-TI-148. The sludge never was removed from the tank.

The groundwater gradient is indeterminate in most of the 200 East Area, including the region surrounding the 241-CX-72 Storage Tank. Well 299-E27-5, located approximately 59 m (193 ft) east of the 241-CX-72 Storage Tank, reported a depth to groundwater for March 2002 at 87 m (284 ft) bgs. The status of groundwater contamination in the area of the 241-CX-72 Storage Tank is illustrated in Figure 3-1 (tank is not shown). Reported groundwater concentrations of I-129 exceed groundwater-protection standards beneath the waste site. Groundwater wells in the area are sparse and provide limited analytical information. No analytical information is available for the nearest well, 299-E27-133, located approximately 43 m (141 ft) from the tank (Figure 2-3). Groundwater sampling results at well 299-E24-8, located 86 m (282 ft) away, showed 2.28 pCi/L gross alpha and 14.8 pCi/L gross beta in 2004.

3.4.5.4 Path Forward for Tanks 241-CX-70, 241-CX-71, and 241-CX-72

The 241-CX-70 Storage Tank and 241-CX-71 Neutralization Tank will be removed and clean closed. Waste characteristics of the remaining residue in the 241-CX-72 Storage Tank needs to be determined. A closure plan for the entire CX Tank System (241-CX-70, 241-CX-71, and 241-CX-72) will be submitted.

3.4.6 Hexone Storage and Treatment Facility

Information is presented here that was compiled relating to sources of the waste managed in the 276-S-141 and 276-S-142 Hexone Storage Tanks, the volume of waste managed, and available sampling and analyses results indicating contaminant distribution outside the tanks.

3.4.6.1 276-S-141 Hexone Storage Tank Sources of Waste Contributions

Essentially pure hexone waste was transferred to the 276-S-141 Hexone Storage Tank from the 276-S Solvent Handling Facility (located to the south of the tank), as shown on Hanford Site Drawing H-2-5304, *276 Organic-Solvent Make-Up Storage Piping*. The tank also received waste during decontamination of the REDOX Plant.

3.4.6.1.1 Volume of Waste Managed

The estimated volume of hexone received by the 276-S-141 Hexone Storage Tank was 606,000 L (160,000 gal). This estimate is based on CCN 100786, "276-S-141/142 Hexone Storage Tank Sludge Sampling Results," which reported that 76,000 L (20,000 gal) of essentially pure hexone was discharged annually to the 276-S-141 Hexone Storage Tank.

3.4.6.1.2 Historical Sampling and Analysis

Limited information is available to evaluate the nature and extent of potential contamination in soil surrounding the 276-S-141 Hexone Storage Tank. In April 1976, ARH-CD-639, *Integrity of Tanks 276-S-141 and 276-S-142,* reported the integrity of the tank as good. The tank's average wall thickness was 0.83 to 0.92 cm (0.327 to 0.363 in.). The only nearby location with reported soil-sampling data is monitoring well 299-W22-86, which was installed and completed in 2006 and is located about 92 m (300 ft) west-northwest of the 276-S-141 Hexone Storage Tank.

The tank was constructed specifically to store clean hexone. The tank was sampled three times, and the results were reported in ARH-CD-685, *Characterization of the Contents of Organic Waste Storage Tanks 276-S-141 and 276-S-142*; WHC-SP-0350, *Hexone Remediation Demonstration Plan for Tanks 276-S-141 and 276-S-142*; and BHI-01521, *Evaluation of Alternatives for the Interim Stabilization of the Hexone Tanks.* The 1976 analytical work characterized the material in the 276-S-141 and 276-S-142 Hexone Storage Tanks and included preliminary distillation tests (ARH-CD-685). The 1988 work obtained fully representative concentrations with the goal of determining a practical means for treating and disposing of the waste (WHC-SP-0350). The results reported in BHI-01521 are discussed below. The sampling results from these three activities are consistent with the operator-based knowledge of process information.

The 1976 and 1988 sampling results indicated that the 276-S-141 Hexone Storage Tank contained the following:

- Hexone: 98.4%
- Water: 1.6%
- Total alpha: <31 pCi/L
- Total beta: 4,910 pCi/L
- I-129: 5,460 pCi/L
- Tritium: 7,470,000 pCi/L (estimate).

Pumpable liquids were removed from the tank in 1991, after which it contained approximately 950 L (250 gal) of residual tar-like sludge. The sludge was collected and analyzed in March 2001. The principal chemical components of the sludge were NPH, TBP, iron oxide, and hexone. The principal radionuclides were Am-141, plutonium isotopes, Sr-90, and Cs-137 (CCN 100786).

The direction of groundwater flow (see Figure 2-4) in the vicinity of the 276-S-141 Hexone Storage Tank generally is west to east. Depth to water measured in May 2006 at the nearest well (299-W22-86, see Figure 2-11) was 71.3 m (234 ft) bgs. The status of groundwater contamination near the 276-S-141 Hexone Storage Tank is illustrated in Figure 3-1 (tank is not shown). No contaminant plumes have been delineated beneath this waste site. Groundwater-monitoring results for 2006 from well 299-W22-86, located about 92 m (302 ft) west of the 276-S-141 Hexone Storage Tank, showed up to 2,000 pCi/L of Tc-99, 10,700 pCi/L of tritium, and 1.39 pCi/g of U-238.

3.4.6.2 276-S-142 Hexone Storage Tank Sources of Waste Contributions

According to Hanford Site Drawing H-2-5304, the 276-S-142 Hexone Storage Tank originally was used to store reagent-grade hexone from the 276-S Solvent handling Facility, located to the south of the tank. The tank also received waste during decontamination of the REDOX Plant. The tank later was used to store NPH and TBP during a one-time separations activity involving fuel from the Shippingport reactor (BHI-01018).

3.4.6.2.1 Volume of Waste Managed

The total estimated effluent volume received by the 276-S-142 Hexone Storage Tank was 980,000 L (256,000 gal) of mainly reagent-grade hexone. This volume is based on the information in DOE/RL-96-82, *Hanford Facility Dangerous Waste Closure Plan, 241-Z Treatment and Storage Tanks*, which reported that 61,000 L (16,000 gal) of hexone waste was discharged annually to the 276-S-142 Hexone Storage Tank.

3.4.6.2.2 Historical Sampling and Analysis

Limited information is available to evaluate the nature and extent of potential contamination in soil surrounding the 276-S-142 Hexone Storage Tank. ARH-CD-639 stated that the integrity of the tank is good. The tank's average wall thickness was 0.89 to 0.91 cm (0.350 to 0.357 in.). The only nearby location with reported soil-sampling data is monitoring well 299-W22-86, which was installed and completed in 2006 and is located about 92 m (300 ft) west-northwest of the 276-S-142 Hexone Storage Tank.

The tank was designed and constructed specifically to store clean hexone. The tank contents were sampled three times. The sampling results from these three activities are consistent with the operator knowledge of process information. The 1976 analytical work characterized the material in both tanks and included preliminary distillation tests (ARH-CD-685). The 1988 analytical work obtained fully representative concentrations, with the goal of determining a practical means for treating and disposing of the waste (WHC-SP-0350). Results reported in BHI-01521 are presented below.

The 1976 and 1988 sampling data indicated that the 276-S-142 Hexone Storage Tank contained the following:

- 7,600 L (2,000 gal) of water
- 53,000 L (14,000 gal) of the following mixture:
  - 60% hexone
  - 25.2% NPH
  - 12.6% TBP and 1.7% water
  - 380 L (100 gal) tarry sludge resting on the base of the tank.

The radionuclide inventory in the liquid media consisted of the following:

- Total alpha: 2,070,000 pCi/L
- Total beta: 871,000 pCi/L
- Iodine-129: 34,500 pCi/L
- Tritium: 3,162,000 pCi/L (estimated).

After the pumpable liquids were removed from the tank in 1991, it contained approximately 950 L (250 gal) of residual, tar-like sludge. The sludge was collected and analyzed in March 2001. The principal chemical components of the sludge were NPH, TBP, iron oxide, and hexone. The principal radionuclides were Am-141, plutonium isotopes, Sr-90, and Cs-137 (CCN 100786).

The direction of groundwater flow (see Figure 2-4) in the vicinity of the 276-S-142 Hexone Storage Tank generally is west to east. Depth to water measured in May 2006 at the nearest well (299-W22-86, see Figure 2-11) was 71.3 m (234 ft) bgs. The status of groundwater contamination near the 276-S-142 Hexone Storage Tank is illustrated in Figure 3-1 (tank is not shown). No contaminant plumes have been delineated beneath this waste site. An upgradient groundwater well, 299-W22-86, located about 92 m (302 ft) west-northwest of the 276-S-142 Hexone Storage Tank, was sampled in 2006 and reported up to 2,000 pCi/L of Tc-99, 10,700 pCi/L of tritium, and 1.39 pCi/g of U-238.

3.4.6.2.3 Combined Hexone Storage Tank Sampling

In March 2001, the 276-S-141 and 276-S-142 Hexone Storage Tanks were sampled, and the samples were analyzed in accordance with DOE/RL-2000-73, Rev. 0, *Sampling and Analysis Plan for the 276-S-141/142 Hexone Tank Stabilization/Characterization Project*. The sampling event included deploying a video camera into the tanks through the 0.61 m (2-ft)-diameter riser to visually survey the inside of the tank and guide the survey activities. Samples were collected through the 0.61 m (2-ft)-diameter riser and the 10 cm (4-in.)-diameter risers of each tank.

The video survey showed that the volume of residual material in each tank was approximately 494 L (130 gal). No free liquid was observed in either tank. The sludge appeared to be a uniform tar-like layer extending the length of the tank across the bottom with a dried, cracked crust. The sludge depth appeared to be approximately equal to the 8.25 cm (3.25-in.) diameter of the sample tool (beaker).

The video survey showed both tanks to be structurally sound. The internal surfaces of the tanks appeared rusted, but had no apparent pits or voids. No evidence was present to suggest that either tank had leaked; however, no soil samples were taken from around the tanks. More details are provided in CCN 088368, "Hexone Tanks 276-S-141 and 142, VHS Videotape Notes."

Analytical results for the sludge samples from the 276-S-141 and 276-S-142 Hexone Storage Tanks are presented in CCN 100786. CCN 100786, Table 2, contains results for sludge collected from the 276-S-141 Hexone Storage Tank; Table 3 contains results for sludge collected from the 276-S-142 Hexone Storage Tank; and Table 4 summarizes the transuranic analytical results for both tanks.

The sludge collected from the 276-S-141 and 276-S-142 Hexone Storage Tanks can be characterized as a dark-colored, mildly acidic phosphate tar. The pH of the sludge samples ranged from 3.2 to 4.8 (standard units). Sludge collected on the west ends of the tanks was less viscous, with densities of 0.97 and 0.91 g/mL for the 276-S-141 and 276-S-142 Hexone Storage Tanks, respectively. Sludge collected from the east ends of the tanks was more granular in texture, with densities of 1.21 and 1.20 g/mL for the 276-S-141 and 276-S-142 Hexone Storage Tanks, respectively. The pH of the sludge samples ranged from 3.2 to 4.8 (standard units). The

principal chemical components of the sludge are NPH, TBP, iron oxide, and hexone. The principal radionuclides detected in the sludge samples are Am-141, plutonium isotopes, Sr-90, and Cs-137. The sludge in the 276-S-142 Hexone Storage Tank contains approximately four times the amount of radioactive material that is in the sludge in the 276-S-141 Hexone Storage Tank. The estimated average amount of transuranic constituents in the 276-S-141 Tank sludge was calculated to be 14.1 nCi/g. In the 276-S-142 Tank sludge, transuranic constituents were estimated to consist of 58.9 nCi/g.

3.4.6.2.4 Path Forward for the Hexone Storage Tanks

The closure plan prepared for the 276-S-141 and 276-S-142 Hexone Storage Tanks (DOE/RL-92-40) will be amended (as needed) and used to complete the closure process for these tanks. The tanks will be removed, and the surrounding soil will be sampled and analyzed as described in DOE/RL-92-40 to verify RCRA clean closure and meet CERCLA site close-out requirements.

3.5 RCRA TREATMENT, STORAGE, AND DISPOSAL UNIT INTERIM-STATUS GROUNDWATER MONITORING

Neither the CX Tank System nor the HSTF is involved in interim-status groundwater monitoring. Pertaining to the tank-farm waste-transfer pipeline system, the EPA, Ecology, and DOE agreed to implement a RCRA groundwater-monitoring system around the SST WMAs in accordance with the Tri-Party Agreement (Ecology et al., 1989a) Milestone M-024 and M-045 series. RCRA groundwater-monitoring wells are located outside the WMA fencelines. The wells are intended to monitor groundwater contamination attributable within the entire WMA, but they not outside of these boundaries.

3.6 POTENTIAL IMPACTS TO HUMAN HEALTH AND THE ENVIRONMENT

This section presents the conceptual exposure model developed to identify potential impacts to human health and the environment from waste sites in the 200-IS-1 OU. Information pertaining to contaminant sources, release mechanisms, transport media, exposure routes, and receptors is discussed to develop a conceptual understanding of potential risks and exposure pathways. Assumptions concerning potential receptors are based on current and anticipated future use of land and groundwater. This information will be used to support an evaluation of potential human health and environmental risk in the RI/FS to be prepared following the investigation.

3.6.1 Land and Groundwater Use

Current and anticipated future uses for land and groundwater in the areas where the 200-IS-1 OU waste sites occur are discussed below. Land- and groundwater-use information is applied as appropriate in conjunction with the identification of potential exposure routes and receptors.

3.6.1.1 Current Land Use

Current land-use activities associated with the 200 Areas and the Central Plateau are industrial in nature. The facilities located in the Central Plateau were built to process irradiated fuel from the plutonium production reactors in the 100 Areas. Most of the facilities directly associated with fuel reprocessing are inactive now and awaiting final disposition. The Plutonium Finishing Plant has encapsulated plutonium and currently is storing it. Several waste management facilities operate in the 200 Areas, including permanent waste-disposal facilities such as the Environmental Restoration Disposal Facility, Low-Level (radioactive waste) Burial Grounds, and a RCRA-permitted, mixed-waste trench. Construction of tank-waste treatment facilities in the 200 Areas began in 2002, and the 200 East Area is the planned disposal location for the vitrified low-activity tank wastes. Other Federal agencies, such as the U.S. Department of the Navy, use the Hanford Site 200 East Area for disposal of TSD units. In addition, a commercial low-level radioactive-waste disposal facility currently is operated by US Ecology, Inc., on a 100-acre tract of land at the southeast corner of the 200 East Area that is leased to the State of Washington.

3.6.1.2 Anticipated Future Land Use

The reasonably anticipated future land use for the 200 Areas is continued industrial activities for the foreseeable future. This land-use assumption is applied to the pathway and receptor considerations in risk calculations for the waste sites.

3.6.1.3 Current Groundwater/Surface-Water Uses

Groundwater in the 200 Areas currently is contaminated and is not withdrawn for beneficial uses. The Columbia River is the second largest river in the contiguous United States in terms of total flow and is the dominant surface-water body on the Hanford Site. The Columbia River is the principal source of drinking water for the Tri-Cities and the Hanford Site. Regionally, it also is used extensively for irrigation and for recreation, which includes fishing, hunting, boating, water skiing, diving, and swimming.

3.6.1.4 Potential Future Groundwater/Surface-Water Uses

Washington State cleanup regulations define groundwater as a "potential future source of drinking water" based on yield, natural quality, and pumpability (WAC 173-340-720[2], "Ground Water Cleanup Standards," "Potable Ground Water Defined"). Based on these technical standards, groundwater underlying the 200 Areas may be considered a potential future drinking-water source. In addition, groundwater underlying the 200 Areas is hydraulically connected to groundwater systems that currently are used for drinking water and irrigation, and it ultimately discharges to the Columbia River. In accordance with 40 CFR 300, "National Oil and Hazardous Substances Pollution Contingency Plan," the goal is to restore the groundwater at the Hanford Site to maximum beneficial uses, if practicable. The groundwater-protection remedial action objective for the 200-IS-1 OU will be based on the WAC 173-340-720, "Ground Water Cleanup Standards," and 40 CFR 141, "National Primary Drinking Water Regulations."

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), "Ground Water Cleanup Standards," "Point of Compliance." It is anticipated that current uses of the Columbia River will continue in the future.

3.6.2 Contaminant Sources and Release Mechanisms

The primary sources of contamination for the process-waste pipeline systems are liquid waste releases to surrounding soils from tanks, lines, pits, diversion boxes, and associated structures. The waste generally was released to the vadose zone through unplanned releases (e.g., leaks). Releases to the environment from the primary contaminant sources have produced contaminated surface soils and subsurface soils beneath waste sites. These are secondary sources that can spread contaminants through the environment by infiltration, resuspension of contaminated soil, volatilization, biotic uptake, leaching, and external radiation. During the periods when unplanned releases to the environment occurred, the dominant mechanism of contaminant transport was infiltration. After a liquid release from a structure ceased, the liquids continued to move through the soil column for an undetermined period. Currently, the dominant mechanism of contaminant transport through the vadose zone is from residual effluent moisture and natural recharge.

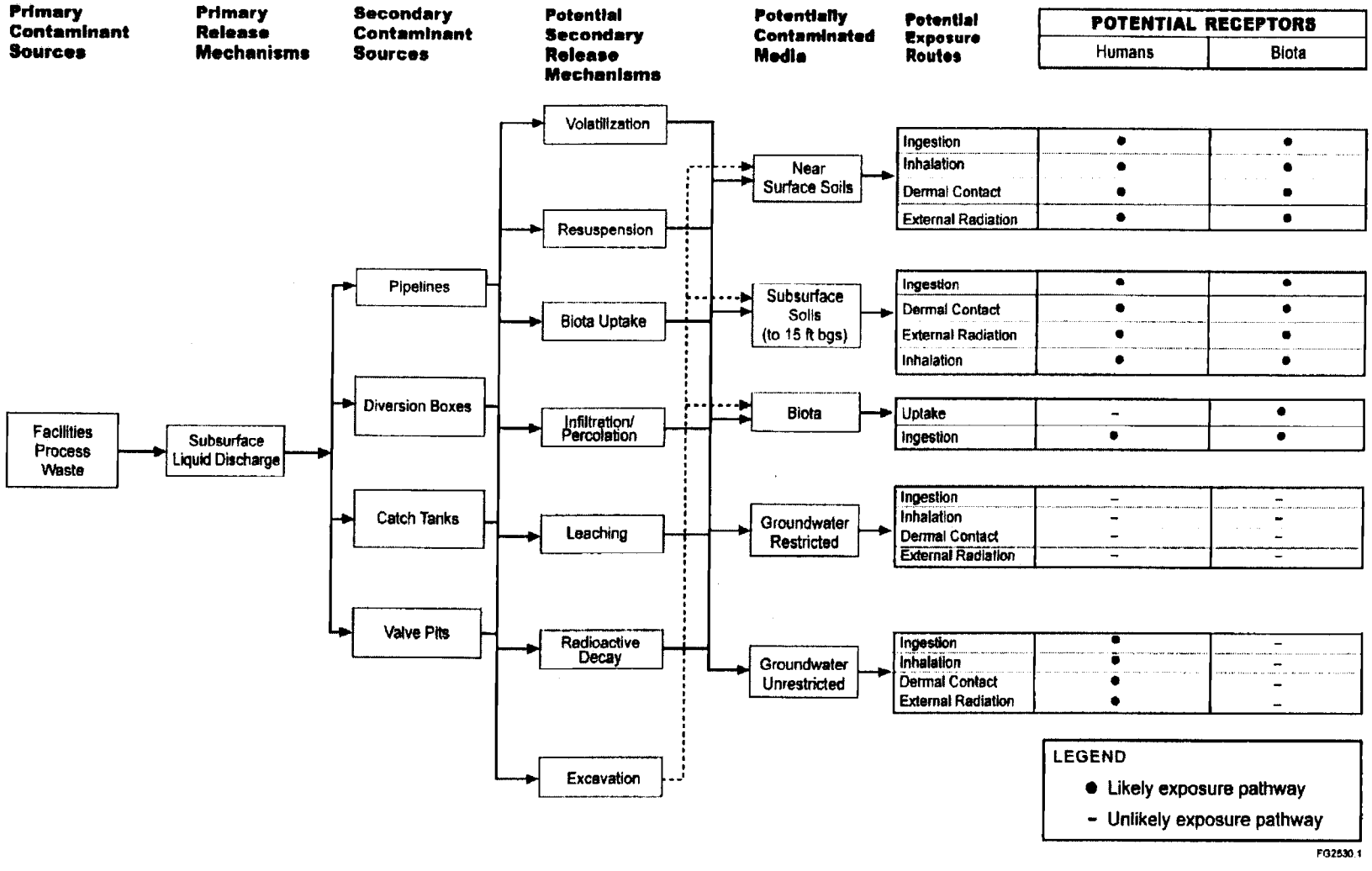
3.6.3 Potential Receptors

Potential receptors (i.e., human and ecological) can be exposed to the affected media through several exposure pathways, including the following:

- Ingestion of contaminated soils (including dust inhalation), sediments, or biota
- Inhalation of contaminant dusts, vapors, or gases
- Dermal contact with contaminated soils
- Direct exposure to external gamma radiation in site soils and sediments.
- Groundwater ingestion.

Potential human receptors include current and future Site workers and Site visitors (i.e., occasional users). Under a restricted future-land-use scenario, site worker and visitor exposure pathways primarily would involve incidental soil and sediment ingestion, inhalation of contaminants, dermal contact with contaminated soils and sediments, and external gamma radiation (Figure 3-4). Under an unrestricted future-land-use scenario, exposure pathways also would include ingestion, inhalation, dermal contact, and external radiation from groundwater (Figure 3-4). Potential ecological receptors include terrestrial plants and animals inhabiting the site. Site biota exposures primarily would result from incidental soil and sediment ingestion, plant uptake, ingestion of contaminated plants or animals (e.g., grazing or predation), dermal contact with contaminated soils and sediments, and external gamma radiation.

Figure 3-4. Conceptual Exposure-Pathway Model.



3.6.4 Potential Impacts

Potential contaminant exposures and health impacts to humans depend largely on allowable land uses. The land use inside the core zone selected by the DOE is industrial (exclusive). Outside the core zone, the selected land use is conservation (mining). The DOE determined these land-use designations through the *National Environmental Policy Act 1969* process; the designations are identified in 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)." Most of the 200-IS-1 OU is located in the core zone.

Ecological receptors have been identified, and potential impacts to those receptors have been evaluated at waste sites in the 200 Areas (PNL-2253, *Ecology of the 200 Area Plateau Waste Management Environs: A Status Report*; WHC-SD-EN-TI-216, *Vegetation Communities Associated with the 100-Area and 200-Area Facilities on the Hanford Site*). The vegetation cover on the Central Plateau is predominantly a rabbitbrush-cheatgrass and sagebrush-cheatgrass association with incidence of herbaceous and annual species. Many areas are disturbed and nonvegetated or sparsely vegetated with annuals and weedy species such as Russian thistle. Potential ecological-contaminant exposures at the waste sites are minimized because of past site-stabilization activities. DOE/RL-2001-54 presents a more recent evaluation of habitats on the Central Plateau and provides a screening-level risk assessment, including an evaluation of threatened and endangered and new-to-science species that may be associated with the Central Plateau.

Existing characterization data and the proposed sampling and analysis activities (Phases 1 and 2) are expected to be sufficient to address potential impacts to human health and the environment. Results of the risk assessment will be presented in the RI report.

3.7 DEVELOPMENT OF CONTAMINANTS OF CONCERN

As part of the DQO process completed for process-waste pipeline systems (D&D-30262), a master list was prepared of all COPCs that could have been associated with the process-waste pipeline systems. This unconstrained or master list of COPCs was developed based on operational process information available for the facilities in the 200 Areas. This master list is presented in the DQO summary report (D&D-30262). The master constituent list was reduced by applying rationale to exclude those constituents that would not be needed for waste-site characterization. The exclusion rationale is presented below. In addition, based on waste-stream characteristics and the binning process developed in the DQO process, separate COPC lists were prepared for facility process-waste-stream pipelines and the tank-farm process-waste transfer lines. Although the waste streams share some common attributes and compositional similarities, separate lists were developed because of the sufficient differences and are presented here.

3.7.1 Use of Exclusion Rationale and Refinement of the Contaminants of Potential Concern

The rationale used in the DQO summary report (D&D-30262) for the process waste pipeline systems to exclude selected constituents from the comprehensive master COPC list is presented below. The COPCs in the following categories were excluded from further consideration in development of the COPC list proposed for characterization activities:

- Short-lived radionuclides
- Radionuclides that constitute less than 1 percent of the fission-product inventory, and for which historical sampling indicates nondetection
- Naturally occurring isotopes that were not created as a result of Hanford Site operations
- Constituents with atomic mass numbers greater than 242, which represent less than 1 percent of the actinide activities
- Progeny radionuclides that build insignificant activities within 50 years, and/or for which parent/progeny relationships exist that permit progeny estimation
- Chemicals that have no known carcinogenic or toxic effects
- Constituents that have been diluted, neutralized, and/or decomposed by high volumes of water discharged and/or the presence of acids and bases
- Chemicals that are unlikely to be present in toxic or high concentrations because of significant dilution during cooling water discharges
- Chemicals that are not persistent in the environment.

Because of known differences in process waste-stream attributes, separate COPC lists were developed for (1) the pipeline systems associated with those effluent wastes discharged from facilities to liquid-disposal waste sites and (2) the pipelines that handled process wastes sent to, transferred between, or transferred out of the tank farms. Comprehensive COPC lists were developed for both the facilities and the tank-farm waste-transfer pipelines to accommodate the diversity of waste-stream attributes associated with different stages of process operations. It was recognized that further refinement of these COPCs may be appropriate as characterization data become available. This project has elected to use general suite type analytical techniques, which yield results on many metal and organic compounds, providing a cost-effective approach for determining waste constituents.

3.7.2 List of Contaminants of Potential Concern for Facilities Process-Waste Pipeline Systems

Numerous characterization investigations have been conducted to date to determine contaminant levels at the process-waste disposal sites that received liquid effluent generated by the facilities

in the Central Plateau. The DQO process was conducted in conjunction with each of these waste-site investigations to determine the list of COPCs that would require analyses at these waste sites. For development of the 200-UR-1 OU DQO summary report, the COPC lists that had been prepared for the liquid-waste disposal sites were compiled, reviewed, and refined into one comprehensive list. Because this comprehensive list encompasses the COPC evaluation process conducted for the process waste-stream-based OUs, it was determined to be well suited for use in evaluating process-waste pipeline systems. The pipeline systems have been in contact with the same waste streams received by the disposal sites. This COPC list encompasses all constituents that are considered the primary target analytes for the laboratory analysis needed to characterize the facilities process-waste pipeline systems. Several additional analytes have been included with the original list at the request of Ecology. The facilities process-waste pipeline systems COPC list is presented in Table 3-3.

Table 3-3. Facilities Process-Waste Pipeline Systems Contaminants of Potential Concern. (2 Pages)

Radionuclide Constituents	
Americium-241	Niobium-94[a]
Carbon-14	Plutonium-238
Cesium-137	Plutonium-239/240
Cobalt-60	Strontium-90
Europium-152	Technetium-99
Europium-154	Tritium
Europium-155	Uranium-233/234
Neptunium-237	Uranium-235/236
Nickel-63	Uranium-238
Chemical Constituents – Metals	
Antimony	Lead
Arsenic	Mercury
Barium	Nickel
Beryllium	Selenium
Cadmium	Silver
Chromium	Uranium
Hexavalent Chromium	Vanadium
Copper	Zinc
Chemical Constituents – Other Inorganics	
Cyanide	Nitrate/nitrite
Fluoride	Sulfate
Chemical Constituents – Volatile Organics	
Acetone	Halogenated hydrocarbons
Acetonitrile	Hexane
Benzene	Methyl ethyl ketone
n-Butyl benzene	Methyl isobutyl ketone (MIBK)
1-Butanol (n-butyl alcohol)	Perchloroethylene
2-Butanone (MEK)	Tetrahydrofuran
Carbon tetrachloride	Toluene

Table 3-3. Facilities Process-Waste Pipeline Systems Contaminants of Potential Concern. (2 Pages)

Chlorobenzene	1,1,1 Trichloroethane (TCA)
Cis-1,2-dichloroethylene	1,1,2 Trichloroethane
Cyclohexane	Trans-1,2-dichlorotheylene
1,1-dichloroethane	Tetrachloroethylene (PCE)
1,2-dichloroethane	Trichloroethylene (TCE)
1,1-dichloroethylene	Vinyl chloride
Dichloromethane (methylene chloride)	Xylene
Ethylbenzene	
Chemical Constituents – Semivolatile Organics[d]	
AMSCO[b] tributyl phosphate dilutant	Normal paraffin hydrocarbon
Cyclohexanone	Polyaromatic hydrocarbons
Diesel fuel[c]	Paint thinner
Dodecane	Phenol
Hydraulic fluids (greases)	Polychlorinated biphenyls (and associated World Health Organization congeners)[e]
Kerosene	Shell E-2342 (naphthalene and paraffin)
Naphthylamine	Soltrol-170 ($C_{10}H_{22}$ to C_6 to H_{34}; purified kerosene)
Dibutylphosphate*	Tributyl phosphate and derivatives (mono, bi)
Monobutylphosphate*	Formate*
Oxalate*	Glycolate*

*Added to list as requested by the Washington State Department of Ecology (chelators or extractants used in processes).

[a] Contaminant of potential concern applicable to Plutonium Finishing Plant area only.

[b] Allen Maintenance Supply Company Inc.

[c] Analyzed as total petroleum hydrocarbons-diesel range; other total petroleum hydrocarbon analyses will include gasoline range.

[d] Trademarks and registered trademarks are the property of their respective owners. All product names mentioned are listed for contaminant potential only; such listing does not imply ownership and does not constitute endorsement.

[e] For polychlorinated biphenyls, 20 percent of analyses will include reporting congener concentrations. The specific congeners designated for analysis are identified in Appendix A, Table A-7.

As presented in Chapter 2.0, waste-stream characteristics varied within and between facilities, depending on the stage or phase of the extraction or recovery process. Waste streams were generated as the result of both direct-process operations (i.e., plutonium and uranium extraction) and indirect noncontact operations (i.e., steam condensate and cooling water). Therefore, not all of the COPCs identified in this comprehensive list of constituents are assumed to occur in every waste stream handled by the facilities process-waste pipeline systems. As analytical data become available following the sampling and analysis of the pipeline systems, further refinement of the COPC list may be appropriate. Use of the existing characterization data available for the liquid-waste disposal-site soils, and newly obtained data for the associated pipelines, are seen as a means of focusing or further refining the radionuclide and nonradionuclide analyte lists. With the characterization of pipeline systems being performed using a phased approach, refinement of the COPC list will be evaluated as appropriate, based on available data.

3.7.3 List of Contaminants of Potential Concern for Tank Farms Process-Waste Pipeline Systems

A separate DQO process has been completed that establishes the COPC list for residual process waste remaining in the SST tank farms following waste retrieval (RPP-23403, *Single-Shell Tank Component Closure Data Quality Objectives*). RPP-23403 was developed to ensure that appropriate data would be collected to support the component closure activities for all SSTs and to cover all sampling and analytical activities for that purpose. While RPP-23403 did not address soil sampling and analysis or any characterization actions associated with ancillary equipment, it did develop a comprehensive approach based on the use of analytical methods to ensure that the wide range of constituents potentially present in SSTs would be addressed. The approach used in RPP-23403 for identification of COPCs and determination of analytical requirements was incorporated into the DQO process completed for the process waste-transfer pipeline systems associated with the tank farms.

This strategy identifies specific or "primary" constituents (03-ED-009, "Hanford Facility Dangerous Waste Part A Permit Application Form 3, Revision 8, for the Single-Shell Tank (SST) System," Attachment: *Hanford Facility Dangerous Waste Part A Permit Application Form 3, Revision 8 for the Single-Shell Tank System*; and underlying hazardous constituents and radionuclides from 10 CFR 61.55, "Licensing Requirements for Land Disposal of Radioactive Waste," "Waste Classification") for analyses performed by selected analytical methods. Development of this primary constituent list is correlative in purpose and use to the COPC list that was prepared for the facilities process-waste pipeline systems. RPP-23403 also includes a strategy for reporting secondary constituents. Primary radionuclide, inorganic, and organic constituents identified for the tank-farm process-waste pipeline systems are presented in Table 3-4. In addition, dioxin-like polychlorinated biphenyl congeners will be analyzed using EPA Method 1668 (EPA/821/R-00/002, *Method 1668, Revision A: Chlorinated Biphenyl Congeners in Water, Soil, Sediment and Tissue by HRGC/HRMS*) on 20 percent of the samples per the test described in Appendix A. Not all of these constituents are assumed to occur in every waste stream handled by the tank-farm process-waste transfer pipelines. As analytical data gathered through the sampling and analysis of tanks and pipelines become available, further refinement of these analyte lists may be appropriate. Use of these characterization data as they become available is seen as a possible means of focusing or further reducing these analyte lists.

Table 3-4. Tank-Farms Process-Waste Pipeline Systems Constituents List. (3 Pages)

Radioactive Constituents	
Antimony-125	Nickel-63
Americium-241	Plutonium-238
Carbon-14	Plutonium-239/240
Cesium-137	Plutonium-241
Cobalt-60	Selenium-79
Curium-242	Strontium-90
Curium-243	Technetium-99
Curium-244	Thorium-228
Europium-152	Thorium-230
Europium-154	Thorium-232

Table 3-4. Tank-Farms Process-Waste Pipeline Systems Constituents List. (3 Pages)

Europium-155	Tin-126
Neptunium-237	Tritium
Nickel-63	Uranium-233/234
Iodine-129	Uranium-235/236
Neptunium-237	Uranium-238
Chemical Constituents – Metals	
Aluminum	Manganese
Antimony	Mercury
Arsenic	Molybdenum
Barium	Nickel
Beryllium	Selenium
Cadmium	Silver
Chromium III/ Chromium (total)	Strontium
Cobalt	Thallium
Copper	Uranium
Hexavalent Chromium	Vanadium
Iron	Zinc
Lead	--
Chemical Constituents – Other Inorganics	
Acetate	Nitrite
Cyanide (includes ferrocyanide)	Nitrogen in nitrate/nitrite
Fluoride	Oxalate
Formate	Sulfide
Ammonia (NH_3) or ammonium (NH_4)	Nitrite
Chloride	Nitrogen in nitrate/nitrite
Cyanide (includes ferrocyanide)	Sulfate
Fluoride	Sulfide
Nitrate	--
Chemical Constituents – Organic Cations	
Acetate	Glycolate
Formate	Oxalate
Chemical Constituents – Volatile Organics	
Acetone	1,1,1-Trichloroethane (TCA)
Benzene	1,1,2-Trichloroethane
Carbon disulfide	Tetrachloroethane; 1,1,2,2-
Carbon tetrachloride	Tetrachloroethene; 1,1,2,2- (PCE)
Chlorobenzene	Toluene
Chloroform (trichloromethane)	trichloro-1,2,2-trifluoroethane; 1,1,2-
1,2-Dichloroethane	Butanol; n- (n-butyl alcohol)
1,1-Dichloroethylene	Isobutyl alcohol (Isobutanol)
Dichloromethane (methylene chloride)	methylphenol; 2,6-Bis(tert-butyl)-4-

Table 3-4. Tank-Farms Process-Waste Pipeline Systems Constituents List. (3 Pages)

Dichloropropene; 1,3,- (trans-)	Trichloroethylene (TCE)
Ethyl acetate	Trichlorofluoromethane
Ethyl ether	Vinyl chloride
Ethyl benzene	Xylenes
Methyl isobutyl ketone (MIBK hexone)	Xylene; m-
Methyl ethyl ketone (MEK)	Xylene; o-
Nitropropane; 2-	Xylene; p-
Chemical Constituents – Semivolatile Organics	
Acrylic acid*	Nitrophenol; o-
Acetonitrile*	Nitroso-di-n-propylamine; N-
Cyclohexanone	1,2,4 - Trichlorobenzene
Hexachloroethane	Nitrosomorpholine; N-
Acenaphthene	Pyrene
Bis-2-ethylhexyl phthalate (Dioctylphthalate)	Pyridine
Butylbenzylphthalate	Trichlorophenol; 2,4,5-
Butadiene;1,3-*	Trichlorophenol; 2,4,6-
Chlorophenol; 2-	Tributyl phosphate
Cresol; m + p (3- and 4-Methylphenol)	Dibutyl phosphate*
Cresol; o- (2-Methylphenol)	Monobutyl phosphate*
Cresylic acid (cresol, mixed isomers)	Benzo (a) anthracene*
Dibutylphthalate (Di-n-butylphthalate)	Benzo (b) fluorathene*
Di-n-octylphthalate	Benzo (k) fluorathene*
Dichlorobenzene; 1,2- (ortho-)	Benzo (a) pyrene*
Dinitrotoluene; 2,4-	Chrysene*
Ethoxyethanol; 2-	Dibenzo (ab) anthracene*
Fluoranthene	Indeno (123-cd) pyrene*
Hexachlorobutadiene	Aroclor 1016 [a]
methylphenol; 4-Chloro-3- (p-Chloro-m-cresol)	Aroclor 1221
Naphthalene	Aroclor 1232
n-nitrosomethyl amine*	Aroclor 1242
n-nitrosomethylethyl amine*	Aroclor 1248
Trimethylamine*	Aroclor 1254
Nitrobenzene	Aroclor 1260

*Additional analyte added as requested by the Washington State Department of Ecology (constituent detected in tank vapor samples).

[a]Aroclor is an expired trademark.

4.0 WORK PLAN APPROACH AND RATIONALE

4.1 SUMMARY OF DATA QUALITY OBJECTIVES PROCESSES FOR THE 200-IS-1 OPERABLE UNIT

The RI needs for assessing potential human-health and environmental impacts from the process-waste pipeline systems in the 200-IS-1 OU were developed in accordance with EPA/600/R-96/055, *Guidance for Data Quality Objectives Process*, EPA QA/G-4. This guidance has since been superseded by 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 used to develop data-collection strategies consistent with data uses and needs. Additional data needs to support the assessment of potential ecological impacts are being evaluated through a separate Central Plateau Ecological Risk DQO process (WMP-20570, WMP-25493, and WMP-29253).

The DQO process for the 200-IS-1 OU was implemented by a team of subject-matter experts who contributed to the development of the characterization and data-gathering approach outlined in the 200-IS-1 OU DQO summary report (D&D-30262). The participants provided input on project objectives, regulatory issues, operational history, and the sampling and analysis approach. The DQO process and the involvement of the team of experts and decision makers provide a high degree of confidence that the key information and data-collection requirements are identified in support of remedial decisions concerning the 200-IS-1 OU.

In the DQO process, it was recognized that the technical and regulatory approach would need to include requirements for both (1) the pipelines associated with process-operations facilities and liquid-waste disposal sites and (2) the tank-farm pipelines, diversion boxes, and associated waste sites located outside of the WMAs that are part of the SST and DST waste-transfer infrastructure. Addressing both of these groups of pipelines and related structures resulted in the development of separate lists for COPCs (discussed in Chapter 3.0), tailored characterization strategies specific to each group, and a comprehensive integrated approach to fulfill RCRA and CERCLA regulatory requirements.

Recognizing both the differences and commonality between certain process-waste streams handled by the pipeline systems, a strategy for grouping or binning of pipelines by shared common chemical-waste-stream attributes was identified as a logical strategy for use in the characterization approach. This grouping or binning logic is based on shared characteristics of the waste streams carried by each group of pipelines. The groups or bins of process-waste pipelines encompass all potential waste-stream and pipeline conditions. Selected pipelines in each process-waste bin will be identified for characterization.

The DQO processes undertaken for the 241-CX-72 Storage Tank, including determining sampling objectives and approach, were based on previous input provided in Revision 0 and Revision 1, Draft A, of this document (DOE/RL-2002-14, Appendix B). Recent consideration of proceeding with closure actions for this tank, which included a review of existing tank-content

data, resulted in identifying the need to collect analytical data characterizing the remaining waste contents.

4.1.1 Approach for Data Collection and Decision Making

The approach for data collection identified in D&D-30262 for the pipeline systems was to prepare separate characterization plans and implement separate characterization activities for those pipeline systems that are associated with 200 Areas facilities process operations and those pipelines that are part of the tank farms waste-transfer operations. Characterization results will be used as needed to address those regulatory-data requirements that apply to each set of pipelines. General data-collection uses and needs, along with the requirements for quality and quantity of data, that are applicable to both sets of pipelines, are presented in the following sections. Those activities or other elements that are specific to tank-farm lines and appurtenances are identified separately. Discussion pertaining to the 241-CX-72 Storage Tank is presented independently of the pipelines.

The primary objectives of the DQO process for the process-waste pipeline systems include the following.

- Determine the environmental measurements necessary to support the RI/FS process and remedial decision making.
- Identify data needed for development of the RI/FS work plan and SAP.
- Identify evaluation and preliminary-remediation strategies that are inclusive of both RCRA and CERCLA requirements for the 200-IS-1 OU pipelines.
- Develop preliminary conceptual contaminant-distribution model(s) that reflect the physical characteristics of the process-waste pipeline systems and surrounding soil and the anticipated distribution of contaminants. Data collection will support refinement of the model(s).

During the DQO process, tank-farm waste-transfer lines and appurtenances and associated soils were identified for field investigations and sampling during RI activities. A two-phase sampling approach, with different data-collection objectives and requirements for each phase, was identified for the process-waste pipeline systems. Appurtenances will be characterized beginning with the Phase 2 investigation. This does not preclude the potential for further sampling, should this be required for remedial alternative analysis post-Phase 2 data collection.

4.1.2 Data Acquired for Process-Waste Pipeline Systems

4.1.2.1 Data Uses

Data collected during the RI will be used for several purposes, including (1) determine if the process-waste pipeline systems are contaminated above remedial action levels, (2) support an initial evaluation of potential human-health and environmental risks, (3) support the evaluation of remedial alternatives and/or closure strategies, and (4) verify or refine the preliminary conceptual contaminant-distribution models, and (5) identify the need for treatability studies.

Phase 1 sampling will gather data to determine if waste residue within the interior of a pipeline or in the soil around a pipeline is contaminated at concentrations above preliminary cleanup levels. These data will be used to decide if additional Phase 1 sampling is required, if Phase 2 sampling should be initiated, or if the data are sufficient to select and implement a remedial action (other than the no-action alternative).

Phase 2 sampling will be used for evaluation of those pipelines and associated structures where there is considerable uncertainty concerning whether contamination exceeds action levels. Proceeding directly to Phase 2 sampling would be appropriate for those pipelines where existing information indicates that contamination will not be present and/or where considerable variability exists in results. Phase 2 sampling will be required if all remedial alternatives need to be assessed, including the no-action alternative. Phase 2 sampling requires a larger data set for decision making.

Determination of the lateral and vertical extent of contamination in soil surrounding the pipelines will be evaluated using the data gathered by geophysical logging in addition to soil-sampling results. If deep contamination is indicated (potentially extending to groundwater) after initial data gathering, subsequent evaluations (Phase 2) will include plans for vadose-zone soil sampling and analysis to be completed to groundwater.

4.1.2.2 Data Needs

For most of the process-waste pipeline systems, information is available concerning location, construction design, and type of waste received or distributed through the structure. However, specific site conditions, such as residual contaminant levels inside pipelines or diversion boxes, extent of releases to surrounding soils, and current concentrations or activities for those contaminants that may be present, has not been determined for most of the pipeline systems. Data are needed to support a risk evaluation, based on exposure to radionuclides and nonradionuclide constituents and an assessment of impact to groundwater, using modeling to simulate fate and transport of contaminants through the vadose zone. These data and evaluations are needed to support remedial decision making for the process-waste pipeline systems. While pertinent existing information was used to develop the general conceptual contaminant-distribution models for the pipeline systems, data also are needed to verify and/or refine the contaminant-distribution model and conceptual exposure-pathway model.

4.1.2.3 Data Quality

Data quality was addressed during the DQO process. Analytical performance criteria were established by evaluating potential applicable or ARARs and preliminary remediation goals, which are regulatory thresholds and/or standards or derived risk-based thresholds. These potential ARARs and preliminary remediation goals represent chemical-, location-, and action-specific requirements that must be met to protect human health and the environment. Regulatory thresholds and/or standards, or preliminary cleanup levels, provide the basis for establishing analytical performance levels (i.e., laboratory detection-limit requirements).

Detection-limit requirements and standards for precision and accuracy are used to define data quality. To provide the necessary data quality, detection limits should be lower than preliminary cleanup levels. Additional data quality is gained by establishing 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 SAPs for the pipeline systems (Appendices A and B). Analytical performance requirements are specified in the DQO summary report (D&D-30262).

4.1.2.4 Data Quantity

Data quantity refers to the number of samples collected. For Phase 1, the number of samples needed to refine the site conceptual model and make remedial decisions 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 and the expected behavior of the COPCs. This sampling approach is defined in Section 6.2.2 of the Implementation Plan (DOE/RL-98-28). Using this approach, sampling locations can be selected that increase the chance of encountering contamination.

Sample locations for pipelines are based on the preliminary conceptual models of contaminant distribution presented in the DQO summary report (D&D-30262). For Phase 1, two pipelines in each of the process-waste stream bins (Bins 1-5) were identified for sampling and analysis. The locations selected for sampling were based on a goal of intersecting potential areas of contamination and to determine the type and extent of contamination at different points along a pipeline. Soil-sample locations adjacent to pipelines were biased toward known or suspected release locations. Release locations are indicated by soil contamination in the vicinity of the pipeline, as documented in radiological survey reports provided in WIDS, and by radiological signs and fenced areas present in the field. If no known contaminated-soil areas are present along a pipeline selected for sampling, potential leak locations such as pipe bends and junctions were selected. This biased sampling approach was designed to provide the data needed to meet DQO for Phase 1.

The Phase 1 pipeline SAPs (Appendices A and B) define specific data quantity requirements based on pipelines to be sampled, geographic location of the sample, access limitations, and current information available about contamination at the sample site. Following review of the initial Phase 1 sampling results, additional sampling may be specified.

Phase 2 SAPs will be developed based on historical knowledge and Phase 1 sampling results. Phase 2 SAPs will be developed separately for Bin 1-5 pipelines and Bin 6 pipelines. Data

quantity for pipelines identified for Phase 2 data collection will require a sufficient number of samples so that a statistical data evaluation can be completed. Calculation of a 95 percent upper confidence level of the mean will be determined using the Phase 2 analytical results. Sample quantities will be defined in the Phase 2 SAPs.

4.1.3 Data Acquired for the 241-CX-72 Storage Tank

4.1.3.1 Data Uses

Analytical data from samples collected from the residual waste in the 241-CX-72 Storage Tank will be used to determine the composition and concentrations of radionuclides and nonradionuclides in the remaining waste. Analytical results will support closure decisions and RCRA waste reporting requirements.

4.1.3.2 Data Needs

Characterization data are needed from the 241-CX-72 Storage Tank to determine the composition of residual waste. The data are required to determine health and safety requirements, waste codes, and disposal-path options. The waste analyses are needed to support the closure decision for the tank and RCRA reporting requirements.

4.1.3.3 Data Quality

Analytical performance criteria for analysis of residual waste in the 241-CX-72 Storage Tank were established by evaluating potential ARARs and preliminary remediation goals. Detection-limit requirements and standards for precision and accuracy are used to define data quality. To provide the necessary data quality, detection limits are defined that are lower than preliminary cleanup levels. These requirements are discussed in detail in the SAP for the 241-CX-72 Storage Tank (Appendix C).

4.1.3.4 Data Quantity

Four samples will be obtained for analysis of the contents of the 241-CX-72 Storage Tank. The sampling objective is to determine concentrations of radionuclide and nonradionuclide constituents in the tank. Two discrete samples will be taken from within the grout overlying the waste material to determine if mixing with the waste has occurred. Two discrete samples will be collected within the 3.4 m (11-ft)-thick layer of residual waste to evaluate potential stratification in content and concentrations. One sample will be collected near the top and one near the bottom of the remaining waste.

4.2 CHARACTERIZATION APPROACH

This section provides an overview of the characterization approach that will be used for collecting the data identified in the DQO process. Characterization activities include evaluation of the interior of pipelines and adjacent vadose-zone soil. Within the interior of pipelines, samples of residual waste in the form of sediment, sludge, or scale will be collected. For the

vadose-zone soil, sampling and geophysical logging using spectral and gross-gamma, passive-neutron, and active-neutron (moisture) detectors will be performed. Direct-push technology (e.g., GeoProbe[1] or equivalent equipment) will used for vadose-zone soil sampling and to provide access for geophysical logging. Sample analysis will be conducted by a laboratory under a contract-required quality program. The sampling strategy is designed to provide focused evaluations on potentially contaminated locations and media inside the pipelines and in adjacent subsurface soils where leakage may have occurred. Samples will be collected within pipelines if sufficient residual waste material is present. Selection of samples in soils used for laboratory analysis will be guided by field-screening results. Field-screening results will assist in identifying the sample depths where the most extensive contamination occurs.

Before intrusive activities are implemented, surface geophysical and radiation surveys will be conducted at all sampling locations. The one exception is the 241-CX-72 Storage Tank. Geophysical surveys are not necessary to obtain a sample. The surface geophysical surveys will be conducted using ground-penetrating radar and/or electromagnetic induction and will aid in verifying buried pipeline locations, other buried utilities, and subsurface anomalies. Surface radiation surveys will identify areas of surface contamination that might impact the intrusive activities and health and safety requirements.

Characterization of the pipeline systems will be conducted in two phases. Phase 1 activities will be a combination of intrusive and nonintrusive activities. This phase consists of biased sampling that targets specific pipelines and specific locations in and around the pipelines. If known or suspected areas of waste accumulation cannot be identified, then pipelines and surrounding soil locations are selected randomly. Evaluation of the Phase 1 sampling data will be used to determine the current contaminant conditions inside the pipelines and in adjacent soils. The Phase 1 SAP for the facility process-waste pipelines is included in Appendix A. The Phase 1 SAP for the tank-farm waste-transfer pipelines is provided in Appendix B. The specific pipelines selected for investigation as part of Phase 1 are identified in each SAP.

Phase 2 characterization activities will be initiated if there is considerable uncertainty concerning whether contamination above a preliminary cleanup level is present. The Phase 2 investigation will be initiated if Phase 1 results show a range of concentration values that are below, both above and below, or close to preliminary cleanup levels. Phase 2 sampling will be required if all remedial alternatives need to be assessed, including the no-action alternative. Phase 2 will require a larger data set for decision making. The Phase 2 evaluation will entail more extensive sampling and laboratory analyses. Phase 2 data will support development of decision documents and completion of the RI/FS processes. Selection of pipelines for Phase 2 sampling will be made after Phase 1 results have been reviewed.

Information regarding the current condition of tank-farm waste-transfer pipeline appurtenances (e.g., catch tanks, diversion boxes, valve pits) is limited. These components have a higher degree of complexity with regard to access and sampling for conducting characterization. This complexity does not make these components amenable to the Phase 1 characterization. Based on the results of Phase 1 for the tank-farm waste-transfer pipelines systems, the DQO report

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[1] GeoProbe is a registered trademark of GeoProbe Systems, Salina, Kansas.

(D&D-30262) may be revised to address these components, or an existing approved SAP will be identified and modified, as needed, to support Phase 2 data collection and characterization requirements for the tank-farm appurtenances.

A biased sampling approach will be used for sample collection in the 241-CX-72 Storage Tank. Samples will be taken from within the grout cap and from the residual waste that underlies the grout.

4.2.1 Characterization of Pipeline Systems

The following discussion outlines the approach that will be used to optimize the collection of data and determine which samples will be selected for laboratory analyses. The investigation of the pipelines and collection of data will be completed using a systematic sequence of steps. Data results will be reviewed at selected points in the process to determine the subsequent actions to be taken. Integration of the activities associated with collection of data and samples in the interior of the pipelines and in the surrounding soil is included in this approach. A description of the data collection steps is presented below.

The site investigation steps are as follows.

1. Conduct surface geophysical surveys at the proposed pipeline-investigation location if needed to verify the exact position of the pipeline, and to determine whether undocumented buried utilities or subsurface anomalies are present in the immediate area.

2. Identify and stake the locations adjacent to the buried pipeline where subsurface soil sampling will occur. All pipeline locations where intrusive activities will be conducted will have two direct-push installations completed. The direct-push locations will be positioned as close to the pipeline as possible, with a lateral distance not to exceed 3 m (10 ft) from each side of the pipeline. Specific conditions such as interfering buried utilities or high-exposure hazards may warrant adjusting locations in some instances.

3. Geophysical logging will be conducted at each direct-push location. The logging suite will consist of gross gamma, spectral gamma, passive neutron, and active neutron. Logging results should be reviewed before any subsequent activities are initiated. Radiological logging data will be used for several purposes, depending on the location.

   - <u>At pipeline locations requiring excavation to gain access for interior pipe sampling:</u> Logging results should be reviewed prior to excavating soil and exposing pipelines for collecting interior samples. Dose and radiological levels determined by logging will be reviewed to determine the potential-worker level of protection, site controls, and waste-handling requirements. Alternate sampling locations can be used if existing site conditions restrict proposed subsequent activities.

   - <u>At pipeline locations identified for soil sampling:</u> Logging results will provide information on the vertical distribution of radionuclide activity and concentration data for major gamma-emitter radionuclides (e.g., Cs-137) in proposed sample intervals. These results will be used in the selection of the sample interval for laboratory

analysis. Dose and radiological levels determined by logging will be reviewed to determine the potential-worker level of protection, site controls, and waste-handling requirements. Alternate sampling locations can be used if existing site conditions restrict proposed subsequent activities.

4. Conduct soil sampling at designated locations along the pipeline. A direct-push dual tube sampling system will be used to collect samples from designated intervals. Soil-sample material will be used initially to conduct field-screening analyses. Target constituents or classes of compounds (e.g., nitrate, mercury, polyaromatic hydrocarbons, polychlorinated biphenyls, hydrocarbons, volatile organic compounds) identified for field screening will be based on available process information and analytical results (if available) for the pipeline and the disposal site connected to the pipeline. All designated sample intervals will have samples analyzed by field-screening techniques. At a minimum, one sample per sampling location will be used for laboratory analyses. Field-screening results will be used to select the sample for laboratory analysis. The sample interval with the overall largest number of positive detections by field screening at the highest levels will be used for laboratory analysis of COPCs. Based on the results of field screening and as directed by the remediation task lead or designated field personnel, additional samples may be obtained for laboratory analysis.

5. Perform interior-pipeline sample collection at locations that do not require excavation for access. Locations with easier access, such as manholes and sampler pits, will be evaluated initially. Limited sampling material (sediment, sludge, or scale) may be available. If sufficient material is available for use of field-screening test kits and laboratory analysis, both will be performed. If not, only instrument field screening will be conducted (i.e., radiological meters and organic vapor analyzer). If radiological screening levels (gamma, beta, and/or alpha) are greater than three times background, available sample material will be allocated to radiological constituents. In the second tier of screening assessment, if volatile organic compound screening results are greater than 1 ppm, as measured with the hand-held organic vapor analyzer, additional material will be used for analysis of organic constituents (volatile organic compounds, semivolatile organic compounds, and other organics). If volatile organic compound levels are less than 1 ppm, available sample material will be used for inorganic analysis (e.g., metals, nitrates, and other inorganic constituents).

6. Pipelines requiring excavation to gain access for interior sample collection will be evaluated last. These locations potentially pose the greatest logistical concerns. Test-pit excavations to expose the pipe section may involve using sloping, shoring, or trench boxes. The specific configuration of the pipe location and the anticipated hazards will be considered in selecting the technique. Excavated soil will be field screened with radiological instrumentation and an organic vapor analyzer during the removal process to determine if contamination is present. Additional field-screening analyses may be performed (e.g., using test kits) based on results of instrument screening and visual observations (e.g., soil discoloration or staining).

7. Exposed pipelines initially may be screened remotely with instrumentation attached to the excavator to determine radiological activity. Liquid waste could be present inside

some pipeline locations selected for sampling. An opening in the top of the pipe will be completed to assess whether liquid is present. A plan for handling released liquids, including notification to regulatory authorities within 24 hours will be developed. Pipe sampling may need to be conducted outside of the excavation, to limit worker risks during this operation. A section or sections of pipe, not to exceed 3.0 m (10 ft) in length, will be removed from the excavation and accessed to acquire sample material. When limited sample material is available, the process described in step 5 will be followed.

4.2.2 Analysis of Pipe Interiors

Inspection of the interiors of pipelines will be conducted at specified locations. Evaluations will include both visual inspections and sampling activities. Inspections will be used to determine if breaks, breaches, or cracks occur in the pipeline; to determine if there is residual waste causing blockage along a pipeline segment; and to characterize the residual waste, if present. Visual inspections will be conducted directly or remotely, depending on access availability and a hazard assessment. Pipeline-interior evaluations may include camera surveys, radiological monitoring, and sampling. Those evaluations or analyses that are applicable for Phases 1 or 2 are identified below. Specific characterization activities that will be used in Phases 1 and 2 are identified in the SAPs.

4.2.2.1 Visual Inspections and Camera Surveys

Examination of the interior of pipelines will be performed using a camera only for selected pipeline segments where access is available and exposure hazards are manageable. This investigative technique will provide real-time information on the current conditions within buried pipelines. Camera surveys/inspections will be used for several purposes. For those pipelines where leakage has been verified to have occurred, a camera survey will be used to assess the locations and the number of release points along certain segments. Areas where leakage has occurred will be visible as cracks, breaks, or gaps in pipe connections. Additional conditions such as the extent of corrosion, debris, or waste residue present also will be noted. Camera surveys also will be used to document pipelines that are fully intact, open and dry, and show no signs of past failure or leakage. Camera surveys currently are planned only for use during Phase 2 for Bins 1-5.

4.2.2.2 Handheld and Deployed Instrument Radiological Surveys

Radiological surveys of pipeline interiors will be used to provide information concerning the presence or absence of residual 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 will be presented in the SAP(s).

4.2.2.3 Sampling Pipe Scale, Sediment, or Sludge (Field Screening and Laboratory Analyses)

Residual build-up of scale, sediment, or sludge may be present in the interiors of some pipelines. Sampling and analysis of this material will be required to determine constituent composition for risk calculations, remedial decisions, and/or disposal considerations. Grab samples will be collected, depending on the evaluation and constituent of interest.

4.2.3 Surface Geophysical Techniques for Pipeline Evaluations

Several geophysical techniques are available and will be used as needed to gather information on buried pipelines. 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*.

4.2.3.1 Magnetometry

Magnetometers permit rapid, noncontact surveys to locate buried metallic objects or features. This technique is applicable for use with buried metal pipelines. 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; they measure gradient or 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.

4.2.3.2 Ground-Penetrating Radar and Electromagnetic Induction

Surface geophysical surveys using ground-penetrating radar (GPR) and electromagnetic-induction techniques will be used to verify the locations of pipelines as needed. GPR uses a transducer to transmit frequency-module 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 electromagnetic-induction technique is a noninvasive 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 electromagnetic-induction 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.

4.2.3.3 Resistivity

The resistivity method is based on the capacity of earth materials to conduct electrical current. Earth resistivity is a function of soil type, porosity, moisture, and dissolved salts. The concept behind applying the resistivity method is to detect and map changes or distortions in an imposed electrical field that are caused by heterogeneities in the subsurface. Resistivity is a volumetric property measured in ohm-meters. Because it is not possible to know the exact volume of the mass of earth being measured under field conditions, readings are in terms of apparent resistivity. Field data are acquired using an electrode array. A four-electrode array employs an electric current injected into the earth through one pair of electrodes (transmitting dipole) and measuring the resultant potential by the other pairs (receiving dipole). High-resolution resistivity methods generally employ a "pole-pole" array. For a pole-pole array, the two rover or "active" electrodes are incrementally spaced from 5 to 400 m apart. This geophysical technique may be useful in delineating the extent of a liquid release(s) associated with some pipelines that have leaked.

4.2.4 Evaluation of Associated Soils

Investigations for the presence of contaminants in the soils surrounding pipelines will be conducted using both indirect and direct evaluation techniques. Subsurface investigations will include geophysical logging and soil sampling.

4.2.4.1 Direct-Push Investigative Techniques

Subsurface investigations using direct-push installations will be employed as part of the assessment for soil surrounding selected pipeline locations. 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 and soil moisture. Discrete sample intervals will have soil collected for field screening and laboratory analyses. This technology will work well in the unconsolidated sediments and fill material adjacent to buried pipelines.

4.2.4.2 Geophysical Logging Through Direct-Push Casing

Radioactivity levels will be measured in soils using geophysical logging instrumentation. Radioactive contamination generally is expected to be primarily represented by gamma emitters (e.g., Cs-137). Driven small-diameter casing will be installed and used for down-hole logging with gamma-logging tools. The depth of a driven casing will be limited by the subsurface conditions (e.g., cobbles, gravel). Gross-gamma and passive-neutron logging probes will be used to determine areas of potentially high Am-241 and Pu-239/240 concentrations. The small-diameter gross-gamma and passive-neutron probe system uses bismuth-germanium detector instrumentation for gross 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.

4.2.4.3 Analysis of Soil (Field Screening and Laboratory Analyses)

Soil samples will be collected for nonradiological and radiological analysis. The list of analytes for laboratory analysis was developed based on an evaluation of all potential contaminants. Development of this list of COPCs is presented in the DQO summary report (D&D-30262). The SAPs (Appendices A and B) provide details regarding the analytical methods and holding times for each contaminant. Designated soil samples will be analyzed for the complete list of COPCs.

Field-screening techniques will be used as part of the soil-sample collection process to determine which samples to use for laboratory analyses. Soil will be obtained for use in screening from four sample intervals from each direct-push hole. Screening analyses for radiological and nonradiological constituents will be performed. Target constituents for screening will be identified based on the process information and disposal-site data associated with the pipeline being evaluated. Soil from the sample interval with the greatest number of positive detections at the highest values will be used for laboratory analysis of the complete list of COPCs. The specific pipelines identified for sampling in each SAP (Appendices A and B) have accompanying information supporting the selection of the target constituents for which screening analyses will be performed.

4.2.5 Test-Pit Excavations

Test-pit excavations will be used to expose sections of those buried pipelines selected for interior sample collection. Test-pit excavations to expose the pipe section may involve sloping, shoring, or trench boxes. The specific configuration of the pipe location and the anticipated hazards will be considered in selecting the technique. Excavated soil will be field screened with radiological instrumentation and an organic vapor analyzer during the removal process to monitor contaminant levels and determine worker-protection requirements. Excavated soil removed to expose and examine the pipeline will be returned to the hole following sampling activities.

4.2.6 Characterization of the 241-CX-72 Storage Tank

4.2.6.1 Drilling and Sampling

The drilling technique for sample collection from the 241-CX-72 Storage Tank will be selected to accommodate health and safety requirements for the drilling crew, site geologist, and other support personnel on site. The properties of matrixes to be drilled, grout and semi-consolidated radioactive sludge, and worker-exposure concerns will require a tailored drilling configuration. Core drilling without the use of liquids currently is anticipated.

4.2.6.2 Field Screening

Cuttings, cored material, and the sludge samples will be field screened with radiological instrumentation. Dose and count data will be collected for gamma, beta, and alpha-emitting radionuclides.

4.2.6.3 Laboratory Analyses

Samples will be analyzed for the complete list of radiological and nonradiological COPCs identified in the SAP (Appendix C).

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5.0 REMEDIAL INVESTIGATION/FEASIBILITY STUDY PROCESS

This chapter describes the RI/FS (investigation/assessment) process for the 200-IS-1 OU pipeline systems. Included in this description of RI/FS activities for the 200-IS-1 OU is the CX Tank System and HSTF units. The development of and rationale for the RI/FS process is provided in DOE/RL-98-28. The process follows the CERCLA remedial-documentation process, with modifications to satisfy the requirements specific to RCRA TSD units undergoing remediation and RPP waste sites undergoing closure. Section 5.1 summarizes the integrated regulatory process for CERCLA and RCRA. Section 5.2 outlines the activities to be completed during the RI phase. Section 5.3 summarizes the evaluation of Phase 1 data. Section 5.4 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 concerning the nature and extent of contamination associated with the waste sites, contaminant concentrations, 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 Phases 1 and 2 of the pipeline-systems evaluation will be used to support these analyses. Phase 1 characterization activities for the pipeline systems are described in the SAPs included in Appendices A and B of this work plan. The results of Phase 1 will be reviewed before the Phase 2 SAP(s) are developed. Data-collection objectives for Phase 2 were identified in the DQO process (D&D-30262) and are discussed in Chapter 4.0 of this work plan. Tasks to be completed following the RI include preparation of an FS with applicable RCRA TSD unit closure plan(s) (Section 5.5). The FS and closure plan(s) will evaluate remedial closure alternatives and recommend a preferred alternative. A proposed plan and proposed RCRA Permit (WA7890008967) modification for RCRA TSD units will be issued to the public for review and comment. Once the public-review process has been completed, the decision on the remedies selected for 200-IS-1 OU waste sites will be documented in a ROD and RCRA Permit modification (as appropriate) (Section 5.6).

Project management occurs throughout the RI/FS process. Project management is used to direct and document project activities so that the objectives of the work plan are met and the project remains within budget and on schedule. The initial project management activity will be to assign individuals according to roles established in Section 7.2 of DOE/RL-98-28. Other project-management activities include 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; and community relations.

DOE/RL-98-28, Appendix A, provides the overall quality assurance framework that was used to prepare an OU-specific quality assurance project plan for the RI. DOE/RL-98-28, Appendix B, includes a review of data-management activities that apply to the RI and describes the process for the collection/control of data, records, documents, correspondence, and other information associated with RI/FS activities.

5.1 INTEGRATED REGULATORY PROCESS

An important part of the Tri-Party Agreement (Ecology et al., 1989a) is the integration of RCRA corrective-action and CERCLA remedial-action activities whenever practicable. In the Tri-Party Agreement, the "Parties intend to integrate DOE's CERCLA response obligations and RCRA corrective action obligations which relate to the release(s) of hazardous substances, hazardous wastes, pollutants and contaminants covered by this Agreement. Therefore, the Parties intend that activities covered by Part Three of this Agreement will achieve compliance with CERCLA, 42 U.S.C. Section 9601 et seq.; will satisfy the corrective action requirements of the HWMA, Sections 3004(u) and (v) of RCRA, 42 U.S.C. Section 6924(u) and (v), for a RCRA permit, and Section 3008(h), 42 U.S.C. Section 6928(h); and will meet or exceed all applicable or relevant and appropriate federal and state requirements to the extent required by Section 121 of CERCLA, 42 U.S.C. Section 9621."

The 200-IS-1 OU consists of RPP waste sites and RCRA TSD units and components (e.g., 241-CX-70 Storage Tank, 241-CX-71 Neutralization Tank, and 241-CX-72 Storage Tank; and the SST pipelines and diversion boxes). The final disposition of the TSD tank-farm components (i.e., RCRA-regulated pipelines and diversion boxes) will have to meet both CERCLA remedial-action and RCRA TSD closure requirements. Integrating RCRA corrective actions and CERCLA remedial actions allows for the integration of cleanup options for disposal, closure, removal, and/or remedial actions. By allowing flexibility in final-disposal options, DOE, Ecology, and the EPA intend to minimize disposal costs to the extent possible while remaining fully protective of human health and the environment.

An integration of CERCLA RI/FS work-plan and HWMA RI/FS work-plan requirements was used to develop this RI/FS work plan, which satisfies the content requirements of both regulations. This work plan provides RCRA TSD unit closure-plan information such as facility description, location, and process information (Section 2.1), waste characteristics (Section 3.4), and groundwater monitoring (Section 3.2). Following completion of the work plan, the RI will be conducted, which will satisfy the requirements for an RFI and will provide the data needed to support the selection of a closure strategy for RCRA TSD units, components, and ancillary equipment. The RI will include an evaluation of 200-IS-1 OU RPP waste sites and the TSD units, components, and ancillary features.

Concurrent with completion of the RI report, the remedial alternatives and closure strategies will be evaluated and compared against performance standards. The integration process for the evaluation-of-remedial-alternatives phase of the RI/FS process includes preparing a CERCLA FS, which evaluates remedial alternatives, and a proposed plan that contains the preferred remedial alternative. These documents will satisfy the requirements for a CMS report and a RCRA TSD unit closure plan. The recommended alternative, which generally is included in the CMS, is in the proposed plan under CERCLA. The FS also will include a section that provides corrective action recommendations for RPP sites. Additional discussion of the FS/closure plan work scope is provided in Section 5.5.

The RCRA closure options (i.e., landfill, clean closure, and alternative as provided in WAC 173-303-610[1][e]) will be integrated with the CERCLA options and based on the alternative selected and the amount of cleanup that can be accomplished by the alternative. Landfill closure

under RCRA will include the construction of an engineered barrier over the unit and equates to what typically is termed as a "containment alternative" under CERCLA. A modified closure option includes alternatives that leave contaminants in place above WAC 173-340-740, Method B cleanup standards in soil, debris, or groundwater (WAC 173-340-740(3)(b)(iii)(A), "Method B Soil Cleanup Levels for Unrestricted Land Use," "Standard Method B Soil Cleanup Levels," "Human Health Protection," "Ground Water Protection"; WAC 173-303-610(2)(b)(ii), "Closure and Post-Closure"; WAC 173-340-740(3)(b)(iii)(B), "Method B Soil Cleanup Levels for Unrestricted Land Use," "Standard Method B Soil Cleanup Levels," "Human Health Protection," "Soil Direct Contact"). A clean-closure option requires that all contaminated material and media be removed and decontaminated to levels below WAC 173-340-740, Method B, unrestricted use standards.

The lead regulatory agency (Ecology) will prepare the CERCLA ROD following completion of the public-involvement process for the proposed plan, which, after signature by the signatories to the Tri-Party Agreement, will authorize the selected remedial action. The closure decisions for the RCRA TSD units that were contained in the CERCLA proposed plan and ROD will be administratively documented in the Hanford Facility RCRA Permit (WA7890008967). The DOE will issue a letter declaring that the closure of the RCRA TSD units/components is finished, once the selected remedies have been implemented and a closure certification has been prepared and attached to the letter. The modification of the Hanford Facility RCRA Permit will consist of adding a section that will include an explanation stating that the required closure information is included in the CERCLA documentation. Additional discussion concerning the proposed plan/proposed RCRA Permit modification is provided in Section 5.6, with Section 5.7 providing additional detail relating to post-ROD and/or permit modifications and postclosure activities.

For the implementation phase, the remedial-design report/remedial-action work plan will contain the required information concerning verification sampling and design of the remedies for the CERCLA waste sites and the RCRA TSD units/components. Finally, the operations and maintenance plan will contain the information, if needed, for surveillance, inspections, monitoring, etc., for the remedies implemented for the CERCLA waste sites and RCRA TSD units/components with contamination left in place. If postclosure requirements are needed for the RCRA TSD components for waste left in place, then a section will be added to the Hanford Facility RCRA Permit to include a statement that postclosure information is included in the CERCLA documentation.

During the CERCLA remedial-action process, there may be an opportunity to implement a remedy for a certain category of waste sites by performing a removal action separate from the remedial action for the 200-IS-1 OU. This removal action will be documented in an engineering evaluation/cost analysis document and either attached to one of the remedial-action documents or issued separately. The categories of waste sites that may be considered for a separate removal action may include TSD units/components. A closure plan will be prepared and attached to the engineering evaluation/cost analysis document that will describe how the implementation of the remedy will satisfy RCRA closure requirements. An action memorandum is issued to document the removal-action decision, and a removal-action work plan is prepared to implement the removal action. Similar steps would be conducted, as previously described, to administratively include closure information in the Hanford Facility RCRA Permit. The Hanford Facility RCRA

Permit information would indicate that the closure information is contained in the engineering evaluation/cost analysis document.

This integration process fully addresses each technical and procedural element of RCRA and CERCLA so that redundant work is not required when remediating these waste sites. The CERCLA public-involvement process, including public notice and opportunity to comment, will be enhanced as necessary to concurrently satisfy the public-involvement requirements for the RCRA closure and corrective-action processes. The public will be given an opportunity to review and comment on the proposed permit conditions that will be contained in the proposed plan. The proposed plan, with a draft permit modification, will be issued for a minimum 45-day public review and comment period. Supporting documents, including the FS and closure plan(s), will be made available to the public for review at the same time. A combined public meeting/public hearing may be held during the comment period to provide information on the proposed action and permit modification and to solicit public comment.

The document sections from a RCRA closure plan that have been integrated into the CERCLA documentation are outlined below:

- 200-IS-1/200-ST-1 OU RI/FS work plan, containing TSD unit/component(s) information applicable to the following closure-plan chapters:
  - Chapter 2.0, "Facility Description and Location Information"
  - Chapter 3.0, "Process Information"
  - Chapter 4.0, "Waste Characterization"
  - Chapter 5.0, "Groundwater Monitoring"
- 200-IS-1 OU RI report, which contains the following TSD unit/component(s) closure information:
  - TSD unit characterization data
- 200-IS-1 OU FS, containing TSD unit/component(s) information applicable to closure-plan sections:
  - Chapter 6.0, "Closure Strategy and Performance Standards"
  - Chapter 7.0, "Closure Activities"
  - Chapter 8.0, "Postclosure Plan"
- 200-IS-1 OU proposed plan:
  - Discusses TSD units/components and proposed actions
  - Contains crosswalk showing where TSD unit closure information can be found in CERCLA documents (e.g., RI/FS work plan, RI report, FS).
- Hanford Facility RCRA Permit modification:
  - Add section for TSD unit(s)/component(s)

  - TSD units/components section contains explanation that closure information is contained in the CERCLA documents
  - CERCLA documents will not be attached or appended to the permit
  - TSD units/components section contains explanation that postclosure information is contained in the CERCLA documents (e.g., remedial-design report/remedial-action work plan, operations and maintenance plan)
- 200-IS-1 OU remedial-design report/remedial-action work plan, which describes final remedies selected for TSD units/components:
  - Includes a SAP for confirmation/verification sampling for both waste sites and TSD units/components
- 200-IS-1 OU operations and maintenance plan:
  - Details postremediation and closure operations, inspection, and/or monitoring activities, as needed.

However, if deemed practicable, separate closure plan(s) may be prepared and submitted to Ecology meeting the requirements specified in WAC 173-303-610 and the Hanford Facility RCRA Permit (WA7890008967).

5.2 REMEDIAL INVESTIGATION ACTIVITIES

The following sections summarize the planned tasks that will be performed during the RI phase for the process-waste pipeline systems. Planned tasks include the following:

1. Planning
2. Field investigation
3. Management of investigation-derived waste
4. Laboratory analysis and data validation.

These tasks and subtasks reflect the work structure that will be used to manage the work and develop the project schedule provided in Chapter 6.0.

5.2.1 Planning

The planning subtask includes tracking and coordinating activities to be completed and documentation that must be completed before RI field activities can begin. This includes interfacing with other organizations and/or project managers who will be providing information for presentation in the 200-IS-1 OU RI report. It also includes the preparation of a site-specific health and safety plan in accordance with 40 CFR 300.430(b)(6), "Remedial Investigation/Feasibility Study and Selection of Remedy," "Scoping," and 29 CFR 1910.120, "Hazardous Waste Operations and Emergency Response," and a preliminary hazard

classification. If required, a final hazard classification and safety analysis will be performed in accordance with approved procedures. Radiological work permits, excavation permits, supporting surveys (e.g., cultural, radiological, wildlife, utilities), work instructions, personnel training, and the procurement of materials and services (e.g., drilling and geophysical logging services) also will be required. In addition, characterization locations identified in the SAPs (Appendices A and B) will be located using a global positioning satellite system.

DOE/RL-98-28, Appendix B, provides a general health and safety plan that outlines health and safety requirements for RI activities. A site-specific health and safety plan will be prepared for characterization activities, following requirements of the general health and safety plan. Initial surface radiological surveys will be performed to document any radiological surface contamination and background levels in and around the sampling locations. This information will be used to document initial site conditions.

5.2.2 Field Investigation

The field-investigation task involves performing data-gathering activities 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 SAPs provided in Appendices A and B of this work plan. The scope includes collection of sediment/sludge/scale samples inside of pipelines and geophysical logging and soil sampling and analysis to characterize the vadose-zone soil at selected locations adjacent to pipelines. Major subtasks associated with the field investigation include the following:

- Test-pit excavations to expose pipelines and provide access for inspection and internal sample collection
- Direct-push installations for geophysical logging and soil-sample collection
- Preparation of a field report.

5.2.2.1 Pipeline Systems

Under this work plan, Phase 1 characterization of the pipeline systems will be implemented. Phase 2 characterization of the pipeline systems will be specified after review of the Phase 1 results either in a revision to this work plan or in a separate work plan. A general description of the characterization methods that may be applied during each phase is presented in Chapter 4.0. Phase 1 characterization activities are presented in Appendix A for the facility pipelines and in Appendix B for the tank-farm waste-transfer pipelines. Phase 2 activities will be specified after the Phase 1 results have been reviewed. Subtasks to be completed under Phase 1 are discussed below.

Pipeline Internal Evaluation

Phase 1 pipeline sample locations will be selected using a focused approach. Field-investigation locations are expected to be selected based on the assumption that residual wastes in the pipelines would accumulate in certain locations (e.g., bends, low pipeline segments). In

addition, areas of known or suspected unplanned-release sites will be targeted for sampling. As-built drawings will be used for generally locating pipelines in the field, and surface geophysical techniques (e.g., GPR, conductivity, and/or magnetometer) will be used to define a lines-specific location.

Evaluating interiors of pipelines involves accessing the inside of selected pipelines at designated locations to gather samples for field screening and laboratory analyses. Access to pipelines to collect samples will be gained by either excavating a test pit or if an appropriate technique is available by constructing a borehole down to the pipeline. Certain pipelines with direct internal access points such as manholes or sampler pits may be sampled without excavation. Sampling techniques at any specific locations will be dependent upon the site's physical characteristics including interferences. Radiological monitoring of soils will occur during excavation activities. All exposed pipeline segments will have their external surface field screened for radiological contamination. Accessing the interior of the pipeline may involve penetrating the pipe by drilling a hole into it so that a probe can be inserted or by cutting out a segment of pipe. Once internal access is acquired, visual inspections of the interior of the pipe will be accomplished either by personnel inspection or via remote video equipment. This inspection will provide information on the presence of waste in the pipeline at the sample location and information on the condition of the pipeline. Observations such as occurrence of breaks, cracks, misaligned joints, corrosion, and internal buildup of sediment, sludge, and/or scale will be recorded. Available residual waste material present inside the lines will be sampled. Field screening for radiological and nonradiological constituents will be performed if sufficient material is available.

Soil Adjacent to Pipelines

Known and suspected unplanned release sites along selected pipelines will be sampled. When two pipeline segments of dissimilar material are joined, the potential exists for a failure at this joint. As part of the focused-sampling approach, sampling will be conducted at some of these locations. At suspected release sites, surface surveys of the area would be conducted prior to any excavation. Direct-push installations will be completed adjacent to pipelines to perform geophysical logging and collect samples for field screening and laboratory analysis. Contaminated soil along pipelines that are suspect leakage areas have been identified for characterization. Small-diameter casing will be installed using direct-push equipment for use in geophysical logging. Geophysical logging will be completed primarily to provide information on the distribution of gamma-emitting radionuclides. Passive-neutron logging may be performed to evaluate whether plutonium is present at high-activity levels. Active-neutron logging will be used to measure moisture distribution in the soil. Logging results will be reviewed before any sampling activities are initiated. At the completion of sampling, the direct-push casing will be removed and decontaminated (if possible). The borehole will be abandoned, and initial site conditions will be reestablished.

A small-diameter direct-push split-spoon sampler will be used for soil-sample collection. Field-screening analysis for radiological and nonradiological constituents will be completed for each interval sampled. Samples selected for laboratory analysis, based on field-screening results, will be packaged for shipment to an offsite laboratory if radiation levels permit. Otherwise, samples will be shipped to an onsite laboratory. At the completion of sampling, the direct-push

casing will be removed and decontaminated (if possible). The borehole will be abandoned, and initial site conditions will be reestablished.

Other activities include work-zone setup, mobilization/demobilization of equipment, and equipment decontamination. Radiological field screening will assist in establishing radiation-control measures and ensure worker health and safety.

Preparation of Field Report

At the completion of the field investigation, a field report will be prepared to summarize the activities performed and information collected in the field, including survey data for direct-push locations, the number and types of samples collected and associated *Hanford Environmental Information System* database numbers, inventory of investigation-derived waste containers, geological logs, field-screening results, and geophysical-logging results.

5.2.2.2 241-CX-72 Storage Tank

Task to be completed for the 241-CX-72 Storage Tank include borehole drilling, sample collection, and laboratory analysis. Samples obtained from the residual waste material in the tank will be sent to a laboratory for analysis of radiological and nonradiological constituents. Radionuclide concentrations may require analysis by an onsite laboratory.

5.2.3 Management of Investigation-Derived Waste

Waste-designation DQOs will be established before the characterization activities are begun, to ensure that the information collected during the field activities supports the designation of all investigation-derived waste for the project. During the investigation-derived waste 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 implemented through the waste-designation DQO summary report that will be prepared at that time.

Waste generated during the RI will be managed in accordance with a waste-control plan to be prepared for the sampling activity. DOE/RL-98-28, Appendix E, provides general waste management processes and requirements for the investigation-derived waste and forms the basis for activity-specific waste-control plans. The site-specific waste-control plan addresses the handling, storage, and disposal of investigation-derived waste 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 investigation-derived waste management task begins when investigation-derived waste is first generated at the start of the field investigation and continues through waste designation and disposal.

5.2.4 Laboratory Analysis and Data Validation of Process-Facility Pipelines

Samples collected from within the pipelines and from adjacent soil will be analyzed for a suite of radionuclides and nonradionuclide constituents identified during the DQO process. The list of analytes, laboratory methods, associated target-detection limits, and quality assurance and quality control requirements for Phase 1 sampling of Process-Facility pipelines is provided in the SAP (Appendix A). This task includes the laboratory analysis of samples, the compilation of laboratory results in data packages, and the validation of a representative number of laboratory data packages.

5.2.5 Laboratory Analysis and Data Validation of Tank-Farm Pipeline-System Samples

Samples collected from within the pipelines and from adjacent soil will be analyzed for a suite of radionuclides and nonradionuclide constituents identified during the DQO process. The list of analytes, methods, and associated target-detection limits is provided in the Phase 1 SAP (Appendix B). The SAP also specifies the quality-assurance, quality-control, and data-reporting requirements for the laboratory analysis. Validation of a representative number of laboratory data packages will be performed. Data review and validation will be completed in accordance with best-basis inventory procedures.

5.3 EVALUATION OF PHASE I DATA

All Phase 1 characterization data will be compiled and reviewed at the completion of field operations and receipt of laboratory results. Field-screening results, geophysical-logging data, and laboratory analyses will be included. Results will be tabulated and maps and plots prepared to show the contaminant distribution. Based on the results of Phase 1, an assessment will be completed concerning the need for additional data collection for each of the process-waste pipeline bins. The data collected in Phase 1 will be used to determine whether contamination is above the preliminary cleanup levels and if remediation is required. If the need for additional data collection is determined to be required to support risk-assessment evaluations and remedial decision making, planning for Phase 2 will be initiated.

Phase 2 will entail gathering additional data to support remedial decisions, including no action. Additional characterization data will be acquired to allow for a statistical analysis of the data set. The data set will be used to determine a 95 percent upper confidence limit of the mean concentration for the COPCs. The uncertainty in the calculated values, based on the proposed total number of analyses that will be used, will be presented in the Phase 2 SAP. Results of both phases of characterization will be presented in the RI report.

5.4 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.

5.4.1 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 lifecycle of planning, implementation, and assessment that began with the DQO process. In this task, the data will be examined to see if they meet the analytical-quality criteria outlined in the DQO and are adequate to evaluate the decision rules in the DQO.

5.4.2 Data Evaluation and Conceptual-Model Refinement

This task will consist of evaluating the information that has been collected. The nonradiological and radiological data associated with the samples taken from within the pipeline structures and surrounding subsurface soil will be compiled, tabulated, and evaluated to satisfy data needs. Data-evaluation tasks may include the following.

- Perform initial screening for contamination by evaluating the data with respect to background, using simple comparisons of maximum values to background concentrations.
- Compare the data to potential cleanup levels.
- Describe the distribution of contamination within the pipelines, based on field-screening and laboratory analytical results for sludge, sediment, or scale samples taken from within the pipelines.
- Describe the vertical and lateral distribution of contamination in soil adjacent to pipelines, based on geophysical-logging results and analytical data for soil samples.
- Construct data diagrams and plots to evaluate spatial correlations within and between sampled media (inside pipelines and surrounding soil). This evaluation will be used to assess whether contamination is concentrated in a particular area, in relationships between contaminant levels and locations inside the pipelines, and in surrounding soil.
- If sufficient data are available, perform statistical analyses. This step has many facets, including determining the distribution of the data and selecting the appropriate statistical tests.

Data requirements for Phase 1 and Phase 2 decision making are documented in D&D-30262, Table 5-4. Use of maximum or detected values was determined to be appropriate for Phase 1. For Phase 2 decision making, data sets will utilize a 95 percent upper confidence level of the mean value.

The combined chemical and geophysical data will be used for refining the preliminary conceptual contaminant-distribution models and as inputs to the risk assessment. Phase 1 results also will be used to determine Phase 2 data needs.

5.4.3 Baseline Risk Assessment

For the 200-IS-1 OU, a quantitative, baseline risk assessment will be prepared as part of the RI report for all potential pathways: human-health direct contact, ecological, and protection of groundwater. It is important to note that for the baseline risk assessment, completed risk assessments conducted for process facilities liquid-waste disposal sites, tank farms, and other applicable waste sites also will be evaluated, with input parameters and results included as appropriate, to support the 200-IS-1 OU analyses. Results of these other risk assessments will be integrated and used to support an evaluation of the risk posed by residual waste associated with pipeline structures and associated soil.

The baseline risk assessment will evaluate risk to human and ecological receptors from potential exposure to contaminants in accessible surface sediments and shallow subsurface soils. The risk assessment also will evaluate the potential for contaminants that are currently in the vadose-zone soil to impact groundwater in the future. Risks from current groundwater contamination will not be evaluated; this evaluation will be conducted as part of the RI/FS process for the Central Plateau respective groundwater OUs.

A baseline risk analysis for those COPCs detected within the pipelines also will be completed. Initial screening will consider the constituents to be directly accessible to potential receptors. Modeling of future exposure risks, as the pipelines degrade and constituents actually become available to surrounding soil, also will be completed. These modeling results will be considered in the risk evaluations associated with various potential leave-in-place remedial alternatives (e.g., no action, decontamination flushes, grouting).

5.4.3.1 Risk Framework

Ecology, EPA, and DOE, cumulatively known as 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 Hanford Advisory Board, 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 results of the risk framework are documented in letter HAB 132, "Exposure Scenarios Task Force on the 200 Area;" in the Tri-Parties' response to HAB 132, (Klein et al., 2002, "Consensus Advice #132: Exposure Scenarios Task Force on the 200 Area"); and in HAB, 2002, *Report of the Exposure Scenarios Task Force*. The risk assessment presented in the RI report will use data collected from the pipeline structures and surrounding soil and will be sufficient to allow quantification of risk.

5.4.3.2 Standards, Guidance Documents, and Computer Codes

The human-health risk assessment will be conducted in accordance with appropriate subsections of WAC 173-340 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*, OSWER 9285.7-01A
- 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, 2002, *Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites*, OSWER Publication 9285.6-10
- EPA/600/R-07/038, *ProUCL Version 4.0 User Guide.*

Human direct contact risks for nonradionuclides 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 and consideration for the site containing TSD components. Risks associated with the vadose zone and groundwater pathways will be evaluated in accordance with WAC 173-340-747, "Deriving Soil Concentrations for Ground Water Protection." 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) 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 to obtain risk and dose estimates for the protection of the groundwater pathway. Additional analysis may be performed using other appropriate fate and transport models when approved by Ecology and EPA to assess impact to the groundwater from chemicals and radionuclides in the vadose zone (in accordance with WAC 173-340-747(8), "Deriving Soil Concentrations for Ground Water Protection," "Alternative Fate and Transport Models").

5.4.3.3 Additional Risk-Assessment Information

For those 200-IS-1 OU pipeline systems and waste sites located inside the Core Zone, risk assessment will be performed for an industrial-exposure scenario to establish the baseline risk. As part of the FS, additional risk assessment for informational purposes may be performed to evaluate other scenarios, such as a Native American scenario or an intruder scenario, to evaluate postremediation residual risks.

The pipelines (including interior contents) and surrounding soil composing each process waste-stream bin will be evaluated in the risk assessment. The pipelines in each bin, with the exception of tank-farm waste-transfer pipelines, may be considered as one entire unit in risk calculations. Site-specific data will be used to justify this grouping into one unit. The characterization data that support this approach will be provided as part of the risk assessment. Tank farm waste-transfer pipelines are considered too heterogeneous for unit risk application. Subdivision of Bins 1-5 may be necessary in some instances because of unique, facility-specific, heterogeneity. Those pipelines identified for subdivision because of characteristics that are not consistent with the primary bin may be evaluated separately in the risk assessment.

Contaminant concentrations, distribution, and pathway availability will be evaluated. Analytical data and hydrogeologic information used in risk calculations include the following:

- Laboratory analytical results from sampled media
- Waste-site configuration and construction (multiple pipelines within a sealed encasement or direct-buried single pipelines)
- Depth of burial (above or below the 4.6 m [15-ft] direct human-exposure point of compliance) (in accordance with WAC 173-340-745(5)(b), "Soil Cleanup Standards for Industrial Properties," "Method C Industrial Soil Cleanup Levels," or WAC 173-340-740(3)(b), "Unrestricted Land Use Soil Cleanup Standards," "Method B Soil Cleanup Levels for Unrestricted Land Use," "Standard Method B Soil Cleanup Levels," as appropriate).
- Comparison of concentrations of contaminants relative to concentrations considered protective of groundwater (e.g., compared with WAC 173-340-747 values).
- Known or estimated volume of a waste stream released in relation to the available pore volume of soil underlying the pipeline
- Types and amounts of contaminants transferred by the pipeline and associated structure; contaminant inventory
- Release mechanism (minor isolated cracks or breaks or major discontinuities and breaks throughout the line)
- Expected distribution of contamination based on configuration of the pipeline structure
- Geological setting

- Neighboring waste sites, structures, or utilities
- Potential for hydrologic and contaminant impacts to groundwater.

Information and assessments completed for each pipeline bin as part of the RI will be incorporated into the FS. Results of the risk assessment will be used to support the evaluation and selection of the appropriate remedial action. The characterization data that will be compiled during Phases 1 and 2 of the RI should provide sufficient information to select remedies for each pipeline-system bin. Following remedial action, additional data collection will be performed as needed to verify achievement of cleanup goals. For sites that are candidates for a removal action, final verification sampling results will provide sufficient data to document that cleanup levels specified in the ROD have been achieved.

5.4.4 Ecological Evaluation and Risk Assessment

The screening-level ecological risk assessment in DOE/RL-2001-54 is meant to be a conservative evaluation of risk to ecological receptors from stressors, in this case, introduction of contaminants and habitat elimination. The screening-level ecological risk assessment identifies pathways for ecological receptors to be exposed to the contamination and evaluates potential risk from those exposures.

The 200-IS-1 OU RI will include the screening of contaminants against ecological soil protection values. WAC 173-340-900, "Tables," Table 749-3 for non-radionuclides and soil biota concentration guideline, (i.e., BCGs [DOE-STD-1153-2002, *A Graded Approach for Evaluating Radiation Doses to Aquatic and Terrestrial Biota*]) for radionuclides. Waste site characterization data from 200-IS-1 OU facility and tank farm processes (e.g., transfer lines and soils) will be assessed against the Central Plateau ecological risk assessment. The ecological risk assessment being performed for the Central Plateau may stand as the ecological risk assessment for the 200-IS-1 OU.

5.4.5 Treatability Studies Needs

In conjunction with the RI data compilation and assessment, the FS activities will be initiated and will include the identification of applicable remedial alternatives. The need to conduct treatability studies will be evaluated as part of the RI process. Treatability studies may be required to verify the feasibility of a technology, cost of a remedy, or applicability of a technology or action under different site conditions. An initial treatability study need was identified. Costs for implementation of the remedial actions being considered will be obtained from completed projects in other parts of the Hanford Site (e.g., 100 or 300 Areas, 200-UW-1 OU pipeline removal) or at other DOE facilities.

Facilities Process-Waste Pipelines

Phase 1 RI characterization activities are expected to provide additional information that may contribute or be used in lieu of treatability studies needed to complete the FS. Information obtained during Phase 1 characterization activities will provide important information

concerning the existing condition of the buried pipelines, level of effort and costs to acquire data, and worker-exposure conditions that will be associated with certain remedies.

5.5 FEASIBILITY STUDY/CLOSURE PLAN

After completion of the RI, remediation alternatives and closure strategies identified in this work plan will be more fully developed and will be evaluated against RCRA closure performance standards and the CERCLA nine criteria (40 CFR 300.430(e)(9)(iii), "Remedial Investigation/Feasibility Study and Selection of Remedy," "Feasibility Study," "Detailed Analysis of Alternatives," "Nine Criteria for Evaluation") in the FS and appended RCRA TSD unit closure plans. The FS process consists of the following steps.

1. Define remedial-action objectives and RCRA closure and RCRA corrective action performance standards.

2. Identify general response actions to satisfy remedial-action objectives.

3. Identify potential technologies and process options associated with each general response action.

4. Screen the process options to select a representative process for each type of technology based on its effectiveness, implementability, and cost.

5. Assemble viable technologies or process options into alternatives representing a range of treatment and containment, plus a no-action alternative.

6. Evaluate alternatives and present information needed to support remedy selection and RCRA closure of the unit, pursuant to Hanford Facility RCRA Permit, Condition II.K (WA 7890008967).

5.5.1 Remedial-Action Alternatives

Potential remedial-action alternatives that have been identified for the 200-IS-1 OU waste sites include the following:

- No-action alternative
- Excavation and disposal of waste
- Excavation with treatment and disposal
- In situ treatment (stabilization)
- Maintain existing soil cover/institutional controls/monitored natural attenuation.

Sections of pipelines and many of the diversion boxes that are part of the 200-IS-1 OU are located in areas where the use of a cap/barrier may be proposed for remedial actions that will be undertaken by another OU or project to address facilities, WMAs, and/or other waste sites. Evaluation of remedial alternatives for the 200-IS-1 OU waste sites will consider the benefits of these proposed barriers and how remedial strategies and decisions can be integrated.

A summary of each of these potential alternatives as it would apply to the 200-IS-1 OU waste sites 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), or maintaining an existing soil cover if already present, with institutional controls.

5.5.1.1 No Action

Title 40 CFR 300 requires that a no-action alternative be evaluated as a baseline for comparison with other remedial alternatives. The no-action alternative represents a situation where no legal restrictions, access controls, or active remedial measures are applied to the site. No action implies allowing the wastes to remain in the current configuration, thus being affected only by natural processes. No maintenance or other activities will be instituted or continued. Selecting the no-action alternative would require that a waste site pose no unacceptable threat to human health or the environment.

5.5.1.2 Maintain Existing Soil Cover/Institutional Controls/Monitored Natural Attenuation

Under this alternative, the existing soil cover on a waste site is maintained and/or augmented as needed to provide protection from intrusion by biological receptors, along with 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 are 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:

- For contaminants that naturally attenuate and are not mobile in the environment
- For contaminants that may be mobile but attenuate/decay before impacting 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 less than 4.6 m (15 ft), more stringent institutional controls (e.g., physical and legal barriers, biological monitoring, removal of deeply rooted plants, control of deep-burrowing animals) will need to be implemented. Water- and land-use restrictions also will be used to prevent exposure.

Natural attenuation relies on natural processes to lower contaminant concentrations until cleanup levels are met. Monitored natural attenuation includes sampling and/or environmental monitoring, consistent with EPA/540/R-99/006, *Radiation Risk Assessment at CERCLA Sites: Q&A*, OSWER 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.

5.5.1.3 Removal, Treatment, and Disposal

Remedial alternatives will be evaluated that may involve different combinations of remove, treat, and dispose 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 will involve excavation of soil and structures. Treatment may include in situ or ex situ operations. Treatment technologies involving in-place stabilization or postremoval stabilization will be evaluated. Additional discussion on the application of these potential actions is discussed below.

- Removal and Disposal:

  Structures and soil with contaminant concentrations above the preliminary remediation goals would be removed using conventional techniques and would be disposed of at an approved disposal facility, most likely the Environmental Restoration Disposal Facility, or at an offsite facility if transuranic constituents are involved. The depth and, therefore, the volume of soil removed largely will depend on which categories of preliminary remediation goals are exceeded. For example, if human-health direct-contact or ecological preliminary remediation goals are exceeded, removals would be conducted to a maximum of 4.6 m (15 ft). Conversely, if groundwater protection is required, soils (to the extent practicable) would be removed to meet groundwater-protection preliminary remediation goals. A decision logic would be developed, with criteria used to determine if belowgrade structures (e.g., pipelines, diversion boxes, catch tanks) that extend deeper than 4.6 m (15 ft) would be removed. Decision inputs would include results of fate and transport modeling (in accordance with WAC 173-340-747(8), risk assessment, and regulatory requirements).

  The remediation of sites under the remove-and-dispose alternative would be guided by the observational approach. The observational approach is a method of planning, designing, and implementing a remedial action that relies on information (e.g., samples) collected during remediation to guide the direction and scope of the activity. Data collected are used to assess the extent of contamination and to make real-time decisions in the field. Targeted (or hot-spot) removals could be considered under this alternative if contamination is localized in only a portion of a waste site.

  Radioactive waste will require special-handling protocols. Remote-controlled equipment and containment structures may be necessary if removal actions involve high-activity waste. Removal actions using the observational approach do not require that the precise extent of contamination be known before excavation; rather, the extent of contamination is assessed as the excavation proceeds, and the extent of remediation is adjusted accordingly. In this alternative, soils will be removed until the preliminary remediation goals are achieved to a maximum depth of 4.6 m (15 ft). In some cases, deeper depths of removal, as agreed upon with the regulators, may be required where removal of an engineered structure is required. If previously unanticipated contamination above the preliminary remediation goals is discovered, the extent of remediation may be increased

following consultation with the Tri-Parties. A decision to excavate to a greater depth to protect groundwater (i.e., if required to meet groundwater maximum contaminant levels) would depend on factors such as the cost of further remediation, amount of risk reduction achieved, volume of soil generated, availability of disposal-facility capacity, impacts on cultural and ecological resources, logistics and interference with other onsite activities/structures, worker safety issues, and implementability of the excavation for the deeper contamination.

- Removal with Ex Situ Treatment and Disposal:

  Low-level radioactive waste and/or hazardous waste are acceptable for disposal at the Environmental Restoration Disposal Facility in accordance with the waste-acceptance criteria (BHI-00139, *Environmental Restoration Disposal Facility Waste Acceptance Criteria*). For certain removal actions involving moderate- or high-activity radiological or mixed waste, ex situ treatment may be required to meet disposal requirements. For this waste, treatment technologies will be identified to meet potential disposal requirements.

- In Situ Treatment with Removal and Disposal:

  Stabilization of residual liquids in pipelines may be required before removal actions are initiated at some waste sites. Injection or pumping of specially formulated grout mixtures designed to encapsulate and stabilize any residual liquids will be considered as a remedial alternative. In situ treatment before removal also will be evaluated for worker-safety, waste-handling, and waste-disposal considerations.

- In Situ Treatment:

  Some pipeline segments may have attributes where application of an in situ treatment technology would be an appropriate remedy. This remedy may be applicable to pipelines that have sorbed contaminants (e.g., vitrified clay pipeline) or that have accumulated a significant build-up of scale or other residual material inside the pipe that would be difficult to remove. Leaking pipelines also may have a localized accumulation of contaminated soil concentrated near the structure. Currently identified in situ treatment technologies consist of grout injection/pumping into a pipeline and/or the surrounding soil and vitrification. For grouting, chemical fixation agents would be mixed with the grout and used to stabilize local contamination. In situ vitrification techniques will be evaluated for situations where a mechanism needs to be considered to stabilize high-activity and/or transuranic-containing materials. These stabilization techniques would be remedial alternatives for those locations where the exposure-pathway assessment identified groundwater as a potentially impacted medium.

  Placement of a plug of material is anticipated to be sufficient to isolate the structure in some pipeline locations. These situations currently are being associated with those pipelines that have been identified where a segment of the line will be positioned under a proposed barrier.

  Certain pipeline segments where the constructed materials have shown no tendency to sorb chemical constituents (e.g., stainless-steel pipelines) only may require application

of a decontamination procedure. Flushing of residual constituents (e.g., liquids, sediments, sludge) may be sufficient action to remove contaminants and eliminate future exposure concerns.

5.5.2 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(e)(9)(iii)):

- 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
- State acceptance
- Community acceptance.

The first two criteria are considered threshold criteria, which the remedial alternatives being evaluated must meet. The next five criteria are considered balancing criteria, which are used to assist in selecting the most appropriate remedial alternative. The last two criteria are considered modifying criteria, which are used to assist in finalizing the selection of a remedial alternative. The modifying criterion of State acceptance will be documented in the ROD. The final modifying criterion, community acceptance, will be applied following the FS during the proposed plan and ROD phase.

The *National Environmental Policy Act of 1969* values will be evaluated and incorporated into the FS as part of DOE's statutory responsibility under the *National Environmental Policy Act of 1969*. These values include impacts to natural, cultural, and historical resources; socioeconomic aspects; and irreversible and irretrievable commitments of resources.

The RCRA closure performance standards (WAC 173-303-610[2], "Closure and Post-Closure," "Closure Performance Standard") 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 unit 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 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 remedial-action objectives and preliminary remediation goals 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.

- Provide corrective-action recommendations for RPPs to fulfill the requirements for a CMS report.

- Include as appendices or separate documents, closure plans to address RCRA TSD units in the OU. The closure plans may incorporate, by reference, specific sections of the work plan or RI report containing specific closure-plan information. The closure plans will include closure performance standards, a closure strategy, general closure activities including verification sampling, and a general postclosure plan.

Additional RCRA integration guidance for preparing an FS/closure plan is provided in DOE/RL-98-28, Section 2.4.

5.6 FEASIBILITY STUDY/CLOSURE PLAN

Remedial actions in the Central Plateau are being investigated and evaluated on an OU-by-OU basis, as defined in 40 CFR 300, 40 CFR 300.430, and the Tri-Party Agreement Acton Plan (Ecology et al., 1989b). To provide flexibility for implementing remedial actions, alternative methods for remediation of Central Plateau waste-site groupings will be considered. Several alternatives currently are under consideration, some of which may be used for the waste sites addressed in this work plan. Three alternatives 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 remedial alternatives are presented below: high-risk waste sites identified by grouping, regional-site closure, and waste-site grouping by characteristics or hazards.

5.6.1 Waste Sites Identified for Early Action

This remedial alternative accelerates the start of remedial actions and closure of waste sites that present an ongoing or expected future threat to groundwater. Some Central Plateau high-risk sites already have been identified for early actions near the U Plant, PUREX Plant, and Plutonium Finishing Plant. These sites will be included in proposed plans and RODs that promote early action. Waste sites also may be identified that would be appropriate for implementing an expedited response action. A "Time Critical Removal Action" could be used to streamline the cleanup and close-out process for selected waste sites. This approach has been used at the U Plant for the 200-W-42 Pipeline removal.

5.6.2 Regional-Site Closure

Waste-site remedial decision making may be adjusted under a regional-closure 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 alternative is being developed for the Central Plateau and has been completed for the U Plant.

5.6.3 Waste-Site Grouping by Characteristics or Hazards

A third example of a remedial alternative is based on a specific characteristic or hazard that mandates additional requirements, such as supplemental ARARs or more robust remedial alternatives. For example, some pipelines and structures in the 200-IS-1 OU are suspected to contain concentrations of transuranic radionuclides in excess of the 100 nCi/g concentration limit for designation as transuranic constituents. Sites containing concentrations of transuranic radionuclides above 100 nCi/g may require selective removal actions or more protective barrier designs to prevent intrusion, based on this particular hazard. Such alternatives might not be required for other process-condensate or process-waste pipelines in the 200-IS-1 OU, where only low-to-moderate levels of radionuclides occur. Grouping certain pipelines or structures (e.g., diversion boxes, catch tanks) with similarly contaminated soil sites (e.g., cribs and

trenches) in other OUs could streamline the decision-making process and tailor the requirements and alternatives to these specific hazards.

Along with the completion of the FS/closure plan, a proposed plan will be prepared that identifies the preferred remedial alternative for the OU. The preferred remedial alternative will include RCRA-closure and corrective-action requirements. In addition to identifying the preferred alternative, the proposed plan will serve the following purposes.

- Summarize the completed RI/FS.
- Provide criteria by which waste sites in the OU will be evaluated after issuance of the ROD to confirm that the contaminant distribution model for the site is consistent with the preferred alternative. Contingencies to move a waste site to a more appropriate waste group also will be developed.
- Identify performance standards and ARARs applicable to the OUs.

After the public-review process is complete, the lead regulatory agency will make a final decision on the remedial action to be taken. The decision will be documented in a ROD and the Hanford Facility RCRA Permit (WA7890008967) will be modified to incorporate the ROD (and subsequent amendments) by reference, authorizing the RCRA actions.

5.7 REMEDY SELECTION, RECORD OF DECISION, RCRA PERMIT MODIFICATION, AND POST-RECORD OF DECISION ACTIVITIES

5.7.1 Remedy Selection, Record of Decision, RCRA Permit Modification

Once the FS process for remedial-alternative evaluation for the waste sites in the 200-IS-1 OU has been completed, a proposed plan will be developed that contains a summary of the key elements of the FS and presents the recommended selected remedies for the OU. The proposed plan will indicate that a draft permit modification also is being conducted, with unit-specific permit conditions for RPPs and the RCRA TSD units and components for incorporation into the Hanford Facility RCRA Permit (WA7890008967).

This proposed plan will undergo a public review and comment process (40 CFR 300.430(f)(3), "Remedial Investigation/Feasibility Study and Selection of Remedy"). After the public-comment period has been completed, a ROD will prepared (40 CFR 300.430(f)(5), "Remedial Investigation/Feasibility Study and Selection of Remedy," "Selection of Remedy," "Documenting the Decision") that documents the remedial-action decisions for the OU and the responses to the public comments. Development of a ROD that supports elements of the "plug-in" approach and use of a contingent or alternate remedy will be evaluated. Design of the ROD will be consistent with use of a process where waste-site attributes are confirmed before a remedial response is implemented.

The draft RCRA permit modification will go through a public involvement process as specified in WAC 173-303-830, "Permit Changes," in conjunction with the proposed plan. The draft permit modification will contain the closure plan for TSD units and the proposed selected remedy for RPP waste sites.

5.7.2 Post-Record of Decision Activities

After the ROD and Hanford Facility RCRA Permit (WA7890008967) modification have been issued, a remedial-design report and remedial-action work plan will be prepared to detail the scope of the remedial action, which will include RCRA closure and corrective-action requirements. As part of this activity, DQOs will be established and SAPs will be prepared to direct verification sampling and analysis. Before remediation begins, data necessary for the remedial design and to support future risk assessments will be obtained. Verification sampling will be performed after the remedial action is complete to determine if the ROD requirements have been met and if the remedy was effective. Additional guidance for verification sampling is provided in DOE/RL-98-28, Section 6.2.

The remedial-design report and remedial-action work plan will contain an integrated schedule of remediation activities for the OU, including the schedule for RCRA TSD unit closures, and will satisfy the requirements for an RPP corrective-measures implementation work plan and design report. The remedial-design report/remedial-action work plan, along with the proposed Tri-Party Agreement milestones, will be submitted 180 days after the ROD is signed. Remediation activities will be designed to ensure integration of CERCLA cleanup activities and RCRA corrective actions and closure. Following the completion of the remediation, closeout activities will be performed as specified in the ROD, remedial-design report and remedial-action work plan, and the Hanford Facility RCRA Permit.

Enforceable sections of the closure plan will be identified in the Hanford Facility RCRA Permit modification. The RCRA closure activities and schedules will be defined in the Hanford Facility RCRA Permit Modification and will be consistent with the closure plan. Certification of closure in accordance with WAC 173-303-610(6), "Closure and Post-Closure," "Certification of Closure," will be performed after cleanup actions are complete. 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.

Fieldwork to implement the post-ROD SAPs and remediation of the waste site will follow the schedule as outlined in the remedial-design report and remedial-action work plan. An operations and maintenance plan will be prepared for implemented remedies that, while still protective of human health and the environment, leave contamination in place. Finally, closeout reports will be prepared to document that all of the remedial activities for the OU have been implemented in accordance with the approved CERCLA documents.

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6.0 PROJECT SCHEDULE

The project schedule for activities discussed in this work plan are provided in Table 6-1. This schedule was prepared using periods outlined in the Tri-Party Agreement (Ecology et al., 1989a) and a two-phase field-investigation approach. Due to the complexities in reviewing the work plan and sampling and analysis plans Table 6-1 was updated for the additional review time. The updated table reflects the additional time required to review and respond to comments. In addition, it reflects the informal 30-day dispute.

The schedule will be evaluated to identify efficiencies; however, the duration of the Phase 2 work will not be known until the Phase 1 data are evaluated. This schedule will serve as the baseline for the work-planning process and will be used to measure the progress of implementing this work plan. The portions of the schedule most germane to this work plan and the attached SAPs are fiscal year 2008 and fiscal year 2009. The schedule concludes with the submittal of the Phase 2 work plan. The Hanford Facility RCRA Permit (WA7890008967) will be modified after the ROD is issued, during Ecology's annual modification process.

This schedule covers the following:

- Submittal of the Revision 1 Draft B RI/FS work plan
- Review and approval of the work plan(s)
- Field work associated with the characterization of the 200-IS-1 OU waste units for Phase 1
- Laboratory analysis for Phase 1
- Management of investigation-derived waste for Phase 1
- Submittal of a modified work plan/SAP for Phase 2 facilities pipelines and associated soil
- Closure plan for the 241-CX-70, 241-CX-71, and 241-CX-72 Tanks.

Interim milestones to be designated under the Tri-Party Agreement will be established through negotiations among the Tri-Parties. A Class II change form will be submitted to Ecology to request the addition of any interim milestones. Any updates to the project schedule or associated milestones will be discussed at the monthly unit managers' meeting prior to implementing the updates. One of the Tri-Party Agreement milestones (M-020-27) associated with this project was met on November 25, 1992. Submission of this work plan meets Tri-Party Agreement Milestone M-013-27, "Submit a revised RI/FS work plan for the 200-IS-1 and 200-ST-1 OUs to Ecology to identify likely response scenarios and potentially applicable technologies, identify the need for treatability investigations, and include sampling and analysis plans by June 30, 2007."

Table 6-1. Project Schedule for 200-IS-1 Operable Unit Pipelines.

Activity	Start	Finish
Project Management	10/01/06	06/29/12
Work Plan	10/01/06	02/08/08
Issue Rev. 1 Draft B Work Plan – Tri-Party Agreement Milestone M-013-27		06/30/07
Ecology Review Work Plan	07/01/07	10/24/07
Comment Resolution	10/25/07	03/28/08
Finalize Work Plan and Obtain Ecology Approval	03/31/08	07/15/08
Phase 1 Field Investigation	05/23/08	01/31/10
Pipelines and Soils Investigations	05/15/08	11/20/08
241-CX-72 Storage Tank Investigation	01/21/08	12/30/09
Management of Investigation-Derived Waste	05/15/08	10/29/10
Lab Analysis and Data Validation Pipeline and Soils	08/18/08	05/12/09
Lab Analysis and Data Validation 241-CX-72 Storage Tank	09/17/09	12/14/09
Submit 241-CX-70, 241-CX-71, and 241-CX-72 Tank Closure Plan – Tri-Party Agreement Milestone M-020-54	06/01/08	12/31/08
Modify Existing Work Plan and/or Sampling and Analysis Plan(s) Phase 2 Pipelines and Associated Soil	06/17/09	06/29/10
Issue Phase 2 Work Plan for Review	06/17/09	06/29/10

Ecology = Washington State Department of Ecology. Tri-Party Agreement = *Hanford Federal Facility Agreement and Consent Order* (Ecology et al., 1989a).

Other Tri-Party Agreement milestones associated with this work plan are as follows:

- M-020-54, "Submit Closure Plan for 241-CX-70, 241-CX-71, and 241-CX-72 Tanks for Regulatory Review: December 31, 2008"

- M-015-00, "Complete RI/FS (or RFI/CMS) Process for All Operable Units: June 29, 2012."

DOE recognizes it is proposing a change to a major milestone, Milestone M-015-00. This change is based on the high level of connections between obtaining characterization data, verifying the data, and the time it takes to evaluate the data to make a remedial action decision. DOE is requesting a change based on the additional time it has taken review and comment resolution.

The following is the proposed project milestone-completion date for the key activity:

- Modify Existing Work Plan and/or Sampling and Analysis Plan(s) for Facilities Phase 2 Pipelines and Associated Soil: June 29, 2010.

A separate closure plan for the 241-CX-70 Storage Tank, 241-CX-71 Neutralization Tank, and 241-CX-72 Storage Tank will be submitted. An RI/FS report for process pipelines and appurtenances and a proposed plan will be generated for the 200-IS-1 OU. The report will meet the site-specific RI/FS objectives. In general, the RI/FS will assess data that have been collected at the time of report preparation (generally, it is anticipated that available information will include Phase 1 and available Phase II characterization information). The assessment will be used to define source areas of contamination; to assess the potential pathways of migration and the potential receptors and associated exposure pathways to the extent necessary to determine whether, or to what extent, a threat to human health or the environment exists; and to develop/evaluate remedial alternatives (including the no-action alternative). The RI/FS will present alternatives that will provide decision makers with a range of options and information to compare alternatives against one another. A general description of ranges for source-control response actions will be developed based on the site-specific information available. A detailed and comparative analysis of remedial alternatives will be assessed against available site-specific information. This information will be used to develop various conceptual models (i.e., pre-defined conditions, such as concentrations, depth, and treatability of contaminants, for various pipeline groups) that will be applied to the remedial alternatives. Through the comparative analysis of alternatives, it is expected that these conceptual models may result in selection of different remedies for different pipeline groupings (e.g., removal, treatment and leave-in place, or leave-in-place). The RI/FS also may define how the determination of the selected remedy will be made at each site, such as through amendments to the ROD.

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APPENDIX A

SAMPLING AND ANALYSIS PLAN FOR THE PHASE 1 CHARACTERIZATION OF THE FACILITY PROCESS-WASTE PIPELINE SYSTEMS

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CONTENTS

A1.0 INTRODUCTION A1-1
A1.1 PIPELINE DESCRIPTIONS AND HISTORY A1-2
A1.1.1 Pipelines Being Evaluated in Bin 1 (Process Condensate, Process Waste, and Laboratory Waste) A1-6
A1.1.2 Pipelines Being Evaluated in Bin 2 (Steam Condensate and Cooling Water) A1-8
A1.1.3 Pipelines Being Evaluated in Bin 3 (Chemical Sewer Waste) A1-12
A1.1.4 Pipelines Being Evaluated in Bin 4 (Miscellaneous Waste) A1-14
A1.1.5 Pipelines Being Evaluated in Bin 5 (Tank/Scavenged Waste) A1-16

A2.0 QUALITY ASSURANCE PROJECT PLAN A2-1
A2.1 PROJECT MANAGEMENT A2-1
A2.1.1 Project/Task Organization A2-1
A2.1.2 Background and Problem Definition A2-4
A2.1.3 Project and Task Description A2-4
A2.1.4 Quality Objectives and Criteria for Measurement Data A2-4
A2.1.5 Special Training Requirements/Certification A2-24
A2.1.6 Documents and Records A2-25
A2.2 DATA GENERATION AND ACQUISITION A2-26
A2.2.1 Phase 1 Sampling Process Design A2-26
A2.2.2 Sampling Activities A2-29
A2.2.3 Analytical Methods A2-68
A2.2.4 Quality Control A2-68
A2.2.5 Instrument and Equipment Testing, Inspection, and Maintenance A2-71
A2.2.6 Instrument and Equipment Calibration and Frequency A2-71
A2.2.7 Inspection and Acceptance of Supplies and Consumables A2-71
A2.2.8 Nondirect Measurements A2-71
A2.2.9 Data Management A2-72
A2.3 ASSESSMENT AND OVERSIGHT A2-72
A2.3.1 Assessments and Response Action A2-72
A2.3.2 Reports to Management A2-72
A2.3.3 Changes in Workscope A2-73
A2.4 DATA VERIFICATION, VALIDATION, AND USABILITY A2-73
A2.4.1 Data Review, Verification, and Validation A2-73
A2.4.2 Verification and Validation Methods A2-73
A2.4.3 Reconciliation with User Requirements A2-74

A3.0 FIELD-SAMPLING PLAN A3-1
A3.1 SAMPLING OBJECTIVES A3-1
A3.2 CHARACTERIZATION APPROACH A3-1
A3.3 FIELD INVESTIGATIONS A3-4
A3.3.1 Surface Measurements A3-4
A3.3.2 Subsurface Measurements – Direct-Push Logging A3-4

A3.3.3 Direct-Push Soil Sampling A3-5
A3.3.4 Soil Field Screening A3-6
A3.3.5 Test-Pit Excavations A3-7
A3.3.6 Preshipment Sample Screening A3-7
A3.4 SURVEYING A3-7
A3.5 WASTE-MANAGEMENT SAMPLING A3-8

A4.0 HEALTH AND SAFETY A4-1

A5.0 MANAGEMENT OF INVESTIGATION-DERIVED WASTE A5-1

A6.0 REFERENCES A6-1

ATTACHMENT

SUPPORTING INFORMATION ..... AA-i

FIGURES

Figure A-1. Index Map for Pipelines to be Sampled in the 200 East Area..... A1-4

Figure A-2. Index Map for Pipelines to be Sampled in the 200 West Area. A1-5

Figure A-3. Project Organization..... A2-2

Figure A-4. Preliminary Conceptual Contaminant-Distribution Model for Buried Process-Waste Pipelines..... A2-27

Figure A-5. Sample Location Map for the 200-E-192-PL Pipeline..... A2-37

Figure A-6. Sample Location Map for the 200-W-174-PL Pipeline. A2-38

Figure A-7. Sample Location Map for the 200-E-160-PL and 200-E-162-PL Pipelines. A2-39

Figure A-8. Sample Location Map for the 200-E-112-PL Pipeline..... A2-40

Figure A-9a. Sample Location Map for the 200-E-127-PL Pipeline. (Page 1 of 3)..... A2-41

Figure A-9b. Sample Location Map for the 200-E-127-PL Pipeline. (Page 2 of 3)..... A2-42

Figure A-9c. Sample Location Map for the 200-E-127-PL Pipeline. (Page 3 of 3)..... A2-43

Figure A-10. Sample Location Map for the 200-E-113-PL Pipeline..... A2-44

Figure A-11. Sample Location Map for the 200-W-79-PL Pipeline. A2-45

Figure A-12. Sample Location Map for the 200-E-187-PL Pipeline..... A2-46

Figure A-13. Sample Location Map for the 200-W-157-PL Pipeline. A2-47

Figure A-14. Sample Location Map for the 200-E-188-PL Pipeline..... A2-48

Figure A-15. Sample Location Map for the 200-W-173-PL Pipeline. A2-49

Figure A-16. Sample Location Map for the 200-E-193-PL Pipeline..... A2-50

Figure A-17. Sample Location Map for the 200-E-194-PL Pipeline..... A2-51

Figure A-18. Sample Location Map for the 200-W-175-PL Pipeline. A2-52

Figure A-19. Sample Location Map for the 200-E-195-PL Pipeline..... A2-53

Figure A-20. Sample Location Map for the Northern Portion of the 200-E-114-PL Pipeline..... A2-54

Figure A-21. Sample Location Map for the Southern Portion of the 200-E-114-PL Pipeline. A2-55

TABLES

Table A-1. Process Waste-Stream Bins for Facility Pipelines. A1-3

Table A-2. Pipeline Summary Information A1-19

Table A-3. Facilities Process-Waste Pipeline-Systems Contaminants of Potential Concern A2-5

Table A-4. Phase 1 Decision Rules A2-8

Table A-5. Alternative Actions. A2-8

Table A-6. Facilities Process-Waste Pipeline Systems – Radionuclide Analytical Performance Requirements. A2-11

Table A-7. Facilities Process-Waste Pipeline Systems – Primary Inorganic and Organic Constituents Analytical Performance Requirements. A2-12

Table A-8. Radionuclide Analytical Performance Requirements for Liquids. A2-19

Table A-9. Inorganic and Organic Constituents Analytical Performance Requirements for Liquids. A2-20

Table A-10. Radiological Field-Screening Methods. A2-30

Table A-11. Nonradiological Field-Screening Methods A2-30

Table A-12. Sample Location Summary Information. A2-33

Table A-13. Summary of Activities at All Pipeline Sample Locations. A2-57

Table A-14. Summary of Activities for Alternate Sampling Locations. A2-61

Table A-15. Summary of Field Screening. A2-63

Table A-16. Summary of Field Quality Control Samples for Laboratory Analysis. A2-64

Table A-17. Sample Preservation, Container, and Holding Time Guidelines. A2-66

TERMS

AA	alternative action
AEA	alpha energy analysis
aG	amber glass
ALARA	as low as reasonably achievable
bgs	below ground surface
CERCLA	*Comprehensive Environmental Response, Compensation, and Liability Act of 1980*
CFR	*Code of Federal Regulations*
CI	cast iron
CM	corrugated metal
COPC	contaminant of potential concern
CS	carbon steel
CUL	cleanup level
CVAA	cold vapor atomic absorption
CZ	contamination zone
d/min	disintegrations per minute
DP	diversion pit
DQO	data quality objective
DR	decision rule
Ecology	Washington State Department of Ecology
EPA	U.S. Environmental Protection Agency
FRE	fiberglass-reinforced epoxy
FS	feasibility study
G	glass
GC	gas chromatograph
GS	gamma spectroscopy
HEIS	*Hanford Environmental Information System* database
HPGe	high-purity germanium
IC	ion chromatograph
ICP	inductively coupled plasma
ICPMS	inductively coupled plasma/mass spectrometry
IDW	investigation-derived waste
LSC	liquid scintillation counter
M-2	stainless steel
M-35	carbon steel
MEK	methyl ethyl ketone
MH	manhole
N/A	not applicable
NAD83	*North American Datum of 1983*
NaI	sodium iodide
NWTPH	Northwest total petroleum hydrocarbon
OU	operable unit
P	plastic
PCB	polychlorinated biphenyl

PFP	Plutonium Finishing Plant
PL	pipeline
PSQ	principal study question
PUREX	Plutonium-Uranium Extraction (Plant or process)
QAPjP	quality assurance project plan
QC	quality control
REDOX	Reduction-Oxidation (Plant or process)
RI	remedial investigation
RL	U.S. Department of Energy, Richland Operations Office
ROD	record of decision
SAP	sampling and analysis plan
SGL	spectral gamma logging
SP	sampler pit
SS	stainless steel
SST	single-shell tank
Stl	steel
SVOA	semivolatile organic analyte
TBD	to be determined
TBP	tributyl phosphate
TOC	total organic carbon
TPH	total petroleum hydrocarbon
URMA	Underground Radioactive Management Area
VC	vitrified clay
VOA	volatile organic analyte
VOC	volatile organic compound
WAC	*Washington Administrative Code*
WIDS	*Waste Information Data System* database
WMA	waste management area

1

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

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APPENDIX A

SAMPLING AND ANALYSIS PLAN FOR THE PHASE 1 CHARACTERIZATION OF THE FACILITY PROCESS-WASTE PIPELINE SYSTEMS

A1.0 INTRODUCTION

This sampling plan and analysis plan (SAP) encompasses the first phase of a two-phased sampling approach for the 200-IS-1 Operable Unit (OU) pipeline systems. This Phase 1 SAP directs the characterization activities for the interior of selected pipelines and vadose-zone soil adjacent to pipelines associated with facility process-waste pipelines. Sampling and analysis requirements for tank-farm waste-transfer pipelines are discussed in the SAP included in Appendix B.

This SAP includes specifications for the evaluation of 30 interior pipeline locations, 68 direct-push soil locations for geophysical logging, and 40 soil-sampling locations. Contaminant levels will be evaluated in the interior of each pipeline at three separate locations along its length. To evaluate whether contamination in surrounding soil has occurred, geophysical logging and sampling will be conducted in two areas along each selected pipeline. Direct-push technology will be used to drive small-diameter casing needed for soil investigations. Each soil-sampling area includes completion of two direct-push installations, one on each side of the pipeline. The objective of Phase 1 characterization is to determine if contaminant concentrations are above preliminary cleanup levels. Preliminary cleanup levels used for determining detection limit requirements for characterization sampling are presented in Tables 3-5a and 3-5b of D&D-30262, *Data Quality Objectives Summary Report for the 200-IS-1 Operable Unit Pipelines and Appurtenances*.

Both field-screening techniques and laboratory analytical methods will be used for analysis. As part of the preparation of this SAP, information was compiled concerning waste-stream characteristics (chemical and radiological composition) and analytical results from samples collected at the disposal sites that received waste through those pipelines that are under investigation. This information, summarized in the Attachment, was used to identify specific constituents (e.g., hexavalent chromium, mercury, nitrate, Cs-137) or classes of compounds (e.g., volatile organic compounds [VOC], polyaromatic hydrocarbons, polycholorinated biphenyls [PCB]) that would be appropriate target compounds for field-screening analyses.

A second phase of sampling and analyses will be undertaken if additional data are needed for the 200-IS-1 OU pipelines after review of the Phase 1 results. The field-investigation objectives for Phase 2 entail collection of sufficient data for remedial decision making, including a no-action decision. Data-collection objectives for both phases were developed during the data quality objectives (DQO) process for 200-IS-1 OU pipeline systems. The sampling design for this subsequent phase will be presented in a Phase 2 SAP that will be included as an amendment to this Phase 1 SAP. The Phase 2 SAP will be prepared after all Phase 1 results have been compiled and reviewed. Modification to D&D-30262 and/or the work plan may be required before completion of the Phase 2 SAP. Where Phase 2 characterization is needed, the decision errors and data confidence requirements will be reevaluated, as appropriate.

The sampling and analyses described in this document will provide data to refine the conceptual contaminant-distribution models, support an assessment of risk, and evaluate remedial alternatives for the facility process-waste pipeline systems. Characterization activities described in this SAP are based on implementing the DQO process. General sampling-design parameters and the objectives for Phase 1 are presented in D&D-30262.

Chapter A1.0 of this SAP provides an overview of the characterization activities to be completed and descriptions of the pipelines and adjacent soil areas to be investigated. Chapter A2.0 includes the content identified for inclusion in a Quality Assurance Project Plan (QAPjP), as outlined in EPA/240/B-01/003, *EPA Requirements for Quality Assurance Project Plans*, EPA QA/R-5. The structure and headings in Chapter A2.0 follow the format defined in the U.S. Environmental Protection Agency (EPA) guidance. Chapter A3.0 presents the field-sampling plan, which describes the sampling objectives, characterization approach, and field investigations to be performed. Chapter A4.0 discusses health and safety, and Chapter A5.0 provides information on the management of investigation-derived waste (IDW).

A1.1 PIPELINE DESCRIPTIONS AND HISTORY

The 200-IS-1 OU includes pipelines and appurtenance located in the 200 East and 200 West Areas on the Hanford Site in south-central Washington State. The majority of the pipelines being evaluated in this SAP are located within the exclusive land-use boundary identified in DOE/EIS-0222-F, *Final Hanford Comprehensive Land-Use Plan Environmental Impact Statement*.

The following subsections provide a listing and brief description and history of the pipelines being evaluated in this SAP. The organization for the descriptions is by process waste-stream bin, indicating the primary and alternate pipelines that have been identified for evaluation. Information provided includes process-waste characteristics, general features of the pipeline, and summary information related to the liquid-waste disposal site that received the process waste via the pipeline. Historical information on operations pertaining to the disposal site often is pertinent to the attached pipeline that carried the waste. Process-waste streams associated with each pipeline bin are summarized in Table A-1. Figures A-1 (200 East Area) and A-2 (200 West Area) show the general locations of all of the pipelines discussed in this SAP and provide the figure numbers for the sample location maps. The detailed sample-location maps for each of the pipelines are presented in Chapter A2.0.

For each pipeline bin, alternate pipelines for characterization are indicated. The alternate pipelines are included to address the potential for encountering field conditions that would result in the candidate primary lines not being able to be investigated. Circumstances such as undocumented buried obstacles and worker health and safety issues could require use of the alternate pipelines for evaluation.

Up to four pipelines are identified per process waste-pipeline bin to accommodate the separate characterizations objectives for the interior of pipelines and for surrounding soils and inclusion of alternate pipelines.

Table A-1. Process Waste-Stream Bins for Facility Pipelines.

Bin Number	Waste Category	Waste Stream Description
1	Process Condensate and Process Waste (Waste streams associated with the 200-PW-1, -2, -3, -4, -5, and -6 Operable Units) Chemical Laboratory Waste (Waste streams associated with the 200-LW-1 and -2 Operable Units)	• Process condensate generally is water condensed from the closed process system and that was in direct contact with radioactive and chemical materials. • Process waste is low-level and/or hazardous waste that directly contacted radioactive material and that may contain organic complexants that could enhance their mobility. • Potential transuranic waste associated with the 200-PW-1, -2, and -6 Operable Unit waste streams. • CCl_4 associated with the 200-PW-1 Operable Unit waste stream. • Laboratory process wastes and/or laboratory decontamination waste streams that generally are low in radionuclides, although some have significant inventories of plutonium, uranium, and fission products. Liquid volumes typically are lower. • Potential transuranic waste associated with some 200-LW-2 Operable Unit waste streams.
2	Steam Condensate and Cooling Water (Waste streams associated with the 200-CW-1, -2, -3, -4, and -5 Operable Units and the 200-SC-1 Operable Unit)	• These waste streams were run in a noncontact manner; that is, a barrier separated the liquids in this category from contaminated process liquids, with little consequent potential for routine radiological contamination. However, contamination did enter these streams in generally negligible to very small quantities through pinhole leaks or through rare pipe ruptures. • Potential transuranic waste associated with the 200-CW-5 Operable Unit waste stream.
3	Chemical Sewer Waste (Waste streams associated with the 200-CS-1 Operable Unit)	• Chemical-sewer waste sites received solvent-extraction waste that was generally low in all radiological contaminants.
4	Miscellaneous Waste (Waste streams associated with the 200-MW-1 Operable Unit)	• Generally consists of waste streams low in radionuclide and chemical constituents. Waste streams associated with plant ventilation and stack drainage, equipment decontamination, and a number of small- to medium- volume radioactive waste streams from multiple sources. • The relationship of the 216-A-4 Crib's high radiological-constituent levels to the general waste characteristics of this group is uncertain
5	Tank/Scavenged Waste (Waste streams associated with the 200-TW-1 and -2 Operable Units)	• Consists of waste streams with relatively high concentrations of radiological constituents. These liquid wastes are associated directly or indirectly with tank wastes collected from the bismuth-phosphate process. • Potential transuranic waste associated with the 200-TW-2 Operable Unit waste stream.

Figure A-1. Index Map for Pipelines to be Sampled in the 200 East Area.

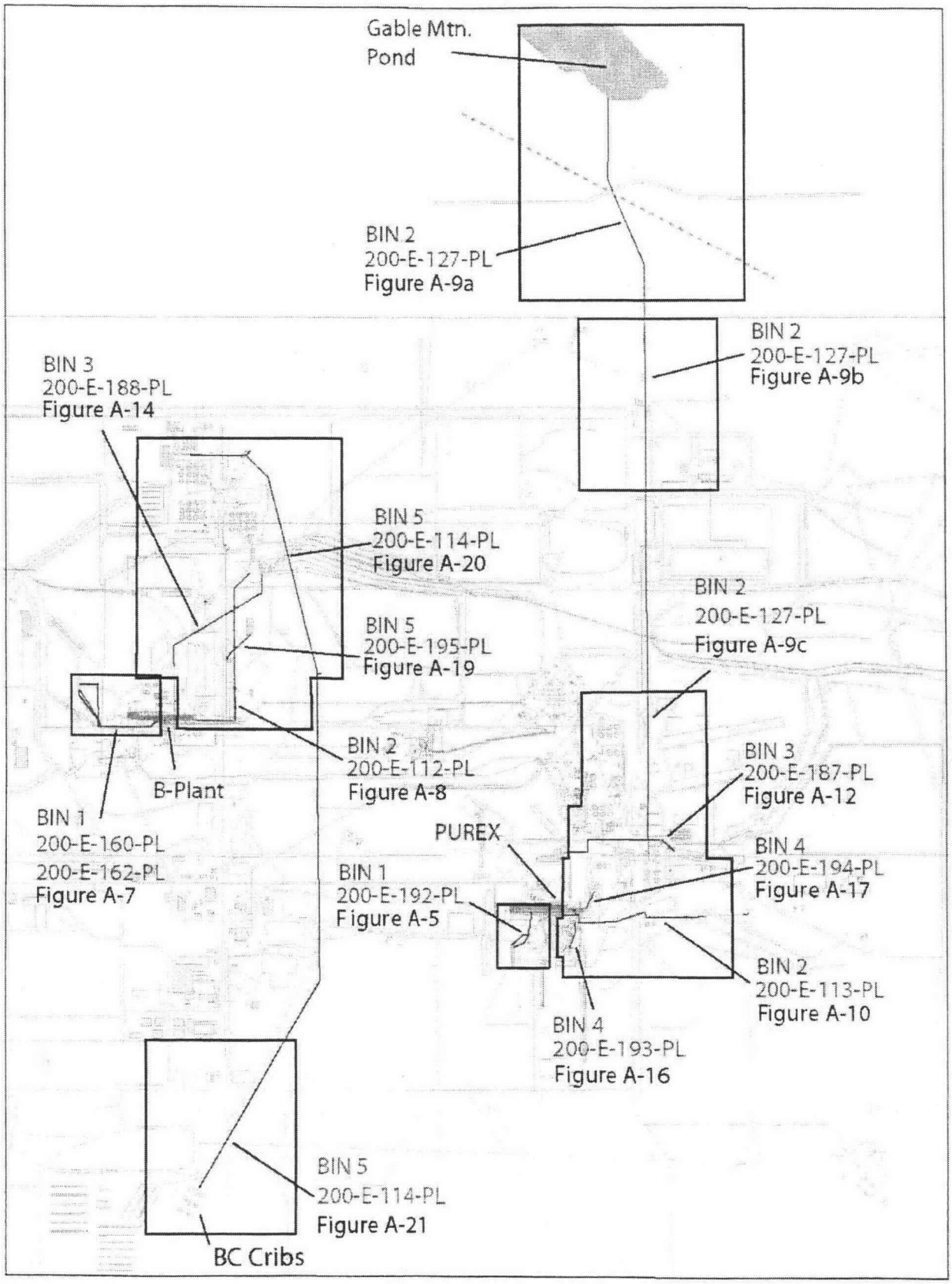
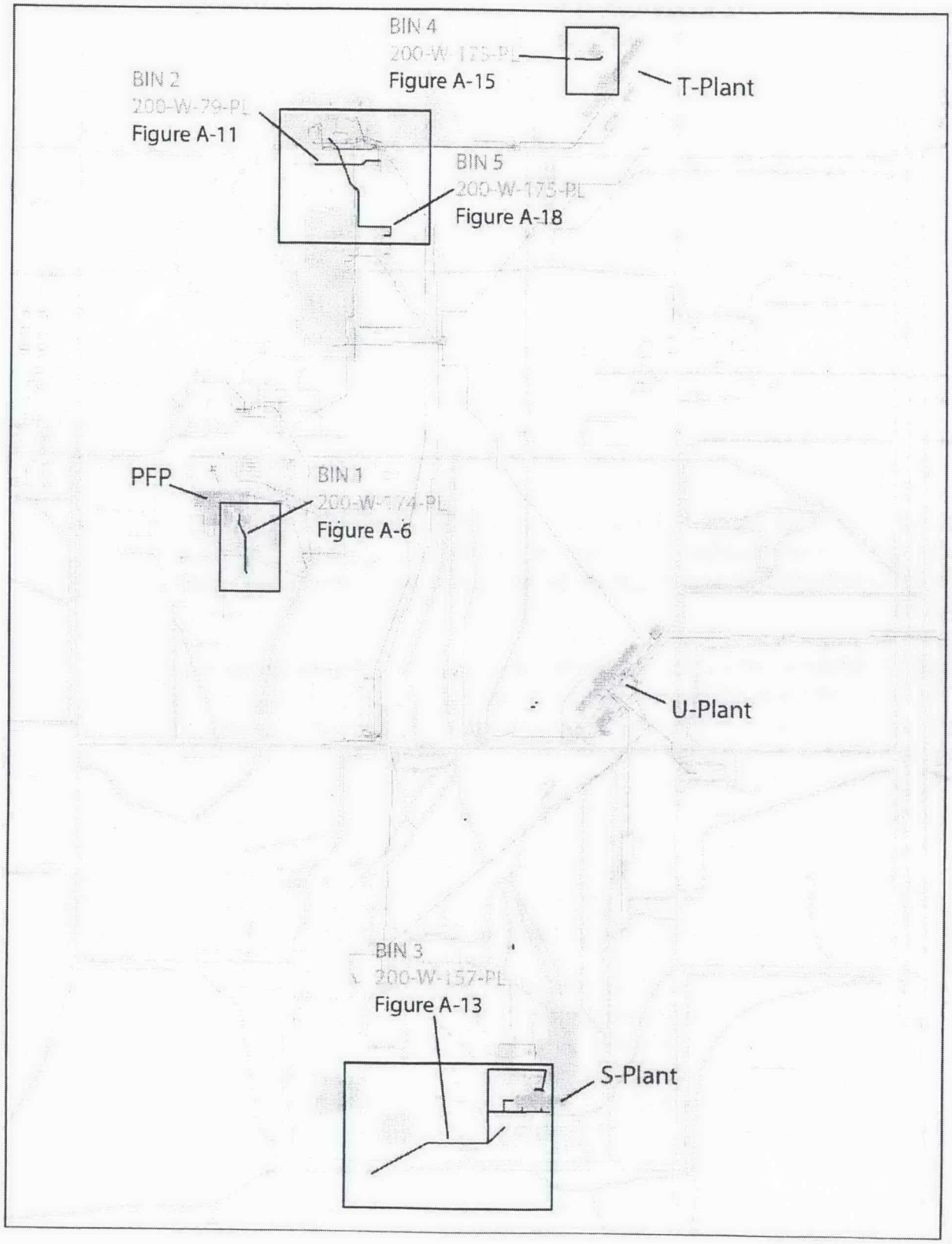


Figure A-2. Index Map for Pipelines to be Sampled in the 200 West Area.



A1.1.1 Pipelines Being Evaluated in Bin 1 (Process Condensate, Process Waste, and Laboratory Waste)

Pipeline Number: **200-E-192-PL**

Pipeline Sampling: Primary pipeline for both interior-pipe and exterior-soil characterization.

Waste Stream, Source: PUREX 202-A Canyon Building; acidic (pH 1.0 to 2.5) process distillate/condensate discharge generated from two product concentrators.

Associated Liquid-Waste Site and OU: 216-A-10 Crib (200-PW-2)

Pipeline Description: This pipeline, located south of the PUREX Plant in the 200 East Area, is made up of two separate segments with separate pipeline identification numbers. One segment (200-E-192-PL:1) is an 8-in. vitrified clay (VC) pipe that extends from Proportional Sampler Pit #4 to the northern end of the 216-A-10 Crib, where it connects to the center-crib distribution line. The second pipeline segment (200-E-192-PL:2) is an 8-in. stainless steel (SS) pipe that extends from Proportional Sampler Pit #4 to near the northern part of the 216-A-10 Crib, where it connects to a second distribution line, east of the center-crib distribution line. The approximate combined total length of the two pipeline segments being evaluated is 173 m (568 ft).

Pipeline and Associated Disposal Waste-Site History: The liquid-waste disposal site (216-A-10 Crib) was operational from 1956 to 1987. In 1956, the site was used for testing purposes, using only nonradioactive water. From 1956 to November 1961, it was inactive. Beginning in November 1961, the site began receiving contaminated waste (process condensate) from the 202-A Canyon Building. On April 19, 1962, the clay distributor pipe to the crib collapsed and caused a surface depression. A new distributor (replacement) line was installed parallel to the collapsed line. The replacement line failed in 1966. The crib was active until January 1978, and then was inactive until October 1981, when it again began receiving acidic process condensate from the 202-A Canyon Building. The site stopped receiving waste on March 3, 1987, and was deactivated that month (*Waste Information Data System* [WIDS]).

Analytical results for soil samples collected from the 216-A-10 Crib are summarized in DOE/RL-2004-25, *Remedial Investigation Report for the 200-PW-2 Uranium-Rich Process Waste Group and 200-PW-4 General Process Condensate Group Operable Units*. Constituents and the maximum detected concentrations in the 216-A-10 Crib include Pu-238 (316 pCi/g), Pu-239/240 (7,100 pCi/g), Am-241 (1,320 pCi/g), Cs-137 (2,950 pCi/g), U-238 (1 pCi/g), Sr-90 (45 pCi/g), H-3 (835 pCi/g), oil & grease (59,400 mg/kg), tributyl phosphate (TBP) (2,000 mg/kg), and a few VOCs (less than 1 mg/kg) (see Table ATT-2).

Pipeline Number: **200-W-174-PL**

Pipeline Sampling: Primary pipeline for interior-pipe characterization and alternate pipeline for exterior-soil characterization.

Waste Stream, Source(s): Z Plant 234-5Z, 236-Z, and 242-Z facility operations; process-waste discharge (aqueous organic, americium, and uranium wastes).

Associated Liquid-Waste Site and OU: 216-Z-1A Tile Field (200-PW-1)

Pipeline Description: This waste-site pipeline is located south of the Plutonium Finishing Plant (PFP) in the 200 West Area, and extends from the PFP facility, at Building 234-5Z, to the northern end of the 216-Z-1A Tile Field. It primarily is made up of two 2-in. SS pipelines running in parallel. The two parallel SS pipes convert to one 8-in. VC pipe just north of the entry to the 216-Z-1A Tile Field. The approximate length of pipeline being evaluated is 173 m (568 ft).

Pipeline and Associated Disposal Waste-Site History: The liquid-waste site was operational from 1949 to 1969. Originally it was constructed to receive liquid-waste overflow from the 216-Z-1 and 216-Z-2 Cribs. Later the cribs were bypassed, and the waste was routed directly to the 216-Z-1A Tile Field. The tile field was deactivated in 1969 (WIDS).

Analytical data for soil samples taken from the 216-Z-1A Tile Field 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*. Constituents and the maximum detected concentrations in the 216-Z-1A Tile Field include Pu-239/240 (38,200,000 pCi/g), Am-241 (2,590,000 pCi/g), Cs-137 (23 pCi/g), chromium (22 mg/kg), nitrate (250 mg/kg), carbon tetrachloride (7 mg/kg), chloroform (3.6 mg/kg), methylene chloride (20 mg/kg), and a few other VOCs and semivolatile organic compounds (SVOC) (less than 1 mg/kg) (see Table ATT-2).

Pipeline Numbers: **200-E-160-PL and 200-E-162-PL**

Pipeline Sampling: Primary pipelines for exterior-soil characterization and alternate pipelines for interior-pipe characterization.

Waste Stream, Source(s): 221-U Canyon Building and 224-U UO_3 Building (via cross-site transfer line) and 221-B Canyon Building; process condensate and construction waste. The waste was low in salt and is neutral to basic.

Associated Liquid-Waste Site and OU: 216-B-12 Crib (200-PW-2)

Pipeline Description: The waste pipeline, located west of B Plant in the 200 East Area, is a 6-in. VC pipeline that extends from the 270-E-1 Neutralization Tank Pit, located west of the 221-B Canyon Building, to the southern end of the 216-B-12 Crib, where it connects to the center-crib distribution line. The 200-E-162-PL Pipeline is made up of two waste pipelines. The first

pipeline (200-E-162-PL:1) extends from a sampler pit, located south of the 221-B Canyon Building, to the southeastern end of the 216-B-62 Crib. The 200-E-162-PL:1 Pipeline is made up of 4-in. carbon steel (CS), M-2 (SS), M-35 (CS), and fiberglass-reinforced epoxy (FRE) pipes. The second pipeline (200-E-162-PL:2) is a 4-in. FRE pipe that extends from a diversion pit, located east of the 216-B-12 Crib along pipeline 200-E-162-PL:1, to the eastern side of the 216-B-12 Crib, where it connects to the center-crib distribution line. The portion of the 200-E-162-PL:1 Pipeline that extends north from the diversion pit (at the connection with 200-E-162-PL:2) to the 216-B-62 Crib is not part of this investigation. A third pipeline may exist and appears to extend from near the 270-E-1 Neutralization Tank Pit to the southern end of the 216-B-12 Crib. This pipeline is constructed of unknown materials, and the pipe diameter also is unknown. The approximate combined total length of the pipelines being evaluated is 886 m (2,907 ft).

Pipeline and Associated Disposal Waste-Site History: The liquid-waste site was operational from 1952 to 1973. From November 1952 to December 1957, the 216-B-12 Crib received process condensate from the TBP uranium recovery processes at the 221-U and 224-U Buildings as well as B Plant condensate. From December 1957 to May 1967, the site was inactive. From May 1967 to November 1967, the site received construction waste from the 221-B Building. After November 1967, the site received process condensate from the 221-B Building (WIDS).

Analytical data for soil samples were taken from DOE/RL-2004-25. Constituents and the maximum detected concentrations in the 216-B-12 Crib include Pu-239/240 (4 pCi/g), Am-241 (2 pCi/g), Cs-137 (61,900 pCi/g), U-238 (12 pCi/g), Sr-90 (12,700 pCi/g), H-3 (8 pCi/g), total uranium (28 mg/kg), chromium (30 mg/kg), nitrate as N (165 mg/kg), ammonia (404 mg/kg), TBP (2 mg/kg), and Aroclor-1254[1] (less than 1 mg/kg) (see Table ATT-2).

Associated Contamination-Zone Information: A contamination zone (CZ) is located relatively near the 216-B-12 Crib, next to the 200-E-160-PL Pipeline and directly in line with the location of the third pipeline that also may extend to the waste site. While no radiological survey information is available for the CZ, its size, shape, and approximate location have been estimated. The CZ is surface stabilized and posted (WIDS).

A1.1.2 Pipelines Being Evaluated in Bin 2 (Steam Condensate and Cooling Water)

Pipeline Number: **200-E-112-PL**

Pipeline Sampling: Primary pipeline for interior-pipe characterization.

Waste Stream, Source: B Plant; process effluent and cooling water normally containing small amounts of radioactivity (see *Pipeline and Associated Waste Site History*, below).

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[1] Aroclor is an expired trademark.

Associated Liquid-Waste Site(s) and OU: 216-B-2 Ditches and 216-B-3 Ditches (200-CW-1), and possibly the 216-B-63 Ditch (200-CS-1) via the 207-B Retention Basin (200-CW-1) and 200-E-191-PL.

Pipeline Description: This pipeline is located east and northeast of B Plant in the 200 East Area, and extends from the south side of the 221-B Canyon Building, to the west side of the 207-B Retention Basin. The pipeline primarily is made up of a 24-in. VC pipe, although a section of 24-in. cast iron (CI) pipe extends from B Plant eastward to a manhole where the pipeline changes direction to the north. Numerous manholes are present along this pipeline. The approximate length of pipeline being evaluated is 659 m (2,162 ft).

Pipeline and Associated Disposal Waste-Site History: The liquid-waste site was operational from 1945 to 1997. In November 1963, a coil developed a leak in Tank 6-1 (Rare Earth Storage Tank) inside the 221-B Canyon Building and released approximately 30 Ci of Ce-144 into the process sewer (see unplanned release UPR-200-E-32) (WIDS).

Analytical results for soil samples taken from the 216-B-2-2 Ditch are summarized in DOE/RL-2000-35, *200-CW-1 Operable Unit Remedial Investigation Report*. Constituents and the maximum detected concentrations in the 216-B-2-2 Ditch include Pu-239/240 (less than 1 pCi/g), Am-241 (1 pCi/g), Cs-137 (721 pCi/g), Sr-90 (12,100 pCi/g), mercury (less than 1 mg/kg), nitrate (330 mg/kg), Aroclor-1260 (9 mg/kg), and a few SVOCs (less than 1 mg/kg) (see Table ATT-2).

Associated Contamination-Zone Information: Two unplanned releases (UPR-200-E-80 and UPR-200-E-1) are located along the 200-E-112-PL Pipeline. Both releases are near the 221-B Building. The first release, UPR-200-E-80, occurred in June 1946 when the line failed, a portion of the area above the line caved in, the dose rate at the surface was 400 rad/h, and it was estimated that about 10 Ci of fission products were released into the soil. The second "release," UPR-200-E-1, occurred in September 1946, approximately 24 m (80 ft) from the first leak, and was assumed to be caused by migration from the June leak. Radiation survey results are not reported for the second leak, but the area was covered with enough soil to reduce surface contamination readings to 2 mrad/h. The area of these leaks is posted with radiation warning signs (WIDS).

Pipeline Number: **200-E-127-PL**

Pipeline Sampling: Primary pipeline for both interior-pipe and exterior-soil characterization.

Waste Stream, Source: PUREX 202-A Building and B Plant operations; cooling water.

Associated Liquid-Waste Site and OU: 216-A-25 Gable Mountain Pond (200-CW-1)

Pipeline Description: This pipeline extends from the 216-A-42 Retention Basin, in the 200 East Area, to the 216-A-25 Gable Mountain Pond, north of the 200 East Area. The pipeline is made up of a corrugated metal (CM) pipe, and pipe diameters are 30, 36, and 42 in. Many manholes

are present along this pipeline. The approximate length of pipeline being evaluated is 5,830 m (19,127 ft).

Pipeline and Associated Disposal Waste-Site History: The liquid-waste site was operational from 1957 to 1987. From 1957 until May 1958, the pond received 202-A Canyon Building waste. In May 1958, it began receiving cooling water from the 241-A-431 Process Building contact condenser. In 1960, it began receiving cooling water from the 241-A-401 Building surface condenser. In November 1967, it began receiving cooling water from the 284-E Powerhouse wastewater. In January 1968, it began receiving cooling water and steam condensate from the 244-AR Vault. In March 1969, the 241-A-431 line was valved out. In March 1977, the pond also began receiving steam condensate cooling water from the 242-A Evaporator. In June 1964, a PUREX Plant tank developed a coil leak, releasing ~10,000 Ci of fission products into the cooling-water stream. Three quarters of this release went to the 216-A-25 Pond (see UPR-200-E-34) (WIDS).

Analytical data for soil samples taken from the 216-A-25 Gable Mountain Pond are summarized in DOE/RL-2000-35. Constituents and the maximum detected concentrations in the 216-A-25 Gable Mountain Pond include Pu-239/240 (less than 1 pCi/g), Am-241 (less than 1 pCi/g), Cs-137 (7,180 pCi/g), Sr-90 (59 pCi/g), chromium (24 mg/kg), nitrate (500 mg/kg), and ammonia as N (77 mg/kg) (see Table ATT-2).

Associated Contamination-Zone Information: Little information is available about the three known CZs located over the 200-E-127-PL Pipeline. WIDS indicates that contaminated tumbleweeds were a problem in these CZs at one time. These three areas are outside and to the north of the 810 Gate. They are roughly rectangular and are surface stabilized. Two of the CZs are posted as Contaminated Areas, and the other is posted as an Underground Radioactive Material Area (URMA) (WIDS).

Pipeline Number: **200-E-113-PL**

Pipeline Sampling: Alternate pipeline for both interior-pipe and exterior-soil characterization.

Waste Stream, Source: PUREX Plant, steam condensate, equipment-disposal-tunnel floor drainage and water-filled door drainage, and the slug storage basin overflow waste from the 202-A Canyon Building. The waste was low in salt and is neutral to basic.

Associated Liquid-Waste Sites and OU: 216-A-30 Crib and 216-A-6 Crib (200-SC-1)

Pipeline Description: This pipeline is located east of the PUREX Plant in the 200 East Area, and is a 16-in. steel pipeline that extends from the PUREX Plant toward the 216-A-6 Crib (where it once ended), then on to the northwestern end of the 216-A-30 Crib, where it connects to the center-crib distribution line. The approximate length of pipeline being evaluated is 535 m (1,755 ft).

Pipeline and Associated Disposal Waste-Site History: The liquid-waste site was operational from 1961 to 1992. It received 202-A waste from 1961 until November 1965, and again from

January 1970 to June 1992. The steam-condensate stream was shut down in June 1992, and all discharges to the crib were discontinued. The crib was permanently isolated in 1995 (WIDS). No analytical sampling data were identified for the cribs associated with this pipeline.

Associated Contamination-Zone Information: Two known CZs are located over the 200-E-113-PL Pipeline. One is a larger (~230 ft^2) and roughly triangular CZ, and another is a small (a few square meters), roughly square CZ next to the 216-A-42C Valve Box, nearer the 216-A-30 Crib. Both sites are surface stabilized and posted as Contaminated Areas, although the site next to the valve box is much older. The maximum radiation survey count for these two CZs was 1,050 c/min beta/gamma in October 2000, obtained for a tumbleweed growing in the area (Radiation Survey Report SS256115, *Vegetation Growth Above Posted Pipeline Associated with 216-A-42C and 216-A-30 Crib*).

Pipeline Number: **200-W-79-PL**

Pipeline Sampling: Primary pipeline for exterior-soil characterization.

Waste Stream, Source: 221-U Canyon Building, 221-T Canyon Building, and 2706-T Decontamination Facility; steam condensate, equipment decontamination, and miscellaneous waste. Some waste contained sodium hydroxide.

Associated Liquid-Waste Site and OU: 216-T-36 Crib (200-SC-1)

Pipeline Description: This pipeline is located south of the T Tank Farm in the 200 West Area, and is a 4-in. VC pipeline that extends from a connection point south of the T Tank Farm to the eastern end of the 216-T-36 Crib, where it connects to the center-crib distribution line. The approximate length of pipeline being evaluated is 193 m (633 ft).

Pipeline and Associated Disposal Waste-Site History: The liquid-waste site was operational from May 1967 until around 1973. The end date for this liquid-waste site is unclear. However, it appears to have to have been site shut down between 1970 and 1973, based on available documentation (WIDS). No analytical sampling data were identified for the crib associated with this pipeline.

Associated Contamination-Zone Information: Three CZs are located over the 200-W-79-PL Pipeline. The two areas nearest the crib are roughly rectangular; the area further from the crib also is basically rectangular, but has an irregular-shaped portion below the main area. This lower portion was created when contaminated vegetation built up along a fence, and it is not considered related to the pipeline. The entire CZ area is ~17,000 ft^2, including the unrelated portion. All three sites are surface stabilized and posted as URMAs. The maximum radiological survey count measured within these CZs was 80,100 c/min beta/gamma in August 1998, obtained from rabbitbrush. The ground surface and several anthills were surveyed along portions of the pipeline in these CZs (Radiation Survey Report SS248978, *Survey of Underground Transfer Lines*). The instrument counts for the anthills were at background. The maximum ground-surface reading was 4,100 c/min beta/gamma (Radiation Survey Report SS248978).

A1.1.3 Pipelines Being Evaluated in Bin 3 (Chemical Sewer Waste)

Pipeline Number: **200-E-187-PL**

Pipeline Sampling: Alternate pipeline for both interior-pipe and exterior-soil characterization.

Waste Stream, Source: PUREX 202-A Building; chemical sewer, acid-fractionator condensate and cooling water.

Associated Liquid Waste Site and OU: 216-A-29 Ditch (200-CS-1)

Pipeline Description: This pipeline is located north and northeast of the PUREX Plant in the 200 East Area, and extends from the north side of the PUREX Plant, at Building 202-A, to the discharge point into the 216-A-29 Ditch. The pipeline is made up primarily of a 12-in. VC pipe, although a newer section of 15-in. CS pipe extends from a manhole near the northeast corner of the AW Tank Farm. Many manholes are present along this pipeline. The approximate length of pipeline being evaluated is 432 m (1,417 ft).

Pipeline and Associated Disposal Waste-Site History: The liquid-waste site was operational from 1955 to 1991. It originally received condenser cooling water and chemical-sewer waste from the 202-A Canyon Building. Beginning in December 1957, the process cooling water was rerouted to the 216-A-25 Gable Mountain Pond. Beginning in February 1958, the liquid-waste site also received acid-fractionator condensate from the 202-A Canyon Building. Beginning in December 1962, it also received seal cooling water from air-sampler vacuum pumps in the 202-A Canyon Building. From December 1963 to January 1966, the vacuum-pump cooling water was rerouted to the 216-A-35 French Drain. The head end of the ditch was modified in 1983, during the construction of the AP Tank Farm (WIDS).

Analytical results for soil samples taken from the 216-A-29 Ditch are summarized in DOE/RL-2004-17, *Remedial Investigation Report for the 200-CS-1 Chemical Sewer Group Operable Unit*. Constituents and the maximum detected concentrations in the 216-A-29 Ditch include Pu-239/240 (667 pCi/g), Am-241 (145 pCi/g), Cs-137 (98 pCi/g), Sr-90 (less than 1 pCi/g), H-3 (7 pCi/g), chromium (37 mg/kg), hexavalent chromium (9 mg/kg), mercury (5 mg/kg), nitrate as N (210 mg/kg), ammonia (9 mg/kg), Aroclor-1254 (9 mg/kg), TBP (less than 1 mg/kg), and a few other VOCs and SVOCs (less than 1 mg/kg) (see Table ATT-2).

Pipeline Number: **200-W-157-PL**

Pipeline Sampling: Primary pipeline for both interior-pipe and exterior-soil characterization.

Waste Stream, Source: Reduction-Oxidation (REDOX) (202-S Canyon Building and high water tower); chemical-sewer waste and overflow from high water tower. Waste stream included hazardous waste salts including sodium nitrite and sodium hydroxide.

Associated Liquid-Waste Site and OU: 216-S-10 Ditch (200-CS-1)

Pipeline Description: This pipeline generally is located west and southwest of the S Plant (REDOX) in the 200 West Area, and extends from the north, west, and south sides of the 202-S Canyon Building, to the discharge point into the 216-S-10 Ditch. The pipeline is made up of 8-in. and 12-in. VC pipe. Numerous manholes are present along this pipeline. The approximate length of pipeline being evaluated is 911 m (2,989 ft), including the ancillary lines to the south of the S Plant.

Pipeline and Associated Disposal Waste-Site History: The liquid-waste site was operational from August 1951 to 1991. Until 1965, it received chemical-sewer waste from the 202-S Canyon Building and overflow from the high water tower. No dangerous wastes have been discharged to the ditch since February 1987 (WIDS).

Analytical results for soil samples collected from the 216-S-10 Ditch are summarized in DOE/RL-2004-17. Constituents and the maximum detected concentrations in the 216-S-10 Ditch include Pu-239/240 (3 pCi/g), Am-241 (less than 1 pCi/g), Cs-137 (9 pCi/g), Sr-90 (less than 1 pCi/g), chromium (813 mg/kg), hexavalent chromium (14 mg/kg), mercury (4 mg/kg), Aroclor-1254 (4 mg/kg), and several VOCs and SVOCs (less than 1 mg/kg) (see Table ATT-2).

Pipeline Number: **200-E-188-PL**

Pipeline Sampling: Primary pipeline for both interior-pipe and exterior-soil characterization.

Waste Stream, Source: 221-B Canyon Building; chemical sewer waste.

Associated Liquid Waste-Site and OU: 216-B-2 Ditches (200-CW-1), and 216-B-63 Ditch (200-CS-1)

Pipeline Description: This pipeline is located north and northeast of the B Plant in the 200 East Area and extends from the north side of the B Plant facility, at the 221-B Canyon Building, to the east side of the of the 207-B Retention Basin (bypassing the 207-B Retention Basin), then to the 216-B-2 Ditches and later to the 216-B-63 Ditch. The pipeline is made up of a 15-in. VC pipe. Many manholes are present along this pipeline. The approximate length of pipeline being evaluated is 436 m (1,430 ft).

Pipeline and Associated Disposal Waste-Site History: The liquid-waste site was operational from 1945 to 1992. Pipeline leakage was documented in the 1970s and 1980s. The leakage was discovered during excavation in the area. Subsequent testing showed that ~1.1 ML (~300,000 gal/d) was leaking from the pipe into the soil, primarily in feeder lines and connector lines, before it reached the measuring station. Major portions of the line were relined in 1985 (RHO-CD-1010, *B Plant Chemical Sewer System Upgrade*; WHC-EP-0342, Addendum 6, *B Plant Chemical Sewer Stream-Specific Report*). An unplanned release also is associated with this pipeline. On March 22, 1970, UPR-200-E-138 resulted in the release of ~1000 Ci of Sr-90 into the chemical-sewer line. The dose rate in the B Plant gallery was 500 R/h at a distance of 4 in. on March 23, 1970 (WIDS).

Analytical data for soil samples taken from the 216-B-63 Ditch are provided in DOE/RL-2004-17. Constituents and the maximum detected concentrations in the 216-B-63 Ditch include Am-241 (less than 1 pCi/g), Cs-137 (4 pCi/g), Sr-90 (30 pCi/g), chromium (22 mg/kg), nitrate as N (188 mg/kg), Aroclor-1254 (less than 1 mg/kg), and a few VOCs (less than 1 mg/kg) (see Table ATT-2).

Associated Contamination-Zone Information: Three roughly rectangular CZs are located over the 200-E-188-PL Pipeline. All three sites are surface stabilized and posted as URMAs. The maximum rad survey count for these CZs was 1,200 c/min beta/gamma in August 2000, obtained for a tumbleweed fragment (Radiation Survey Report SS255613, *Survey of Transfer Line Northeast of B Plant to 207-B*).

A1.1.4 Pipelines Being Evaluated in Bin 4 (Miscellaneous Waste)

Pipeline Number: **200-W-173-PL**

Pipeline Sampling: Primary pipeline for both interior-pipe and exterior-soil characterization.

Waste Stream, Source: T Plant, 2706-W Decontamination Building; decontamination liquid waste. The waste is low in salt, neutral to basic, and contains sodium hydroxide.

Associated Liquid Waste-Site and OU: 216-T-33 Crib (200-MW-1)

Pipeline Description: This pipeline is located northwest of the T Plant in the 200 West Area and consists mainly of 8-in.-diameter VC that extends from the southeast side of the 2706-T Building, in the northwestern part of the T Plant facility, to the eastern end of the 216-T-33 Crib, where it connects to the center-crib distribution line. A short section of 6-in. VC pipe runs from the 2706-T Building connection point to a weir pit, located at the southeast corner of the same building. The approximate length of pipeline being evaluated is 80 m (262 ft). Analytical results for soil samples collected from the 216-T-33 Crib are provided in DOE/RL-2005-62, *Remedial Investigation Report for the 200-MW-1 Miscellaneous Waste Group Operable Unit*. Constituents and the maximum detected concentrations in the 216-T-33 Crib include Am-241 (2 pCi/g), Pu-239/240 (63 pCi/g), Cs-137 (33 pCi/g), Sr-90 (49 pCi/g), chromium (34 mg/kg), nitrate (254 mg/kg), oil & grease (842 mg/kg), Aroclor-1254 (9 mg/kg), Aroclor-1260 (4 mg/kg), and a few VOCs (less than 1 mg/kg) (see Table ATT-2).

Pipeline and Associated Disposal Waste-Site History: The liquid-waste site was operational from January to February 1963, when the pipeline to the waste site plugged. Operating management believed that the line to the unit retained all of the waste. Sections of the line were removed (WIDS).

Pipeline Number: **200-E-193-PL**

Pipeline Sampling: Primary pipeline for both interior-pipe and exterior-soil characterization.

Waste Stream, Source: PUREX 202-A, 293-A, and 291-A facilities; sump waste, laboratory-cell drainage, stack drainage. The waste is low in salt and is neutral to basic.

Associated Liquid Waste-Site and OU: 216-A-21 Crib (200-MW-1)

Pipeline Description: This pipeline is located south of the PUREX Plant in the 200 East Area, and is a 6-in. VC pipeline that extends from the eastern side of Building 293-A, in the southern part of the PUREX Plant, to the northern end of the 216-A-21 Crib, where it connects to the center-crib distribution line. The approximate length of pipeline being evaluated is 114 m (374 ft).

Pipeline and Associated Disposal Waste-Site History: The liquid-waste site was operational from October 1957 to June 1965. Until June 1958, the site received sump waste from the 293-A Building. In June 1958, this pipeline failed, and the liquid-waste site was taken out of service until a new distribution system could be installed. The unit was brought back into service in December 1958. From December 1958 to June 1965, it received laboratory-cell drainage from the 202-A Canyon Building and 291-A Stack drainage (WIDS). No analytical sampling data were identified for the waste site associated with this pipeline.

Pipeline Number: **200-E-194-PL**

Pipeline Sampling: Alternate pipeline for both interior-pipe and exterior-soil characterization.

Waste Stream, Source: PUREX 202-A Building, miscellaneous liquid waste containing less than 1 Ci of total beta activity.

Associated Liquid Waste-Site and OU: 216-A-32 Crib (200-MW-1)

Pipeline Description: This pipeline is located northeast of the PUREX Plant in the 200 East Area and is a 6-in. VC pipeline that extends from the east side of the PUREX Plant, at Building 202-A, to the southwestern end of the 216-A-32 Crib, where it connects to the center-crib distribution line. The pipe diameter is 6 in. The approximate length of pipeline being evaluated is 83 m (272 ft).

Pipeline and Associated Disposal Waste-Site History: The liquid-waste site was operational from January 1959 to 1972. The crib received floor, sink, and shower drainage from the 202-A Canyon Building. BHI-00178, *PUREX Plant Aggregate Area Management Study Technical Baseline Report*, indicates that Isochem Corporation intended to dispose of 24,600 L (6,500 gal) of a product containing kerosene into the crib, but reports that investigators were unable to verify whether the proposed disposal took place (WIDS). No analytical sampling data were identified for the waste site associated with this pipeline.

A1.1.5 Pipelines Being Evaluated in Bin 5 (Tank/Scavenged Waste)

Pipeline Number: **200-W-175-PL**

Pipeline Sampling: Primary pipeline for interior-pipe characterization and an alternate pipeline for exterior-soil characterization.

Waste Stream, Source: T Plant; first-cycle scavenged supernatants (flowing into the 216-T-26 Crib), 221-T steam condensate and process-decontamination waste and equipment-decontamination waste from 2706-T (flowing to the 216-T-27 Crib), and steam condensate and process decontamination waste from the 241-T-112 Tank in the T Tank Farm and from 2706-T (flowing to the 216-T-28 Crib) (WIDS). A portion of the pipeline also carried cooling water from the 242-T Evaporator to the 207-T Retention Basin (see 200-W-167-PL discussion below).

Associated Liquid-Waste Site and OU: the 216-T-26 Crib (200-TW-1) and the 216-T-27 and 216-T-28 Cribs (200-MW-1)

Pipeline Description: This pipeline generally is located west and southwest of the T Plant in the 200 West Area. It is a 3-, 3.5-, and 4-in. steel pipeline that extends from the southern portion of the T Tank Farm, at the 241-T-112 Tank, to the northern end of the 241-TY-201 Flush Tank, where the associated waste was subsequently sent to the 216-T-26 Crib. The approximate length of pipeline being evaluated is 405 m (1,329 ft).

It should be noted that the blank ends of two other previously connected pipelines (from the TX Tank Farm and the 207-T Retention Basin) occur near two locations at the northern and southern ends of the 4-in. section of this pipeline (200-W-175-PL). Before it was disconnected at these two locations, the 4-in. section of this pipeline was used as part of another waste pipeline site, 200-W-167-PL. Another pipeline from TY Tank Farm was disconnected in 1955 at the southern end of the 4-in. section of this pipeline (200-W-175-PL) That pipeline previously was connected to the 3-in. section of this pipeline (200-W-175-PL) leading to the 241-TY-201 Flush Tank.

Pipeline and Associated Disposal Waste-Site(s) History: The liquid-waste sites were operational from 1955 to 1966. From August 1955 until November 1956, the pipeline was used to carry first-cycle scavenged supernatant from the TY Tank Farm, and later from the 241-T-112 Tank, to the 216-T-26 Crib. This waste contained ferrocyanide, fluoride, nitrate, nitrite, phosphate, sodium, sodium aluminate, sodium hydroxide, sodium silicate, and sulfate. From September 1965 to November 1965, the pipeline carried 221-T Canyon Building steam condensate and process-decontamination waste and equipment-decontamination waste from 2706-T to the 216-T-27 Crib. From February 1960 through February 1963, the 200-W-175-PL Pipeline carried steam condensate and process-decontamination waste from the 241-T-112 Tank in the T Tank Farm to the 216-T-28 Crib. In 1963, the pipeline also began carrying 2706-T steam condensate and process-decontamination waste to the 216-T-28 Crib. The 216-T-28 Crib was deactivated in December 1966 (WIDS).

Analytical data for soil samples taken from the 216-T-26 Crib are summarized in DOE/RL-2002-42, *Remedial Investigation Report for the 200-CS-1 Chemical Sewer Group Operable Unit*. Constituents and the maximum detected concentrations in the 216-T-26 Crib include Am-241 (227 pCi/g), Pu-239/240 (6,320 pCi/g), U-238 (21 pCi/g), Cs-137 (47,900 pCi/g), Sr-90 (49,100 pCi/g), H-3 (2,650 pCi/g), total uranium (61 mg/kg), chromium (94 mg/kg), hexavalent chromium (4 mg/kg), nitrate as N (693 mg/kg), ammonia (95 mg/kg), fluoride (168 mg/kg), TBP (91 mg/kg), acetone (less than 1 mg/kg), and xylenes (less than 1 mg/kg) (see Table ATT-2).

Pipeline Number: **200-E-195-PL**

Pipeline Sampling: Primary pipeline for exterior-soil characterization and alternate pipeline for interior-pipe characterization.

Waste Stream, Source: 221-B Canyon Building, cell drainage and other liquid waste. The waste is low in salt, neutral to basic, and contains transuranic and fission products.

Associated Liquid-Waste Site and OU: 216-B-9 Crib (200-TW-2)

Pipeline Description: This pipeline is located northeast of the B Plant in the 200 East Area and is a 3.5-in. SS pipeline that extends from the connection point with Line 204 (from B Plant), east of the 241-B-361 Settling Tank, to the southwestern end of the 216-B-9 Crib, where it connects to the center-crib distribution line. The approximate length of pipeline being evaluated is 145 m (476 ft).

Pipeline and Associated Disposal Waste-Site History: The waste site was operational from August 1948 to July 1951, receiving cell drainage and other liquid waste via Tank 5-6 in the 221-B Canyon Building (WIDS). No sampling analytical data were identified for the waste site associated with this pipeline.

Associated Contamination-Zone Information: A CZ (UPR-200-E-7) is located over the pipeline from the 221-B Canyon Building to the 216-B-9 Crib. WIDS indicates that the CZ was caused by leakage in the waste line that led to a cave-in in 1954. An estimated 19,000 L (5,000 gal) of waste leaked into the soil at the time, and the maximum surface dosage rate observed was 1.7 rad/h over a 30 ft^2 area. While the cave-in was filled in and once was marked, its exact location no longer can be determined, according to WIDS.

Pipeline Number: **200-E-114-PL**

Pipeline Sampling: The northern and southern portions of the 200-E-114-PL Pipeline were selected as a primary pipeline for both interior-pipe and exterior-soil characterization.

Waste Stream, Source: 221-U Canyon Building; scavenged TBP supernatant waste from uranium recovery operations containing Cs-137, Sr-90, and uranium isotopes. The waste was

high in salt and neutral to basic. It also contained inorganic compounds such as ferrocyanide, nitrate, and phosphate.

Associated Liquid-Waste Site and OU: BC Cribs and Trenches Area and 216-B-51 French Drain (200-TW-1). The 216-B-46 Crib received the same liquid-waste stream from the BY Tank Farm that the northern portion of the 200-E-114-PL Pipeline received. Waste-stream disposal data available for the 216-B-46 Crib are considered indicative of the liquid-waste transferred through 200-E-114-PL.

Pipeline Description: Two portions of the 200-E-114-PL Pipeline were identified for investigation. In the northern section, the part of the line that extends from the north side of the BY Tank Farm to the junction with the C Tank Farm line was selected. The eastern segment of the pipeline that connects with C Tank Farms was not included. The southern area being evaluated includes the portion of line near the BC Cribs. The 200-E-114-PL Pipeline consists of two 4-in. carbon steel lines running in parallel. The operational history of this pipeline is complex. This pipeline received waste streams from several sources and served multiple waste sites. The approximate length of the pipeline being evaluated is 3,415 m (11,201 ft).

Pipeline and Associated Disposal Waste-Site History: This pipeline was used to transfer liquid waste to the BC Cribs and Trenches Area (216-B-14, 216-B-15, 216-B-16, 216-B-17, 216-B-18, and 216-B-19 Cribs) from January 1956 through December 1957. The 216-B-51 French Drain, located along the 200-E-114-PL Pipeline nearer the BY Tank Farm, received liquid waste from January 1956 to January 1958. The 216-B-46 Crib, associated with the same waste stream, received liquid waste from September to December 1955 (WIDS).

Analytical data for soil samples taken from the 216-B-46 Crib are provided in DOE/RL-2002-42. Constituents and the maximum detected concentrations in the 216-B-46 Crib include Pu-239/240 (227 pCi/g), Cs-137 (364,000 pCi/g), Sr-90 (353,000 pCi/g), H-3 (53 pCi/g), total uranium (44 mg/kg), chromium (30 mg/kg), nitrate and N/N as N (5,470 mg/kg), and TBP (19 mg/kg) (see Table ATT-2).

Associated Contamination-Zone Information: Two CZs are located over the northern portion of the 200-E-114-PL Pipeline, with a larger (~4500 ft^2), roughly square CZ at or near the connection to the 216-B-51 French Drain and a smaller (~2800 ft^2), roughly rectangular CZ further from the tank farms, at or near a bend in the line. Both sites are surface stabilized and posted as URMAs. The maximum radiation survey count for these two CZs was 8,050 c/min beta/gamma in October 2000, obtained for a tumbleweed in the area (Radiation Survey Reports SS253960, *Survey of B Plant Transfer Line*; and SS256142, *Vegetation Growth in Posted CA Associated with UPR-200-E-144*). A later, May 2002, radiation survey reported 72,500 c/min from an area in the second CZ (Radiation Survey Report SS261107, *Assessment Survey in a Posted CA South of 12th Street*).

Table A-2 provides a summary of the information presented in the previous pipeline discussions. The process facilities, associated liquid-disposal waste sites and operable units, and physical characteristics of the pipelines are provided.

Table A-2. Pipeline Summary Information. (2 Pages)

Bin	Pipeline Number	Area/Assoc. Facility	Associated Liquid Waste Disposal Site	Operable Unit	Pipeline Physical Attribute Summary		Breakout of Pipe Materials and Diameters									
					Pipe Materials [a] and Pipeline Length (ft)	Pipe Diameters (in.) [a]	Stl	SS	CS	M-2	M-35	CM	VC	FRE	CI	Other
1	200-E-192-PL	200 East/ PUREX	216-A-10 Crib	200-PW-2	Stainless steel and vitrified clay (539.5ft)	8		8					8			
	200-W-174-PL	200 West/ Plutonium Finishing Plant	216-Z-1A Tile Field	200-PW-1	Stainless steel and vitrified clay (982 ft)	2, 3, and 8		2, 3					8			
	200-E-160-PL; 200-E-162-PL	200 East/ B Plant and U Plant	216-B-12 Crib	200-PW-2	Vitrified clay, M-2, M-35, carbon steel, fiberglass reinforced epoxy, and unknown (2,907 ft)	4, 6, and unknown			4	4	4		6	4		Unk
2	200-E-112-PL	200 East/ B Plant	216-B-2-2 Ditch	200-CW-1	Vitrified clay and cast iron (2,162 ft)	24							24		24	
	200-E-127-PL	200 East/ PUREX and B Plant	216-A-25 Gable Mountain Pond	200-CW-1	Corrugated metal (19,127 ft)	30, 36, and 42						30, 36, 42				
	200-E-113-PL	200 East/ PUREX	216-A-30 Crib	200-SC-1	Steel (1,755 ft)	16	16									
	200-W-79-PL	200 West/ T Plant and U Plant	216-T-36 Crib	200-SC-1	Vitrified clay (6,33 ft)								4			

Table A-2. Pipeline Summary Information. (2 Pages)

Bin	Pipeline Number	Area/Assoc. Facility	Associated Liquid Waste Disposal Site	Operable Unit	Pipeline Physical Attribute Summary		Breakout of Pipe Materials and Diameters									
					Pipe Materials [a] and Pipeline Length (ft)	Pipe Diameters (in.) [a]	Stl	SS	CS	M-2	M-35	CM	VC	FRE	CI	Other
3	200-E-187-PL	200 East/ PUREX	216-A-29 Ditch	200-CS-1	Vitrified clay and carbon steel (1,417 ft)	12 and 15			15				12			
	200-W-157-PL	200 West/ S Plant (REDOX)	216-S-10 Ditch	200-CS-1	Vitrified clay (2,989 ft)	8 and 12							8, 12			
	200-E-188-PL	200 East/ B Plant	216-B-63 Ditch	200-CS-1	Vitrified clay (1,430 ft)	15							15			
4	200-W-173-PL	200 West/ T Plant	216-T-33 Crib	200-MW-1	Vitrified clay (262 ft)	6 and 8							6, 8			
	200-E-193-PL	200 East/ PUREX	216-A-21 Crib	200-MW-1	Vitrified clay (374 ft)	6							6			
	200-E-194-PL	200 East/ PUREX	216-A-32 Crib	200-MW-1	Vitrified clay (272 ft)	6							6			
5	200-W-175-PL	200 West/ T Plant	216-T-26 Crib	200-TW-1	Steel (1,329 ft)		3, 3.5, 4									
	200-E-195-PL	200 East/ B Plant	216-B-9 Crib	200-TW-2	Stainless steel (476 ft)			3.5								
	200-E-114 PL	200 East/ B Plant	216-B-46 Crib [b]	200-TW-1	Carbon steel (11,201 ft)	4			4							

[a] The pipe materials and diameters listed are only for pipelines selected for sampling and are based on the current level of review of engineering drawings (see Table ATT-1). This listing is subject to change, should additional information become available.

[b] Because of its complex operational history, the 200-E-114-PL Pipeline has been associated with many liquid-waste disposal sites. The 216-B-46 Crib was selected as the best candidate for association with the northern portion of this pipeline that is being evaluated as part of this investigation.

CI = cast iron.
CM = corrugated metal.
CS = carbon steel.
FRE = fiberglass reinforced steel.
M-2 = stainless steel.
OU = operable unit.
PL = pipeline.
M-35 = carbon steel.
PUREX = Plutonium-Uranium Extraction Plant.
REDOX = Reduction-Oxidation Plant.
SS = stainless steel.
Stl = steel (unknown).
VC = vitrified clay.

Table ATT-1 in the Attachment lists the engineering drawings that were reviewed to determine the pipeline locations, materials, and pipe diameters. These drawings provide additional pipeline construction details and should be referenced if additional information is needed during the field investigation.

1

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A2.0 QUALITY ASSURANCE PROJECT PLAN

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

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

A2.1 PROJECT MANAGEMENT

The following section addresses basic areas of project management. It also identifies project elements including the project task and goals, quality objectives, and required documentation.

A2.1.1 Project/Task Organization

The project organization is described in the subsections that follow and is shown in Figure A-3.

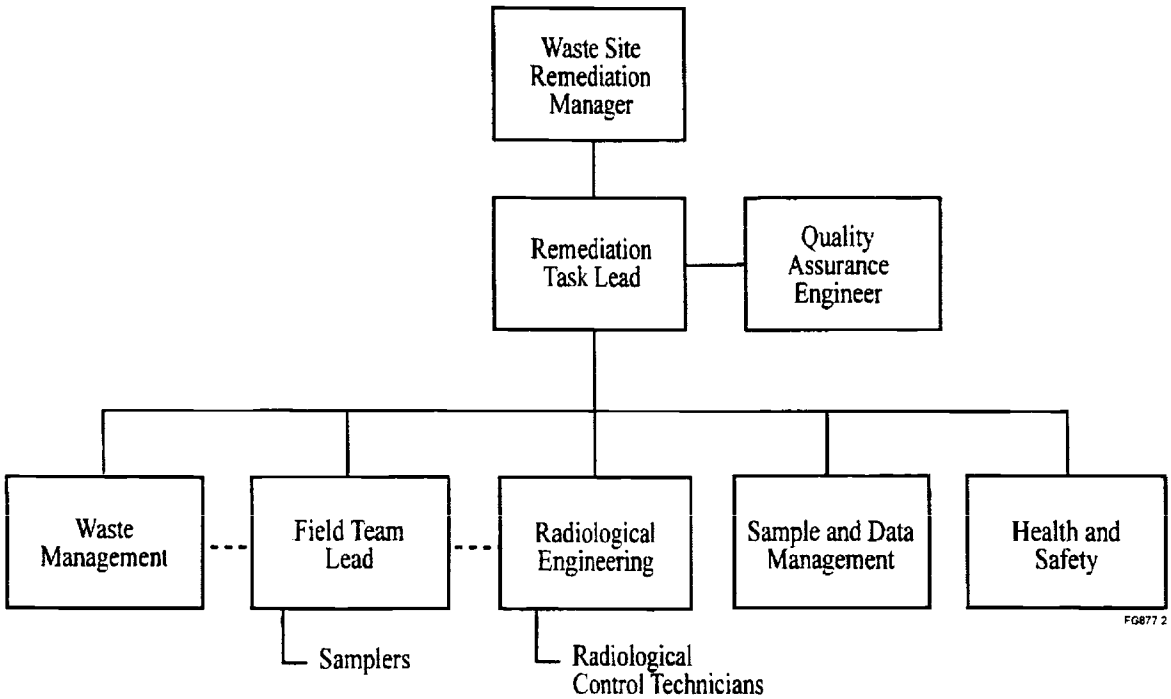
A2.1.1.1 Waste Site Remediation Manager

The Waste Site Remediation Manager provides oversight for all activities and coordinates with the U.S. Department of Energy, Richland Operations Office (RL) and regulators in support of sampling activities. In addition, support is provided to the task lead to ensure that the work is performed safely and cost effectively.

A2.1.1.2 Remediation Task Lead

The Remediation Task Lead is responsible for direct management of sampling documents and requirements, field activities, and subcontracted tasks. The Remediation Task Lead ensures that the Field Team Lead, samplers, and others responsible for implementing this SAP and the QAPjP are provided with current copies of this document and any revisions thereto. The Remediation Task Lead works closely with quality assurance, health and safety, and the Field Team Lead to integrate these and the other lead disciplines in planning and implementing the workscope. The Remediation Task Lead also coordinates with, and reports to, RL, regulators, and the Project Hanford Management Contractor on all sampling activities.

Figure A-3. Project Organization.



A2.1.1.3 Quality Assurance Engineer

The Quality Assurance Engineer is matrixed to the Remediation Task Lead and is responsible for quality assurance issues on the project. Responsibilities include oversight of implementation of the project quality assurance requirements; review of project documents, including SAPs (and the QAPjP); and participation in quality assurance assessments on sample collection and analysis activities, as appropriate.

A2.1.1.4 Waste Management

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 (e.g., with WAC 173-303, "Dangerous Waste Regulations") of the characterization data to generate waste designations, profiles, and other documents that confirm compliance with Environmental Restoration Disposal Facility waste acceptance criteria specified in BHI-00139, *Environmental Restoration Disposal Facility Waste Acceptance Criteria.*

A2.1.1.5 Field Team Lead

The Field Team Lead has the overall responsibility for planning, coordinating, and executing 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 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 materials and equipment needed to support the field work.

The Field Team Lead oversees field-sampling activities that include sample collection, packaging, provision of certified clean sampling bottles/containers, documentation of sampling activities in controlled logbooks, chain-of-custody documentation, and packaging and transportation of samples to the laboratory or shipping center.

The Field Team Leads, samplers, and others responsible for implementation of this SAP and the QAPjP will be provided with current copies of this document and any revisions thereto.

A2.1.1.6 Radiological Engineering

The Radiological Engineering Lead is responsible for the radiological engineering and health physics support on 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. Radiological Engineering interfaces with the project health and safety representative and plans and directs radiological control technician support for all activities.

A2.1.1.7 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 quality-assurance requirements, or their equivalent, as approved by RL, the EPA, and the Washington State Department of Ecology (Ecology). Sample and Data Management periodically initiates audits of the laboratories to ensure compliance. Sample and Data Management receives the analytical data from the laboratories, makes the data entry into the *Hanford Environmental Information System* (HEIS) database, and arranges for data validation. Validation will be performed on completed data packages (including quality control [QC] samples) by the Fluor Hanford, Inc. (Fluor Hanford) Environmental Information Services group or by a qualified independent contractor.

A2.1.1.8 Health and Safety

Responsibilities include coordination of industrial safety and health support on the project as carried out through health and safety plans, job-hazard analyses, and other pertinent safety documents required by Federal regulation or by internal Fluor Hanford 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 Background and Problem Definition

The 200-IS-1 OU includes pipelines used to transfer liquid waste containing low to high concentrations of radionuclides and nonradiological constituents. The 200-IS-1 OU DQO summary report (D&D-30262) and the work plan provide additional discussion concerning development of the rationale and use of process-waste characteristics for the assignment of the pipeline bins used in this SAP.

The objective of the DQO process for the pipelines addressed in this SAP was to determine the environmental measurements necessary to support the remedial investigation/feasibility study process and remedial decision making, including refinement of the preliminary conceptual contaminant-distribution models for process-waste pipeline systems. The DQO process supported development of the content presented in this SAP.

Given that the process pipeline systems in the Central Plateau received waste discharges, the task is to determine from process history and/or data collection and analysis whether pipelines and/or surrounding soils contain constituents that are above regulatory and/or risk thresholds.

A2.1.3 Project and Task Description

The field activities described in this Phase 1 SAP include evaluation of both the pipeline interiors and the surrounding soil. For the interior evaluations, the pipelines will be accessed to permit visual inspection, field instrument measurements, and the collection of residual sediment, sludge, or scale. For the soil surrounding the pipelines, geophysical logging, field instrument measurements, soil sampling, and visual inspection will be used to assess whether contamination is present. Sampling requirements for waste-disposal determinations of IDW will be addressed through a waste-designation DQO process before the field characterization activities begin. A separate waste management plan is under development and will be submitted for Ecology's approval.

At the completion of the field investigation, a field report will be prepared to summarize the activities performed and information collected in the field. The report will include survey coordinates for direct-push locations, the number and types of samples collected and their associated HEIS numbers, inventory of IDW containers, laboratory and field-screening analyses performed, and geophysical-logging results.

A2.1.4 Quality Objectives and Criteria for Measurement Data

EPA 600/R-96/055, *Guidance for the Data Quality Objectives Process*, EPA QA/G-4, was used to support the development of this SAP. The DQO process is a strategic-planning approach that provides a systematic process for defining the criteria that a data-collection design should satisfy. Using the DQO process ensures that the type, quantity, and quality of environmental data used in decision making will be appropriate for the intended application. This section summarizes the key outputs resulting from the implementation of the DQO process.

A2.1.4.1 Contaminants of Concern

The DQO process identifies the need to develop a list of contaminants of potential concern (COPC) for the 200-IS-1 OU process-waste pipeline systems. Development of the COPCs is an essential step toward refining the preliminary conceptual contaminant-distribution models.

Liquid process-waste streams carried through the pipeline systems required disposition decisions that involved either transfer to tanks within waste management areas (WMA) or disposal from facilities operations to cribs, trenches, or other liquid-waste disposal sites. These waste-transfer and -disposal decisions were based on waste composition. Because of known differences in process waste-stream characteristics, separate evaluations were completed to determine the COPC and analytical reporting requirements for pipeline systems associated with (1) waste streams transferred from facilities directly to liquid-disposal waste sites and (2) those process wastes sent to/transferred between or transferred out of tank farms. Refinement of the master list of COPCs as applicable to the facilities or tank-farm process-waste pipelines was completed as part of the DQO process.

Process waste generated in the facilities in the Central Plateau 200 Areas and transferred directly to liquid-waste disposal sites has been the focus of the numerous characterization investigations conducted to date. Previously, a DQO process was conducted in conjunction with each of these waste-site investigations to prepare final COPC lists. For development of the 200-UR-1 OU DQO, all previous DQO COPC lists were compiled, reviewed, and refined into one comprehensive list. The list encompasses all COPCs that would be considered as primary constituents for laboratory analysis associated with the facility process-waste pipeline systems included in pipeline Bins 1-5. As part of the 200-IS-1 DQO process, several additional analytes were included at the request of Ecology. The facility process-waste pipelines COPC list is presented in Table A-3.

Table A-3. Facilities Process-Waste Pipeline-Systems Contaminants of Potential Concern. (3 Pages)

Radioactive Constituents	
Americium-241	Niobium-94[a]
Carbon-14	Plutonium-238
Cesium-137	Plutonium-239/240
Cobalt-60	Strontium-90
Europium-152	Technetium-99
Europium-154	Tritium
Europium-155	Uranium-233/234
Neptunium-237	Uranium-235/236
Nickel-63	Uranium-238
Chemical Constituents – Metals	
Antimony	Lead
Arsenic	Mercury
Barium	Nickel

Table A-3. Facilities Process-Waste Pipeline-Systems Contaminants of Potential Concern. (3 Pages)

Beryllium	Selenium
Cadmium	Silver
Chromium	Uranium
Hexavalent Chromium	Vanadium
Copper	Zinc
Chemical Constituents – Other Inorganics	
Cyanide	Nitrate/Nitrite
Fluoride	Sulfate
Chemical Constituents – Volatile Organics	
Acetone	Halogenated hydrocarbons
Acetonitrile	Hexane
Benzene	Methyl ethyl ketone
n-Butyl benzene	Methyl isobutyl ketone (MIBK)
1-Butanol (n-butyl alcohol)	Perchloroethylene
2-Butanone (MEK)	Tetrahydrofuran
Carbon Tetrachloride	Toluene
Chlorobenzene	1,1,1 Trichloroethane (TCA)
Cis-1,2-dichloroethylene	1,1,2 Trichloroethane
Cyclohexane	Trans-1,2-dichlorotheylene
1,1-dichloroethane	Tetrachloroethylene (PCE)
1,2-dichloroethane	Trichloroethylene (TCE)
1,1-dichloroethylene	Vinyl chloride
Dichloromethane (Methylene Chloride)	Xylene
Ethylbenzene	
Chemical Constituents – Semivolatile Organics[d]	
AMSCO[b] Tributyl phosphate dilutant	Normal paraffin hydrocarbon
Cyclohexanone	Polyaromatic hydrocarbons
Diesel fuel[c]	Paint thinner
Dodecane	Phenol
Hydraulic fluids (greases)	Polychlorinated biphenyls (and associated World Health Organization congeners)
Kerosene	Shell E-2342 (naphthalene and paraffin)
Naphthylamine	Soltrol-170 ($C_{10}H_{22}$ to C_6 to H_{34}; purified kerosene)

Table A-3. Facilities Process-Waste Pipeline-Systems Contaminants of Potential Concern. (3 Pages)

Dibutylphosphate*	Tributyl phosphate and derivatives (mono, bi)
Monobutylphosphate*	
Low Molecular Weight Organic Acids	
Oxalate*	Glycolate*
Formate*	

*Added to list as requested by the Washington State Department of Ecology (chelators or extractants used in processes).
[a] Contaminant of potential concern applicable to Plutonium Finishing Plant area only.
[b] Allen Maintenance Supply Company Inc.
[c] Analyzed as total petroleum hydrocarbons-diesel range; other total petroleum hydrocarbon analyses will include gasoline range.
[d] Trademarks and registered trademarks are the property of their respective owners. All product names mentioned are listed for contaminant potential only; such listing does not imply ownership and does not constitute endorsement.

If additional analytes not identified as COPCs are detected by the analytical methods used for laboratory analysis, these detected analytes and their concentrations will be evaluated against regulatory cleanup standards, or risk-based screening levels if toxicity and exposure data are available, and existing process knowledge. All detected analytes will be assessed in support of remedial-action decision making. When regulatory standards or screening levels are unavailable for a particular detected COPC and nondetections of the COPC also occur, the screening methodology applied will be consistent with EPA/540/1-89/002, *Risk Assessment Guidance for Superfund (RAGS), Volume I -- Human Health Evaluation Manual, (Part A) Interim Final,* OSWER 9285.7-01A, and EPA/540/R-97/006, *Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments Interim Final.*

A2.1.4.2 Decision Rules

Decision rules (DR) are developed from the results of the principal study questions, decision statements, remedial-action alternatives, data needs, COPC action levels, analytical requirements, and scale of the decisions. The DRs generally are structured as "IF…THEN" statements that indicate the action that will be taken when a prescribed condition is met. The DRs incorporate the parameters of interest (e.g., COPCs), the scale of the decision (e.g., location), the preliminary action levels, and the resulting actions. The decision rules for Phase 1 only are summarized in Table A-4. The associated alternative actions specified in the decision rules are presented in Table A-5.

Table A-4. Phase 1 Decision Rules. (2 Pages)

DR #	Constituents/ Media	Decision Rule
1	Nonradiological/ pipeline structures	If the concentration of chemical constituents in the pipelines, pipeline appurtenances, or plugged pipelines (as estimated by the maximum or detected values) is greater than or equal to the preliminary cleanup levels, select an appropriate alternative action (refer to Table A-5). Excludes Alternative Action 1-1b. Otherwise, evaluate the need for additional sampling.
2	Nonradiological/ soil	If the concentration of chemical constituents (as estimated by the maximum or detected values) in vadose zone soils in known leakage areas, suspect leakage areas, and/or unknown leakage areas is greater than or equal to the preliminary cleanup levels, select an appropriate alternative action (refer to Table A-5). Excludes Alternative Action 2-1b. Otherwise, evaluate the need for additional sampling.
3	Radiological/ pipeline structures	If the activity of radionuclides in the pipelines, pipeline appurtenances, or plugged pipelines (as estimated by the maximum or detected values) results in a direct radiological exposure dose greater than or equal to 15 mrem/yr above background or a groundwater radiological dose greater than or equal to 4 mrem/yr above background (based on fate and transport modeling), select an appropriate alternative action (refer to Table A-5). Excludes Alternative Action 3-1b. Otherwise, evaluate the need for additional sampling.
4	Radiological/ soil	If the activity of radionuclides (as estimated by the maximum or detected values) in vadose zone soils in known leakage areas, suspect leakage areas, and/or unknown leakage areas results in a direct radiological exposure dose greater than or equal to 15 mrem/yr above background, a groundwater radiological dose greater than or equal to 4 mrem/yr above background (based on fate and transport modeling), or 0.1 rad/d for protection of terrestrial animals select an appropriate alternative action (refer to Table A-5). Excludes Alternative Action 4-1b. Otherwise, evaluate the need for additional sampling.
5	Dangerous waste	If the concentration of chemical constituents in the pipelines, pipeline appurtenances, or plugged pipelines (as estimated by the maximum or detected values) is greater than or equal to the preliminary cleanup levels, select an appropriate alternative action (refer to Table A-5). Excludes Alternative Action 5-1b. Otherwise, evaluate the need for additional sampling.

DR = decision rule.

Table A-5. Alternative Actions. (2 Pages)

PSQ #	AA #	Alternative Actions
1	1-1a	Evaluate the need for remedial-action alternatives in an FS.*
	1-1b	Evaluate the no-action alternative in an FS.*
	1-2	Evaluate a streamlined approach (e.g., CERCLA removal actions, interim actions, voluntary actions, plug into an existing ROD) to pipeline system decision making, based on field-screening data and/or analytical data, and take appropriate actions.
	1-3	Evaluate the need for additional sampling.
2	2-1a	Evaluate the need for remedial-action alternatives in an FS.*
	2-1b	Evaluate the no-action alternative in an FS.*
	2-2	Evaluate a streamlined approach (e.g., CERCLA removal actions, interim actions, voluntary actions, plug into an existing ROD) to piping system decision making, based on field screening data and/or analytical data, and take appropriate actions.

Table A-5. Alternative Actions. (2 Pages)

PSQ #	AA #	Alternative Actions
	2-3	Evaluate the need for additional sampling.
3	3-1a	Evaluate the need for remedial-action alternatives in an FS.*
	3-1b	Evaluate the no-action alternative in an FS.*
	3-2	Evaluate a streamlined approach (e.g., CERCLA removal actions, interim actions, voluntary actions, plug into an existing ROD) to piping system decision making, based on field-screening data and/or analytical data, and take appropriate actions.
	3-3	Evaluate the need for additional sampling.
	3-4	Evaluate the need for remedial-action alternatives that include transuranic contamination in an FS.*
	3-5	Evaluate the need for remedial-action alternatives that include greater than Class C waste concentrations in an FS.*
4	4-1a	Evaluate the need for remedial-action alternatives in an FS.*
	4-1b	Evaluate the no-action alternative in an FS.*
	4-2	Evaluate a streamlined approach (e.g., CERCLA removal actions, interim actions, voluntary actions, plug into an existing ROD) to piping system decision making, based on field-screening data and/or analytical data, and take appropriate actions.
	4-3	Evaluate the need for additional sampling.
	4-4	Evaluate the need for remedial-action alternatives that include transuranic contamination in an FS.*
	4-5	Evaluate the need for remedial-action alternatives that include greater than Class C waste concentrations in an FS.*
5	5-1a	Evaluate the need for remedial-action alternatives in an FS.*
	5-1b	Evaluate the no-action alternative in an FS.*
	5-2	Evaluate a streamed-line approach (e.g., CERCLA removal actions, interim actions, voluntary actions, plug into an existing ROD, etc.) to piping system decision making, based on field screening data and/or analytical data, and take appropriate actions.
	5-3	Evaluate the need for additional sampling.

*May include innovative decision making approaches (e.g., probabilistic).
AA = alternative action.
CERCLA = *Comprehensive Environmental Response, Compensation, and Liability Act of 1980.*
FS = feasibility study.
PSQ = principal study question.
ROD = record of decision.

A2.1.4.3 Error Tolerance and Decision Consequences

A nonstatistical sampling design was identified as appropriate for Phase 1. For DRs to be resolved using a nonstatistical sampling design, there is no need to define the tolerable limits on decision error, because these only apply to statistical designs. The qualitative consequence of selecting an inadequate sampling design for this activity was considered to range from low to severe. If the sampling design is determined to be inadequate, the waste sites can be accessed readily for resampling/additional sampling during Phase 2. Chapter 5.0 of the main text summarizes the activities that are planned for after the characterization activities described in this SAP are evaluated.

A2.1.4.4 Analytical Quality Objectives

Analytical quality objectives and criteria for soil laboratory data are presented in Tables A-6 for radiological and A-7 for nonradiological analytes. For liquids that are encountered, the analytical quality objectives and criteria for soil laboratory data are presented in Tables A-8 for radiological and A-9 for nonradiological analytes. Following the completion of the DQO report (D&D-30262), RL and Ecology agreed that 12 World Health Organization PCB congeners would be included as COPCs for laboratory analysis. The specific congeners are identified in Table A-7. Laboratory analysis of these PCB congeners will be completed on 20 percent of all samples collected for laboratory analysis of PCB aroclors. Those samples designated for analysis of PCB congeners will be jointly identified by Fluor Hanford, RL, and Ecology. Criteria used in the selection process will be jointly developed and potentially could include historical process waste stream information, previous disposal site analytical sampling data, and/or field-screening results obtained during the pipeline field investigation. The measurement quality objectives for accuracy and precision for laboratory control samples, duplicates, matrix spikes, and matrix spike duplicates for the analytical laboratory are contained in DOE/RL-96-68, *Hanford Analytical Services Quality Assurance Requirements Documents*.

For all analyses, in the event of a laboratory analytical failure, the laboratory is required to initiate corrective actions with the Sample and Data Management team of the Environmental Information Systems group. As part of the data-package transmittal procedure, a sample disposition record is generated to define the problem and to indicate the agreed-upon solution reached with discussions by the project manager or task lead. As part of the sample-disposition process, quarterly trend reports containing quality statistics are compiled based on the sample-disposition records. This provides an insight into emerging problems and the effectiveness of past responses to problems.

A2.1.4.5 Laboratory Sample Custody

Sample custody during laboratory analysis will be addressed in the applicable laboratory standard operating procedures. Laboratory custody procedures will ensure the maintenance of sample integrity and identification throughout the analytical process.

A2.1.4.6 Quality Assurance Objective

The quality-assurance objective of this plan is to provide implementation guidance that will result in data of known and appropriate quality and adhere to the approved Fluor Hanford QAPjP. Data quality is assessed by representativeness, comparability, accuracy, and precision. The applicable QC guidelines, quantitative target limits, and levels of effort for assessing data quality are dictated by the intended use of the data and the nature of the analytical method. Each of these is addressed in the following subsections.

A2.1.4.6.1 Representativeness

Representativeness is a measure of how closely the results reflect the actual concentration and distribution of the chemical and radiological constituents in the matrix sampled. 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. The documentation will establish that protocols have been followed and that sample identification and integrity are ensured.

Table A-6. Facilities Process-Waste Pipeline Systems – Radionuclide Analytical Performance Requirements. (2 Pages)

Chemical Abstracts Service No. or Constituent Identifier No.	Analyte	Survey or Analytical Method	Lowest Overall CUL [a] (pCi/g)	Target Detection Limits [b] (pCi/g)	Precision Required (%) [c]	Accuracy Required (%) [c]
14596-10-2	Americium-241	Am-241 AEA	31.1	1	±30	70-130
14762-75-5	Carbon-14	C-14 LSC (low level)	4.65	1	±30	70-130
10045-97-3	Cesium-137	Gamma GS	6.2	0.1	±30	70-130
10198-40-0	Cobalt-60	Gamma GS	1.4	0.05	±30	70-130
14683-23-9	Europium-152	Gamma GS	3.3	0.1	±30	70-130
15585-10-1	Europium-154	Gamma GS	3.0	0.1	±30	70-130
14391-16-3	Europium-155	Gamma GS	125	0.1	±30	70-130
13994-20-2	Neptunium-237	Np-237 AEA	2.5	1	±30	70-130
13981-37-8	Nickel-63	Ni-63 LSC	4,026	30	±30	70-130
14681-63-1	Niobium-94[d]	Gamma GS	2.43	1	±30	70-130
13981-16-3	Plutonium-238	AEA	37.4	1	±30	70-130
Pu-239/240	Plutonium-239/240	AEA	33.9	1	±30	70-130
13982-63-3	Radium-226	Gamma GS	7.03	0.2	±30	70-130
Rad-Sr	Strontium-90	Strontium-89,90 - Total Sr – Gas Proportional Counting	4.5	1	±30	70-130
14133-76-7	Technetium-99	Technetium-99 LSC (low level)	1.93	1	±30	70-130
10028-17-8	Tritium	Tritium - H_3 LSC (mid level)	48.2	30	±30	70-130
13966-29-5	Uranium-233/234	Isotopic Uranium AEA	1.1	1	±30	70-130
15117-96-1	Uranium-235		101	1	±30	70-130
U-238	Uranium-238		1.06	1	±30	70-130
N/A	Gross cesium-137 counts	Portable NaI detector		3.1	N/A	N/A
N/A	Gross alpha	Portable contamination detector		100 d/min/ 100 cm^2	N/A	N/A

Table A-6. Facilities Process-Waste Pipeline Systems – Radionuclide Analytical Performance Requirements. (2 Pages)

Chemical Abstracts Service No. or Constituent Identifier No.	Analyte	Survey or Analytical Method	Lowest Overall CUL [a] (pCi/g)	Target Detection Limits [b] (pCi/g)	Precision Required (%) [c]	Accuracy Required (%) [c]
N/A	Gross beta/gamma	Portable contamination detector		5,000 d/min/ 100 cm^2	N/A	N/A

[a] Lowest overall CUL as identified in D&D-30262, *Data Quality Objectives Summary Report for the 200-IS-1 Operable Unit Pipelines and Appurtenances.*
[b] Units are in pCi/g (radioisotopes) unless otherwise specified.
[c] Accuracy criteria for associated batch laboratory-control sample percent recoveries. With the exception of gamma energy analysis, additional analysis-specific evaluations also are performed for matrix spikes, tracers, and carriers, as appropriate to the method. Precision criteria are based on batch laboratory replicate sample analyses.
[d] Contaminant of potential concern analysis only applicable to Plutonium Finishing Plant Area.

AEA = alpha energy analysis.
CUL = cleanup level.
GS = gamma spectroscopy.
LSC = liquid scintillation counter.
N/A = not applicable.
NaI = sodium iodide.

Table A-7. Facilities Process-Waste Pipeline Systems – Primary Inorganic and Organic Constituents Analytical Performance Requirements. (7 Pages)

Chemical Abstracts Service No. or Constituent Identifier No.	Analyte	Survey or Analytical Method [a]	Lowest Overall CUL [b] (mg/kg)	Target Detection Limits [c] (mg/kg)	Precision Required (%) [d]	Accuracy Required (%) [d]
Inorganics						
7440-36-0	Antimony	EPA Methods 6010 (trace), 6020, or 200.8 (trace)	5	0.6	±30	70-130
7440-38-2	Arsenic	EPA Methods 6010 (trace), 6020, or 200.8	6.47	1	±30	70-130
7440-39-3	Barium	EPA Methods 6010, 6020, or 200.8	132	20	±30	70-130
7440-41-7	Beryllium	EPA Methods 6010, 6020, or 200.8	10	0.5	±30	70-130
7440-43-9	Cadmium	EPA Methods 6010, 6020, or 200.8	0.81	0.5	±30	70-130
7440-47-3	Chromium (III)/Chromium (total)	EPA Methods 6010, 6020, or 200.8	42	1	±30	70-130

Table A-7. Facilities Process-Waste Pipeline Systems – Primary Inorganic and Organic Constituents Analytical Performance Requirements. (7 Pages)

Chemical Abstracts Service No. or Constituent Identifier No.	Analyte	Survey or Analytical Method [a]	Lowest Overall CUL [b] (mg/kg)	Target Detection Limits [c] (mg/kg)	Precision Required (%) [d]	Accuracy Required (%) [d]
7440-50-8	Copper	EPA Methods 6010, 6020, or 200.8	50	1	±30	70-130
18540-29-9	Hexavalent chromium	EPA Method 7196	18.4	0.5[e]	±30	70-130
7439-92-1	Lead	EPA Methods 6010, 6020, or 200.8	50	5	±30	70-130
7439-97-6	Mercury	EPA Methods 7471, 6020, or 200.8	0.33	0.2	±30	70-130
7439-98-7	Molybdenum	EPA Methods 6010, 6020, or 200.8	2	2	±30	70-130
7440-02-0	Nickel	EPA Methods 6010, 6020, or 200.8	30	4	±30	70-130
7782-49-2	Selenium	EPA Methods 6010 (trace), 6020, or 200.8	0.78	1[f]	±30	70-130
14808-79-8	Sulfate	IC Anions, EPA Method 300.0	1,000	5	±30	70-130
7440-22-4	Silver	EPA Methods 6010, 6020, or 200.8	2	2	±30	70-130
7440-28-0	Thallium	EPA Methods 6010 (trace), 6020, or 200.8	1	0.5	±30	70-130
7440-61-1	Uranium (total)	Kinetic phosphorescence analysis, or EPA Method 200.8	3.21	0.2	±30	70-130
7440-62-2	Vanadium	EPA Methods 6010, 6020, or 200.8	560	2.5	±30	70-130
7440-66-6	Zinc	EPA Methods 6010, 6020, or 200.8	86	1	±30	70-130
57-12-5	Cyanide	EPA Methods 9010 total cyanide or 335	0.80	0.5	±30	70-130
14797-55-8	Nitrate	IC, EPA Method 300.0	40	2.5	±30	70-130
14797-65-0	Nitrite	IC, EPA Method 300.0	4	2.5	±30	70-130
NO_3/NO_2	Nitrogen in nitrite and nitrate	EPA Method 353	12	0.75	±30	70-130

Table A-7. Facilities Process-Waste Pipeline Systems – Primary Inorganic and Organic Constituents Analytical Performance Requirements. (7 Pages)

Chemical Abstracts Service No. or Constituent Identifier No.	Analyte	Survey or Analytical Method [a]	Lowest Overall CUL [b] (mg/kg)	Target Detection Limits [c] (mg/kg)	Precision Required (%) [d]	Accuracy Required (%) [d]
Organics						
208-96-8	Acenaphthylene	EPA Method 8270	97.9	0.33	±30	70-130
67-64-1	Acetone	EPA Method 8260	28.9	0.02	±30	70-130
75-05-8	Acetonitrile	EPA Method 8260	0.196	0.1	±30	70-130
71-43-2	Benzene	EPA Method 8260	0.00448	0.0015	±30	70-130
120-12-7	Anthracene	EPA Method 8270	1,140	0.33	±30	70-130
56-55-3	Benzo(a)anthracene	EPA Method 8270	0.856	0.33	±30	70-130
50-32-8	Benzo(a)pyrene	EPA Method 8270	0.137	0.33	±30	70-130
205-99-2	Benzo(b)fluoranthene	EPA Method 8270	1.37	0.33	±30	70-130
191-24-2	Benzo(ghi)perylene	EPA Method 8270	2,400	0.33	±30	70-130
207-08-9	Benzo(k)fluoranthene	EPA Method 8270	13.7	0.33	±30	70-130
100-51-6	Benzyl alcohol	EPA Method 8260/8270	20.7	0.33	±30	70-130
75-27-4	Bromodichloromethane	EPA Method 8260	0.00368	0.005	±30	70-130
71-36-3	n-butyl alcohol (1-butanol)	EPA Method 8015 or 8260	6.62	5	±30	70-130
56-23-5	Carbon tetrachloride	EPA Method 8260	0.00310	0.002	±30	70-130
108-90-7	Chlorobenzene	EPA Method 8260	0.874	0.005	±30	70-130
67-66-3	Chloroform (trichloro-methane)	EPA Method 8260	0.0381	0.005	±30	70-130
218-01-9	Chrysene	EPA Method 8270	95.6	0.33	±30	70-130
156-59-2/ 156-60-5	Cis/Trans-1,2-Dichloro-ethylene	EPA Method 8260	720	0.005	±30	70-130
108-94-1	Cyclohexanone	EPA Method 8270	344	0.5	N/A	N/A
53-70-3	Dibenzo(ah)anthracene	EPA Method 8270	0.137	0.33	±30	70-130
75-34-3	1,1-Dichloroethane	EPA Method 8260	4.37	0.001	±30	70-130

Table A-7. Facilities Process-Waste Pipeline Systems – Primary Inorganic and Organic Constituents Analytical Performance Requirements. (7 Pages)

Chemical Abstracts Service No. or Constituent Identifier No.	Analyte	Survey or Analytical Method [a]	Lowest Overall CUL [b] (mg/kg)	Target Detection Limits [c] (mg/kg)	Precision Required (%) [d]	Accuracy Required (%) [d]
107-06-2	1,2-Dichloroethane	EPA Method 8260	0.00232	0.002	±30	70-130
75-35-4	1,1-Dichloroethylene	EPA Method 8260	0.000522	0.002	±30	70-130
75-09-2	Dichloromethane (methylene chloride)	EPA Method 8260	0.0218	0.005	±30	70-130
106-46-7	p-Dichlorobenzene	EPA Method 8270	0.03	0.33	±30	70-130
107-66-4	Dibutylphosphate	EPA Method 300.0 (modified)	--	0.2	±30	70-130
100-41-4	Ethyl benzene	EPA Method 8260	6.05	0.005	±30	70-130
60-29-7	Ethyl ether	EPA Method 8015	6.68	5	±30	70-130
86-73-7	Fluorene	EPA Method 8270	30	0.33	±30	70-130
64-18-6	Formate (formic acid)	EPA Method 300.0 (modified)	--	10.0	±30	70-130
79-14-1	Glycolate (glycolic acid)	TBD	--	4	±30	70-130
110-54-3	Hexane	EPA Method 8260	96.2	0.005	±30	70-130
193-39-5	Indeno(123-cd)pyrene	EPA Method 8270	1.37	0.33	±30	70-130
108-10-1	Methyl isobutyl ketone (MIBK hexone)	EPA Method 8260	2.71	0.01	±30	70-130
78-93-3	Methyl ethyl ketone (MEK)	EPA Method 8260	19.6	0.01	±30	70-130
--	Monobutylphosphate	EPA Method 300.0 (modified)	--	0.2		
144-62-7	Oxalate (oxalic acid)	EPA Method 300.0 (modified)	--	2		
127-18-4	Perchloroethylene (tetrachloro-ethene, PCE)	EPA Method 8260	0.000859	0.005	±30	70-130
88-01-8	Phenanthrene (ethanedionic acid)	EPA Method 8270	1,140	0.33	±30	70-130
108-95-2	Phenol	EPA Method 8270	22	0.33	±30	70-130
95-63-6	Pseudocumene (1,2,4-trimethyl benzene)	EPA Method 8260	4,000	0.2	±30	70-130

Table A-7. Facilities Process-Waste Pipeline Systems – Primary Inorganic and Organic Constituents Analytical Performance Requirements. (7 Pages)

Chemical Abstracts Service No. or Constituent Identifier No.	Analyte	Survey or Analytical Method [a]	Lowest Overall CUL [b] (mg/kg)	Target Detection Limits [c] (mg/kg)	Precision Required (%) [d]	Accuracy Required (%) [d]
109-99-9	Tetrahydrofuran	EPA Method 8260	0.05	0.05	±30	70-130
108-88-3	Toluene	EPA Method 8260	4.65	0.005	±30	70-130
71-55-6	1,1,1-Trichloroethane (TCA)	EPA Method 8260	1.58	0.005	±30	70-130
79-00-5	1,1,2-Trichloroethane	EPA Method 8260	0.00427	0.002	±30	70-130
79-01-6	Trichloroethylene (TCE)	EPA Method 8260	0.0263	0.005	±30	70-130
75-01-04	Vinyl chloride	EPA Method 8260	0.000184	0.01	±30	70-130
1330-20-7	Xylenes	EPA Method 8260	14.6	0.01	±30	70-130
126-73-8	Tributyl phosphate	EPA Method 8270	6.18	3.3	±30	70-130
2674-11-2	Aroclor-1016	PCBs, EPA Method 8082	0.65	0.02	±30	70-130
11104-26-2	Aroclor-1221	PCBs, EPA Method 8082	0.092	0.02	±30	70-130
11141-16-5	Aroclor-1232	PCBs, EPA Method 8082	0.092	0.02	±30	70-130
53969-21-9	Aroclor-1242	PCBs, EPA Method 8082	0.394	0.02	±30	70-130
126572-29-6	Aroclor-1248	PCBs, EPA Method 8082	0.386	0.02	±30	70-130
11097-6999-1	Aroclor-1254	PCBs, EPA Method 8082	0.066	0.02	±30	70-130
11096-82-5	Aroclor-1260	PCBs, EPA Method 8082	0.5	0.02	±30	70-130
32598-13-3 (BZ77)	3,3',4,4'-Tetrachlorobiphenyl	PCB congeners, EPA Method 1668	TBD	0.00001	±30	70-130
70362-50-4 ((BZ81)	3,4,4',5-Tetrachlorobiphenyl	PCB congeners, EPA Method 1668	TBD	0.00001	±30	70-130
32598-14-4 (BZ105)	2,3,3',4,4'-Pentachlorobiphenyl	PCB congeners, EPA Method 1668	TBD	0.00001	±30	70-130
74472-37-0 (BZ114)	2,3,4,4',5-Pentachlorobiphenyl	PCB congeners, EPA Method 1668	TBD	0.00001	±30	70-130
31508-00-6 (BZ118)	2,3',4,4',5-Pentachlorobiphenyl	PCB congeners, EPA Method 1668	TBD	0.00001	±30	70-130
65510-44-3 (BZ123)	2',3,4,4',5-Pentachlorobiphenyl	PCB congeners, EPA Method 1668	TBD	0.00001	±30	70-130
57465-28-8 (BZ126)	3,3',4,4',5-Pentachlorobiphenyl	PCB congeners, EPA Method 1668	TBD	0.00001	±30	70-130

Table A-7. Facilities Process-Waste Pipeline Systems – Primary Inorganic and Organic Constituents Analytical Performance Requirements. (7 Pages)

Chemical Abstracts Service No. or Constituent Identifier No.	Analyte	Survey or Analytical Method [a]	Lowest Overall CUL [b] (mg/kg)	Target Detection Limits [c] (mg/kg)	Precision Required (%) [d]	Accuracy Required (%) [d]
38380-08-4 (BZ156)	2,3,3',4,4',5-Hexachlorobiphenyl	PCB congeners, EPA Method 1668	TBD	0.00001	±30	70-130
69782-90-7 (BZ157)	2,3,3',4,4',5'-Hexachlorobiphenyl	PCB congeners, EPA Method 1668	TBD	0.00001	±30	70-130
52663-72-6 (BZ167)	2,3',4,4',5,5'-Hexachlorobiphenyl	PCB congeners, EPA Method 1668	TBD	0.00001	±30	70-130
32774-16-6 (BZ169)	3,3',4,4',5,5'-Hexachlorobiphenyl	PCB congeners, EPA Method 1668	TBD	0.00001	±30	70-130
39635-31-9 (BZ189)	2,3,3',4,4',5,5'-Heptachlorobiphenyl	PCB congeners, EPA Method 1668	TBD	0.00001	±30	70-130
TPH gasoline	Total petroleum hydrocarbon-gasoline range w/benzene	NWTPH gasoline	30	5	±30	70-130
TPH diesel	Total petroleum hydrocarbon-diesel range	NWTPH diesel	200	5	±30	70-130

Table A-7. Facilities Process-Waste Pipeline Systems – Primary Inorganic and Organic Constituents Analytical Performance Requirements. (7 Pages)

Chemical Abstracts Service No. or Constituent Identifier No.	Analyte	Survey or Analytical Method [a]	Lowest Overall CUL [b] (mg/kg)	Target Detection Limits [c] (mg/kg)	Precision Required (%) [d]	Accuracy Required (%) [d]
Oil/grease	Hydraulic fluids (greases)	EPA Method 413.1 oil/grease or 1664A	2,000	200	±30	70-130
8008-20-6, TPH-kerosene	Kerosene, normal paraffins, paint thinner	NWTPH-Dx modified for kerosene range	2,000	5	±30	70-130

[a] For 4-digit EPA methods, see SW-846, *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, Third Edition; Final Update III-B*, as amended. For EPA Methods 335, 353, and 413.1, see EPA/600/4-79/020, *Methods of Chemical Analysis of Water and Wastes*. For EPA Method 200.8, see EPA/600/R-94/111, *Methods for the Determination of Metals in Environmental Samples, Supplement 1*. For EPA Method 300.0, see EPA/600/R-93/100, *Methods for the Determination of Inorganic Substances in Environmental Samples*. For NWTPH Methods, see Ecology 97-602, *Analytical Methods for Petroleum Hydrocarbons*.

[b] Lowest overall CUL as identified in D&D-30262, *Data Quality Objectives Summary Report for the 200-IS-1 Operable Unit Pipelines and Appurtenances*.

[c] Detection limits are based on optimal conditions in a standard fixed laboratory. Interferences and matrix effects may degrade the values shown.

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

[e] Target detection limit is less than the inhalation limit of 2 mg/kg.

[f] Special arrangements will be made with the laboratory to achieve the detection limit needed for the ecological action level for selenium.

"--" No information available.

Aroclor is an expired trademark.

(BZ#) = PCB congener number originally assigned by Ballschmiter & Zell ("BZ Number") (Ballschmiter, K., and M. Zell, 1980, "Analysis of Polychlorinated Biphenyls (PCB) by Glass Capillary Gas Chromatography").

CUL = cleanup level.
EPA = U.S. Environmental Protection Agency.
IC = ion chromatography.
N/A = not applicable.
NWTPH = Northwest total petroleum hydrocarbon.
PCB = polychlorinated biphenyl.
TBD = to be determined; method and/or detection limit currently are under evaluation.
TPH = total petroleum hydrocarbon.

Table A-8. Radionuclide Analytical Performance Requirements for Liquids.

CAS #	Analyte	Survey or Analytical Method	Practical Quantitation Limit[a] (pCi/L)	Precision Required (%)[b]	Accuracy Required (%)[b]
14596-10-2	Americium-241	Am-241 AEA	1	±30	70-130
14762-75-5	Carbon-14	C-14 LSC	200	±30	70-130
10045-97-3	Cesium-137	Gamma GS	15	±30	70-130
10198-40-0	Cobalt-60	Gamma GS	25	±30	70-130
14683-23-9	Europium-152	Gamma GS	50	±30	70-130
15585-10-1	Europium-154	Gamma GS	50	±30	70-130
14391-16-3	Europium-155	Gamma GS	50	±30	70-130
13994-20-2	Neptunium-237	Np-237 AEA	1	±30	70-130
13981-37-8	Nickel-63	Ni-63 LSC	15	±30	70-130
14681-63-1	Niobium-94 [c]	Gamma GS	10	±30	70-130
13981-16-3	Plutonium-238	AEA	1	±30	70-130
Pu-239/240	Plutonium-239/240	AEA	1	±30	70-130
13982-63-3	Radium-226	AEA	1	±30	70-130
10098-97-2	Strontium-90	Gas proportional counting	2	±30	70-130
14133-76-7	Technetium-99	Technetium-99 LSC	15	±30	70-130
10028-17-8	Tritium	Tritium – H_3 LSC	400	±30	70-130
13966-29-5	Uranium-233/234	Isotopic uranium AEA	1	±30	70-130
15117-96-1	Uranium-235	Isotopic uranium AEA	1	±30	70-130
U-238	Uranium-238	Isotopic uranium AEA	1	±30	70-130

[a] Units are in pCi/L (radioisotopes) unless otherwise specified.
[b] Accuracy criteria for associated batch laboratory-control sample percent recoveries. With the exception of gamma energy analysis, additional analysis-specific evaluations also are performed for matrix spikes, tracers, and carriers, as appropriate to the method. Precision criteria are based on batch laboratory replicate sample analyses.
[c] Contaminant of potential concern analysis only applicable to Plutonium Finishing Plant Area.

AEA = alpha energy analysis.
CAS = Chemical Abstracts Service.
GS = gamma spectroscopy.
LSC = liquid scintillation counter.

1

Table A-9. Inorganic and Organic Constituents Analytical Performance Requirements for Liquids. (4 Pages)

CAS #	Analyte	Survey or Analytical Method [a]	Practical Quantitation Limit [b] (µg/L)	Precision Required (%) [c]	Accuracy Required (%) [c]
7440-36-0	Antimony	EPA Methods 6010 (trace), 6020, or 200.8	6	±30	70-130
7440-38-2	Arsenic	EPA Methods 6010 (trace), 6020, or 200.8	10	±30	70-130
7440-39-3	Barium	EPA Methods 6010, 6020, or 200.8	20	±30	70-130
7440-41-7	Beryllium	EPA Methods 6010, 6020, or 200.8	5	±30	70-130
7440-43-9	Cadmium	EPA Methods 6010, 6020, or 200.8	5	±30	70-130
7440-47-3	Chromium (III)/Chromium (total)	EPA Methods 6010, 6020, or 200.8	10	±30	70-130
7440-50-8	Copper	EPA Methods 6010, 6020, or 200.8	10	±30	70-130
18540-29-9	Hexavalent chromium	EPA Method 7196 (trace)	10	±30	70-130
7439-92-1	Lead	EPA Methods 6010 (trace), 6020, or 200.8	5	±30	70-130
7439-97-6	Mercury	EPA Methods 7471, 6020, or 200.8	0.5	±30	70-130
7439-98-7	Molybdenum	EPA Methods 6010, 6020, or 200.8	20	±30	70-130
7440-02-0	Nickel	EPA Methods 6010, 6020, or 200.8	40	±30	70-130
7782-49-2	Selenium	EPA Methods 6010 (trace), 6020, or 200.8	100	±30	70-130
14808-79-8	Sulfate	IC Anions, EPA Method 300.0	500	±30	70-130
7440-22-4	Silver	EPA Methods 6010, 6020, or 200.8	10	±30	70-130
7440-28-0	Thallium	EPA Methods 6010, 6020, or 200.8	50	±30	70-130
7440-61-1	Uranium (total)	Kinetic phosphorescence analysis, or EPA Method 200.8	1	±30	70-130
7440-62-2	Vanadium	EPA Methods 6010, 6020, or 200.8	25	±30	70-130
7440-66-6	Zinc	EPA Methods 6010, 6020, or 200.8	10	±30	70-130
57-12-5	Cyanide	EPA Methods 9010 total cyanide or 335	5	±30	70-130
14797-55-8	Nitrate	IC, EPA Method 300.0	250	±30	70-130
14797-65-0	Nitrite	IC, EPA Method 300.0	250	±30	70-130
14808-79-8	Sulfate	IC, EPA Method 300.0	500	±30	70-130
208-96-8	Acenaphthylene	EPA Method 8270	10	±30	50-150
67-64-1	Acetone	EPA Method 8260	20	±30	50-150
75-05-8	Acetonitrile	EPA Method 8260	100	±30	50-150
71-43-2	Benzene	EPA Method 8260	5	±30	50-150

Table A-9. Inorganic and Organic Constituents Analytical Performance Requirements for Liquids. (4 Pages)

CAS #	Analyte	Survey or Analytical Method [a]	Practical Quantitation Limit [b] (µg/L)	Precision Required (%) [c]	Accuracy Required (%) [c]
120-12-7	Anthracene	EPA Method 8270	10	±30	50-150
56-55-3	Benzo(a)anthracene	EPA Method 8270	10	±30	50-150
50-32-8	Benzo(a)pyrene	EPA Method 8270	10	±30	50-150
205-99-2	Benzo(b)fluoranthene	EPA Method 8270	10	±30	50-150
191-24-2	Benzo(ghi)perylene	EPA Method 8270	10	±30	50-150
207-08-9	Benzo(k)fluoranthene	EPA Method 8270	10	±30	50-150
100-51-6	Benzyl alcohol	EPA Method 8260/8270	10	±30	50-150
75-27-4	Bromodichloromethane	EPA Method 8260	5	±30	50-150
71-36-3	n-butyl alcohol (1-butanol)	EPA Method 8015 or 8260	5000	±30	50-150
56-23-5	Carbon tetrachloride	EPA Method 8260	5	±30	50-150
108-90-7	Chlorobenzene	EPA Method 8260	5	±30	50-150
67-66-3	Chloroform (trichloro-methane)	EPA Method 8260	5	±30	50-150
218-01-9	Chrysene	EPA Method 8270	10	±30	50-150
156-59-2/ 156-60-5	Cis/Trans-1,2-Dichloro-ethylene	EPA Method 8260	5	±30	50-150
108-94-1	Cyclohexanone	EPA Method 8270	20	N/A	N/A
53-70-3	Dibenzo(ah)anthracene	EPA Method 8270	10	±30	50-150
75-34-3	1,1-Dichloroethane	EPA Method 8260	10	±30	50-150
107-06-2	1,2-Dichloroethane	EPA Method 8260	1.5	±30	50-150
75-35-4	1,1-Dichloroethylene	EPA Method 8260	10	±30	50-150
75-09-2	Dichloromethane (methylene chloride)	EPA Method 8260	5	±30	50-150
106-46-7	p-Dichlorobenzene	EPA Method 8270	10	±30	50-150
107-66-4	Dibutylphosphate	EPA Method 300.0 (modified)	1000	±30	50-150
112-40-3	Dodecane	EPA Method 8270	500	±30	50-150
100-41-4	Ethyl benzene	EPA Method 8260	5	±30	50-150
60-29-7	Ethyl ether	EPA Method 8015	5	±30	50-150
86-73-7	Fluorene	EPA Method 8270	10	±30	50-150
64-18-6	Formate (formic acid)	EPA Method 300.0 (modified)	1000	±30	50-150
79-14-1	Glycolate (glycolic acid)	EPA Method 300.0 (modified)	1000	±30	50-150
110-54-3	Hexane	EPA Method 8260	5	±30	50-150
193-39-5	Indeno(123-cd)pyrene	EPA Method 8270	10	±30	50-150

Table A-9. Inorganic and Organic Constituents Analytical Performance Requirements for Liquids. (4 Pages)

CAS #	Analyte	Survey or Analytical Method[a]	Practical Quantitation Limit[b] (µg/L)	Precision Required (%)[c]	Accuracy Required (%)[c]
108-10-1	Methyl isobutyl ketone (MIBK hexone)	EPA Method 8260	10	±30	50-150
78-93-3	Methyl ethyl ketone (MEK)	EPA Method 8260	10	±30	50-150
--	Monobutylphosphate	EPA Method 300.0 (modified)	1000	±30	50-150
91-20-3	Naphthalene	EPA Method 8270	10	±30	50-150
91-59-8	2-Naphthylamine	EPA Method 8270	25	±30	50-150
144-62-7	Oxalate (oxalic acid)	EPA Method 300.0 (modified)	1000	±30	50-150
127-18-4	Perchloroethylene (tetrachloro-ethene, PCE)	EPA Method 8260	5	±30	50-150
88-01-8	Phenanthrene (ethanedionic acid)	EPA Method 8270	5	±30	50-150
108-95-2	Phenol	EPA Method 8270	10	±30	50-150
95-63-6	Pseudocumene (1,2,4-trimethyl benzene)	EPA Method 8260	200	±30	50-150
109-99-9	Tetrahydrofuran	EPA Method 8260	50	±30	50-150
108-88-3	Toluene	EPA Method 8260	5	±30	50-150
71-55-6	1,1,1-Trichloroethane (TCA)	EPA Method 8260	5	±30	50-150
79-00-5	1,1,2-Trichloroethane	EPA Method 8260	5	±30	50-150
79-01-6	Trichloroethylene (TCE)	EPA Method 8260	5	±30	50-150
75-01-04	Vinyl chloride	EPA Method 8260	5	±30	50-150
1330-20-7	Xylenes	EPA Method 8260	10	±30	50-150
126-73-8	Tributyl phosphate	EPA Method 8270	100	±30	50-150
2674-11-2	Aroclor-1016	PCBs, EPA Method 8082	20	±30	50-150
11104-26-2	Aroclor-1221	PCBs, EPA Method 8082	20	±30	50-150
11141-16-5	Aroclor-1232	PCBs, EPA Method 8082	20	±30	50-150
53969-21-9	Aroclor-1242	PCBs, EPA Method 8082	20	±30	50-150
126572-29-6	Aroclor-1248	PCBs, EPA Method 8082	20	±30	50-150
11097-6999-1	Aroclor-1254	PCBs, EPA Method 8082	20	±30	50-150
11096-82-5	Aroclor-1260	PCBs, EPA Method 8082	20	±30	50-150
TPH gasoline	Total petroleum hydrocarbon-gasoline range w/benzene	NWTPH gasoline	500	±30	50-150

Table A-9. Inorganic and Organic Constituents Analytical Performance Requirements for Liquids. (4 Pages)

CAS #	Analyte	Survey or Analytical Method[a]	Practical Quantitation Limit[b] (µg/L)	Precision Required (%)[c]	Accuracy Required (%)[c]
TPH diesel	Total petroleum hydrocarbon-diesel range	NWTPH diesel	500	±30	50-150
Oil/grease	Hydraulic fluids (greases)	EPA Method 413.1 oil/grease or 1664A	2000	±30	50-150
TPH-kerosene	Kerosene, normal paraffins, paint thinner	NWTPH-Dx modified for kerosene range	500	±30	50-150

[a] For 4-digit EPA methods, see SW-846, *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, Third Edition; Final Update III-B*, as amended. For EPA Methods 335 and 413.1, see EPA/600/4-79/020, *Methods of Chemical Analysis of Water and Wastes*. For EPA Method 200.8, see EPA/600/R-94/111, *Methods for the Determination of Metals in Environmental Samples, Supplement 1*. For EPA Method 300.0, see EPA/600/R-93/100, *Methods for the Determination of Inorganic Substances in Environmental Samples*. For NWTPH Methods, see Ecology 97-602, *Analytical Methods for Petroleum Hydrocarbons*.

[b] Detection limits are based on optimal conditions in a standard fixed laboratory. Interferences and matrix effects may degrade the values shown.

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

"--" No information available.

Aroclor is an expired trademark.

CAS = Chemical Abstracts Service.
EPA = U.S. Environmental Protection Agency.
IC = ion chromatography.
N/A = not applicable.
NWTPH = Northwest total petroleum hydrocarbon.
PCB = polychlorinated biphenyl.
TBD = to be determined; method and/or detection limit currently are under evaluation.
TPH = total petroleum hydrocarbon.

A2.1.4.6.2 Comparability

Comparability expresses the confidence with which one data set can be compared to another. Data comparability will be maintained using standard procedures and consistent methods and units. Tables A-6 and A-7 list applicable fixed-laboratory methods for analytes and target detection limits. Actual detection limits will depend on the sample matrix and the sample quantity available. Data will be reported as defined for specific samples.

A2.1.4.6.3 Accuracy

Accuracy is an assessment of the closeness of the measured value to the true value. Accuracy of chemical-test results is assessed by spiking samples with known standards and establishing the average recovery. A matrix spike is the addition to a sample of a known amount of a standard compound similar to the compounds being measured. Radionuclide measurements that require chemical separations use this technique to measure method performance. For radionuclide measurements that are analyzed by gamma spectroscopy, laboratories typically compare results of blind audit samples against known standards to establish accuracy. Validity of calibrations are evaluated by comparing results from the measurement of a standard to known values and/or by generation of in-house statistical limits based on three standard deviations (+/- 3 SD). Tables A-6 and A-7 list the accuracy provided for fixed-laboratory analyses for the project.

A2.1.4.6.4 Precision

Precision is a measure of the data spread when more than one measurement has been taken on the same sample. Precision can be expressed as the relative percent difference for duplicate measurements or relative standard deviation for triplicates. Tables A-6 and A-7 list the analytical precision for fixed-laboratory analyses.

A2.1.4.6.5 Completeness

A target value for data completeness was not defined in the DQO process; therefore, no requirement applies to this SAP.

A2.1.4.6.6 Detection Limits

Detection limits are functions of the analytical method used to provide the data and the quantity of the sample available for analyses. Method detection limits for the COPCs are presented on Tables A-6 and A-7.

A2.1.5 Special Training Requirements/Certification

Typical training or certification requirements have been instituted by the Project Hanford Management Contract 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, U.S. Department of Energy orders, contractor requirements documents, American National Standards Institute/American Society of Mechanical Engineers standards, *Washington Administrative Code*,

etc. For example, training or certification requirements needed by sampling personnel will be in accordance with Site analytical quality requirements.

The environmental health and safety 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 radiation training
- Radiological-worker training.

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 U.S. Department of Energy orders and government regulations. Specialized employee training includes prejob briefings, on-the-job training, emergency preparedness, plan-of-the-day activities, and facility/worksite orientations.

A2.1.6 Documents and Records

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 procedures. In the event that specific procedures do not exist for a particular work evolution, or if 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 requirements include the activities associated with the following:

- Chain of custody/sample-analysis requests
- Project and sample identification for sampling services
- Control of certificates of analysis
- Logbooks, checklists
- Sample packaging and shipping.

Approved work control packages and procedures will be used to document radiological measurements when implementing this SAP. Examples of the types of documentation for field radiological data include the following:

- Instructions regarding the minimum requirements for documenting radiological controls information as discussed in 10 CFR 835, "Occupational Radiation Protection"
- Instructions for managing the identification, creation, review, approval, storage, transfer, and retrieval of Hanford Site 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 survey/sample plans
- The requirements associated with preparing and transporting regulated material.

A2.2 DATA GENERATION AND ACQUISITION

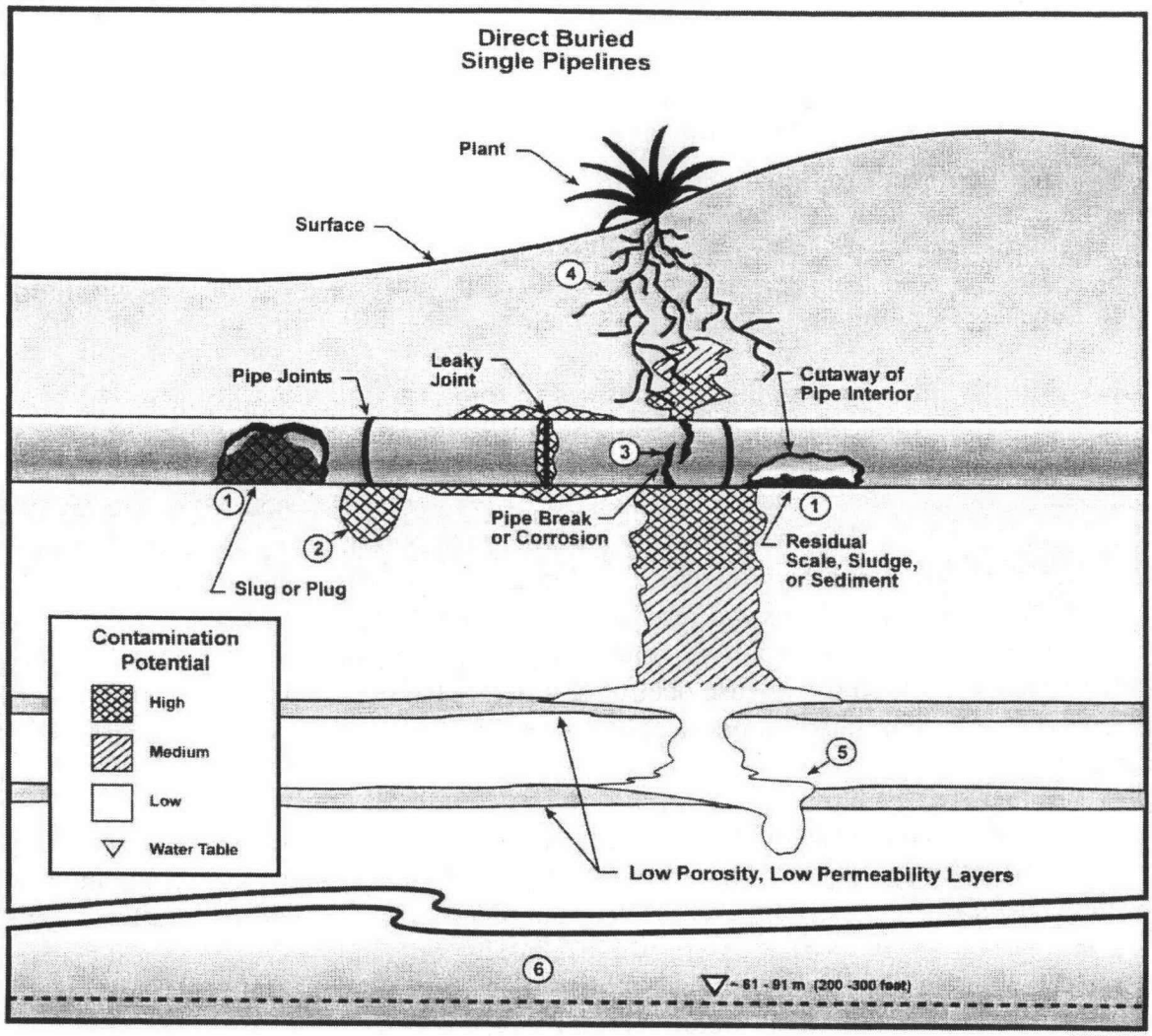
A2.2.1 Phase 1 Sampling Process Design

A nonstatistical sampling design (professional judgment) was used to determine sample locations in the pipelines and surrounding soil. A biased (or focused) sampling approach was selected based on process knowledge, expected behavior of COPCs, pipeline configuration, and the preliminary conceptual contaminant-distribution model developed for the facility process-waste pipeline systems (Figure A-4). Using this approach, sample locations are defined that increase the likelihood of encountering contamination. The total number of samples selected for each pipeline was based on criteria identified during the 200-IS-1 DQO process (D&D-30262). Decision rules applicable for only Phase 1 sample results (i.e., use of the maximum or detected values) are presented in Table A4-7. Quality assurance requirements for the data collected were discussed previously in Section A2.1.

For the facility process-waste pipelines, the purpose of the Phase 1 investigation is to determine if hazardous and/or radioactive COPCs are present in the pipelines and/or in the surrounding soil. The conceptual contaminant-distribution model for the facility process-waste pipelines (Figure A-4) suggests that the highest potential for vadose-zone soil contamination should be near potential release locations such as leaky pipe joints and fractures or pipe breaks. The potential for encountering contamination in the soil, if present, would be near the pipe, with decreasing potential for encountering contamination with increasing depth and distance from the pipeline. In the vadose-zone soils, where liquid releases have occurred, low-mobility COPCs, such as plutonium and Cs-137 normally sorb near the point of release. Mobile contaminants, such as nitrate and tritium, migrate with the moisture front to greater depths.

The pipeline structures are buried at depths ranging from several feet to tens of feet below the ground surface. Engineering designs and as-built drawings provide information on the locations of the pipelines and associated structures, construction materials, and pipe diameters. Burial depths can be determined at intermittent locations, based on survey elevation data for the bottoms of the pipelines (i.e., inverts) provided on engineering drawings and surface topographic elevations. Materials used in pipeline construction vary and include CI, CS, SS, VC, CM, polyethylene, polyvinyl chloride, and concrete.

Figure A-4. Preliminary Conceptual Contaminant-Distribution Model for Buried Process-Waste Pipelines.



1. Residual material in the form of scale, sludge, and/or sediment may occur at some locations within pipelines. Extensive buildup may have resulted in formation of plugged areas.
2. Pipe connection locations such as joints and fittings are susceptible to leakage. The releases are characterized as low-volume leaks and most likely are attributed to faulty or degraded seals, joints, or fittings. The effluent and contaminants move according to the permeability of surrounding soils at various points of release. Low-mobility contaminants such as cesium and plutonium sorb near points of release, and concentrations decrease with depth.
3. Fractures, cracks, and breaks are more prevalent in some pipelines such as those constructed of vitrified clay. Pipe breakage may have occurred in some cases as the result of loading and differential settling of surrounding soils. Larger breaks where flow was under pressure may have resulted in releases that extend both above and below the pipe into surrounding soil.
4. Contamination extends above the pipeline to the surface in some places because of uptake by vegetation (or possible animal intrusion).
5. Mobile contaminants such as nitrate and tritium migrate with the moisture front to greater depths.
6. Process fluids and contaminants may or may not impact groundwater, depending on the volume of releases.

A2.2.1.1 Contaminant Distribution Inside Pipelines

Data are not available concerning the concentrations and distribution of contaminants inside the majority of the pipelines. Residual material, if present, may occur as scale, corrosion products, sludge, and/or sediment. The tendency for materials to sorb contaminants is expected to vary with pipe composition. Some pipelines, over time, may tend to accumulate debris and sludge. Depending on the characteristics of the pipe, length of use, and the waste-stream type, debris may accumulate through the pipeline. In general, material such as stainless steel is assumed to be less likely to have sorbed waste-stream constituents than pipeline material such as VC. Many of the disposal sites on the Central Plateau received liquid waste from gravity-flow pipelines. The conceptual model for this type of pipeline would show waste accumulation within the pipe and at pipe bends or low points, if present.

A2.2.1.2 Soil Adjacent to Pipeline Structures

The potential distribution of contaminants in the soil surrounding the pipeline structures is assumed to be variable and to depend on a number of factors. The occurrence and magnitude of potential releases would be affected by the integrity of fittings at pipe joints, breaks or fractures in the line related to loading or subsidence, and degradation associated with age and incompatibility of waste streams and pipeline materials. The extent of vertical and/or lateral migration in surrounding soil would be related to factors such as size of the release opening, period of time over which the release occurred, whether the release was under pressure, the soil characteristics (e.g., porosity and permeability), and the total volume of liquid that was discharged.

For pipelines where inadvertent liquid releases to the surrounding soil have occurred, the contaminant distribution may be limited to the shallow-zone soil interval (i.e., the interval from the ground surface to a depth of 4.6 m [15 ft]), but could extend to a deeper depth. Liquid releases at pipeline failure locations may display simple or complex concentration distributions within the impacted soil area. The distribution will depend on the a number of factors, including the chemistry of the liquid waste stream, volume of the release, attributes of the pipe failure, and properties of surrounding soil.

A2.2.1.2.1 Vertical Contaminant Distribution

The specific vertical contaminant distribution in the soil will depend on several influencing factors: volume of the release, time period over which the release occurred, waste stream composition, and mobility of the constituents (e.g., soil-water partition distribution coefficients and porosity/permeability of the sediments).

For small-volume release to surrounding soil associated with minor pipe-joint offsets or small cracks or fractures, it is expected that the vertical contaminant migration will be limited to within several feet of the bottom of the structure. Large-magnitude releases could result in vertical migration (toward the surface or toward the groundwater) of contaminants in the soil to depths of tens of feet.

A2.2.1.2.2 Lateral Contaminant Distribution

Some lateral migration could occur of liquid releases from pipelines in the impacted soils, and the spread of the contamination would depend on site-specific conditions and the volume of the release. For small-volume releases, lateral spreading might be greater than vertical migration, while for large-volume releases, vertical migration might be greater than lateral migration because of the hydraulic head associated with the large-volume release and its preference for vertical migration. However, this also is dependent on the local geologic characteristics in the vicinity of the release.

A2.2.2 Sampling Activities

Information concerning sample-collection techniques, sample locations, and number of samples is presented below.

A2.2.2.1 Investigation Techniques

Field-screening measurements, in addition to the collection of samples for laboratory analysis, will be used to determine occurrence and concentrations of COPCs. Application of these measurements with the selected characterization approach is presented in Chapter A3.0 of this SAP.

A2.2.2.2 Field-Screening Analyses

To support the selection of appropriate field-screening techniques to be used at the pipeline-sampling locations, a review of available radiological and chemical data for each pipeline was completed. This review involved compiling data concerning waste-stream composition including primary constituents identified by waste-stream inventory records, primary chemical components noted in the process operations that generated the waste streams, and laboratory analytical results of soil samples collected from the disposal site connected to the pipeline. A summary of this compilation and the primary radiological and nonradiological constituents that were identified using all three data sources is presented in the Attachment, Table ATT-2. The footnotes to Table ATT-2 describe the systematic process that was followed to review each data source and identify the target constituents for field screening. References used for compiling the lists of chemical constituents provided in Table ATT-2 are presented in the Attachment, Table ATT-3. Selected primary constituents will be used as target constituents for field screening. In some cases, groups of constituents or types of compounds are the targets for screening, such as VOCs, hydrocarbons, PCBs, and polyaromatic hydrocarbons.

The applicable field-screening methods that were identified for this project, and their performance capabilities, are presented in Tables A-10 and A-11. Special care should be taken to prevent cross-contamination of field-screening equipment by properly storing and handling the equipment and performing proper decontamination between sampling events.

Table A-10. Radiological Field-Screening Methods.

Measurement Type	Emission Type	Method/Instrument	Detection Limit
Exposure/dose rate	Beta/gamma	RO-20/RO-03 portable ionization chamber	0.5 mrem/h
Contamination level	Alpha	100 cm^2 Portable alpha meter or equivalent instrument	90 d/min α/100 cm^2 (10 sec static count) 250 d/min α/100 cm^2 (1 in./sec scan speed)
Contamination level	Beta/gamma	100 cm^2 ruggedized scintillation detector or equivalent	500 d/min β–γ/100 cm^2 (20 sec static count @ 13% efficiency) 1,400 d/min β–γ/100 cm^2 (2 in./sec scan speed)
Contamination level	Gamma	2 in. x 2 in. sodium iodide detector (e.g. Ludlum 44-3 or equivalent)	5 pCi/g Cs-137 in soils
Contamination level	Gamma	2 in. x 10 mm sodium iodide low-energy gamma detector (e.g., Eberline PG-2 or equivalent)	20 pCi/g Am-241 in soils
Spectral-gamma logging	Gamma isotopic emissions	High-purity germanium	~25 nCi/g to 50 nCi/g Am-241 and Pu-239 through well casing; ~100 pCi/g for Np-237 through well casing
Gross-gamma logging	Gamma emissions	Bismuth-germanium or sodium iodide detector	~25 nCi/g for Am-241 and Pu-239 through well casing
Spectral-gamma logging	Gamma emissions	Bismuth-germanium or sodium iodide detector	~0.5 pCi/g (100 sec static count time) (5 pCi/g with 10 sec count)
Passive-neutron logging	Neutron emissions	Helium-3 detector	~100 nCi/g for Am-241 and Pu-239 through well casing
Active-neutron logging	Thermal neutron	Helium-3 detector	Less than 1% volume fraction moisture in soil.

Eberline E-600 and SHP380-A/B are trademarks of Eberline Instruments, a subsidiary of Thermo Electron Corporation, Waltham, Massachusetts.
Ludlum is a trademark of Ludlum Measurements, Inc., Sweetwater, Texas.
PG-2, RO-20, and RO-03 are trademarks of Eberline Instruments, a subsidiary of Thermo Electron Corporation, Waltham Massachusetts.

d/min = disintegrations per minute.

Table A-11. Nonradiological Field-Screening Methods. (2 Pages)

Measurement Variable	Measurement Method*	Detection Limit
Chromium (VI)	Water extraction and colorimetric analysis	2 to 5 mg/kg
Mercury	Immunoassay or equivalent method	0.5 mg/kg. Results reported within a prespecified range.
Polyaromatic hydrocarbons	Immunoassay or equivalent method	1 to 5 mg/kg. Results reported within a prespecified range.
Polychlorinated biphenyls	Immunoassay equivalent method	0.1 to 0.3 mg/kg. Results reported within a prespecified range.
Nitrate	Colorimetric or Immunoassay	10 to 500 mg/kg. Analyses performed using test strips and reflectometer.
Total petroleum hydrocarbons	Immunoassay or equivalent method	5 to 10 mg/kg. Results reported within a prespecified range. Used for gasoline or diesel products.

Table A-11. Nonradiological Field-Screening Methods. (2 Pages)

Measurement Variable	Measurement Method[a]	Detection Limit
VOCs (vapor screening)	Photoacoustic infrared analyzer (e.g., B&K 1302) [b]	Specific to VOCs of interest.
VOCs (vapor screening)	MIRAN SapphIRe infrared analyzer [c]	Specific to VOCs of interest.
VOCs (vapor screening)	Photoionization detector (e.g., thermoanalytical organic vapor monitor)	1 to 5 mg/kg (isobutylene-equivalent). Specific to VOCs of interest. Limited to photoionizing compounds at 10.6 eV.
VOCs (vapor screening)	Portable gas chromatograph with photoionization detector (e.g., Photovac 10S Plus) [d]	Sub-mL/m^3 levels depending on VOC of interest. Specific to VOCs of interest. Limited to photoionizing compounds at 11.7 eV.

[a] Other methods may be identified and implemented in conjunction with technology development.
[b] B&K is a trademark of Brüel and Kjær, S&V, Nærum, Denmark.
[c] MIRAN and SapphIRe are registered trademarks of Thermo Electron Corporation, Franklin, Massachusetts.
[d] Photovac 10S Plus is a trademark of Photovac, Inc., Waltham, Massachusetts.

VOC = volatile organic compound.

A2.2.2.3 Radiological Field Data

Alpha, gamma, and beta/gamma field data will be used to support the characterization described in this SAP, as appropriate. The following information will be disseminated to personnel performing work in support of this SAP, as appropriate:

- Measuring instructions: Instructions to the radiological control technicians on methods required to measure sample activity and media for gamma, alpha, and/or beta emissions, as appropriate. This will include direction to allow the radiological control technicians to calculate a number of quantities supporting sample analysis

- Geiger-Mueller[2] portable instrument: A physical description of the Geiger-Mueller instrument, radiation and energy response characteristics, calibration/maintenance and performance testing descriptions, and the application/operation of the instrument. The Geiger-Mueller instrument is a commonly used beta/gamma instrument on the Hanford Site when removable surface-contamination measurements and direct measurements of the total surface contamination are performed. Instrument calibration is every 12 months.

- Portable alpha meter: A physical description of the portable alpha meter, radiation and energy response characteristics, calibration/ maintenance and performance-testing descriptions, and the application/operation of the instrument. The portable alpha meter is a commonly used alpha instrument on the Hanford Site when removable surface-contamination measurements and direct measurements of the total surface contamination are performed. Instrument calibration is every 12 months.

[2] Geiger-Mueller is not a trademark.

- Sodium-iodide detector: A physical description of the sodium-iodide detector, radiation and energy response characteristics, calibration/ maintenance and performance testing descriptions, and the application/operation of the instrument. The sodium-iodide detector instrument is a commonly used gamma detector on the Hanford Site when direct measurements are performed. Instrument calibration is every 12 months.

- Hand-held probes: Characteristics associated with the hand-held probes to be used in the performance of direct radiological measurements include a physical description of the probe, the radiation- and energy-response characteristics, calibration/maintenance and performance testing descriptions, and the application/operation of the instrument. Probes appropriate for the type and energy range of radioactivity present in the soils are commonly used on the Hanford Site when removable surface-contamination measurements and direct measurements of the total surface contamination are performed.

A2.2.2.4 Sampling Locations

Table A-12 provides information on the sampling locations selected for each pipeline. The information listed includes the pipeline identification number, pipe material and diameter at the sample location, a physical description of the location, and additional comments concerning aspects of some of the sample-location information. Primary locations identified for sample collection are listed, along with alternate locations that can be used if access to primary locations is restricted. For each bin, alternate internal-pipeline-sample locations and alternate exterior-soil-sample collection locations are identified on Table A-12. An alternate location will be used only if a primary (i.e., preferred) location is not accessible for sample collection. Circumstances such as encountering undocumented buried obstacles and worker health and safety issues could require use of an alternate sampling location. No hierarchy or preference is associated with the use of any of the alternate locations. Temporary sample identification numbers are provided on the table that correspond directly to the sampling locations shown on Figures A-5 through A-21.

The sampling locations (e.g., manholes, pipeline interior, direct-push locations) will be identified in the field before characterization activities are begun. Locations will be staked by the technical lead or field team leader assigned by the project manager. After the locations have been staked, minor adjustments to the location may be made to mitigate unsafe conditions, avoid structural interferences, or bypass utilities. Sample-location identification numbers will be defined during or after sampling. Changes in sample locations that do not affect the DQOs will require approval of the task lead. Changes to sample locations that result in impacts to the DQOs will require concurrence by RL and the lead regulatory agency.

Surface geophysical and radiation surveys will be performed at all sampling locations. The surface geophysical surveys will be conducted using ground-penetrating radar and/or electromagnetic imaging and will aid in verifying the locations of buried pipelines and in selecting soil-probe locations to avoid subsurface obstructions. The surface radiation surveys will identify areas of surface contamination that might affect the field activities and health and safety.

Table A-12. Sample Location Summary Information. (4 Pages)

Bin	Associated Waste Site	Pipeline Number(s)	Pipe Material at Sampling Location	Interior Pipe Sampling Locations [Sample Identification Numbers in Brackets]			Exterior Soil Sampling Locations Sample Identification Numbers in Brackets]		Comments
				Pipe Location 1 (P1)	Pipe Location 2 (P2)	Pipe Location 3 (P3)	Soil Locations 1 and 2 (S1/S2)	Soil Locations 3 and 4 (S3/S4)	
1 (B1)	216-A-10	200-E-192-PL:1, 200-E-192-PL:2 (L1)		At an accessible point along the 8-in. SS pipeline east of the 216-A-10 Crib.	At an accessible point along the 8-in. VC pipeline northeast of the 216-A-10 Crib.	At the "Proportional Sampler Pit #4," northeast of the internal PUREX security fence.	At a point on the 8 in. VC pipeline (west of "Proportional Sampler Pit #4" and northeast of the 216-A-10 Crib) where the pipeline changes direction from west to southwest.	At a point on the 8-in. SS pipeline (east of the 216-A-10 Crib) where the pipeline changes direction from south-southwest to west-southwest.	Interior pipe sampling locations P1 and P2 will require a "dig-and-cut" approach for pipeline access, and the exact points for this internal sampling should be determined based upon clearance from nearby pipelines, structures/features, and contamination areas. The P3 interior pipe sampling location will potentially provide access to both the SS pipelines and the VC pipeline.
				[B1L1P1]	[B1L1P2]	[B1L1P3]	[B1L1S1 & B1L1S2]	[B1L1S3 & B1L1S4]	
			SS	8 in.	NA	8 in. (via SP)	N/A	8 in.	
			VC	N/A	8 in.	8 in. (via SP)	8 in.	N/A	
	216-Z-1A	200-W-174-PL (L2)		At an accessible point along the two 2-in. SS pipelines north of the contamination area associated with the 216-Z-1A Tile Field.	At an accessible point along the two 2-in. SS pipelines west of the 241-Z-361 Settling Tank.	At an accessible point along the two 2-in. SS pipelines east of Building 243-Z.	**Alternate:** At an accessible point along the two 2-in. SS pipelines north of the contamination area associated with the 216-Z-1A Tile Field.	**Alternate:** At a point along the two 2-in. SS pipelines (southeast of Building 243-Z and northeast of the 241-Z Tank Pit) where the pipeline changes direction from south-southeast to south.	Marker posts generally are located along the two 2-in. SS pipelines where there are changes in pipe direction. All interior pipe sampling locations will require a "dig-and-cut" approach for pipeline access, and the exact points for this internal sampling should be determined based on clearance from nearby pipelines, structures/features, and contamination areas. This pipeline was selected as an alternate for exterior soil sampling.
				[B1L2P1]	[B1L2P2]	[B1L2P3]	[B1L2S1] (Alt) & [B1L2S2] (Alt)	[B1L2S3] (Alt) & [B1L2S4] (Alt)	
			SS	2 in. (x2)	2 in. (x2)	2 in. (x2)	2 in. (x2)	2 in. (x2)	
	216-B-12	200-E-160-PL, 200-E-162-PL:1, 200-E-162-PL:2 (L3)		**Alternate:** At an accessible point along the 6-in. VC pipeline, preferably at the 45° elbow south of the 216-B-12 Crib.	**Alternate:** At the "Diversion Pit" located east of the 216-B-12 Crib at the connection with the line leading to the 216-B-62 Crib.	**Alternate:** At the "Sampler Pit" located near the origin of this pipeline south of Building 221-B (B Plant).	At the 45° elbow on the 6-in. VC pipeline (Line V219) south of the 216-B-12 Crib.	At a point along the pipeline southeast of the 216-B-12 Crib, where a contamination area occurs that is potentially associated with this pipeline.	A large portion of this pipeline lies within a large "underground radioactive material" area and is surrounded by unrelated pipelines and structures/features. Consequently, few "dig and cut" options are available for interior pipe sampling on the upstream half of this pipeline. The P1 interior pipe sampling location will require a "dig-and-cut" approach for pipeline access, and the exact points for this internal sampling should be determined based upon clearance from nearby pipelines, structures/features, and contamination areas. The section of this pipeline associated with S3/S4 exterior soil sampling locations is constructed of unknown materials. The S3/S4 sampling locations were chosen because of the presence of a contamination area around this section of the pipeline. This pipeline was selected as an alternate for interior pipe sampling.
				[B1L3P1] (Alt)	[B1L3P2] (Alt)	[B1L3P3] (Alt)	[B1L3S1] & [B1L3S2]	[B1L3S3] & [B1L3S4]	
			M35	N/A	N/A	4 in. (via SP)	N/A	N/A	
			VC	6 in.	N/A	N/A	6 in.	N/A	
			FRE	N/A	4 in. (via DP)	N/A	N/A	N/A	
			Unknown					Unknown Diameter	
2 (B2)	216-B-2-2	200-E-112-PL (L1)		At the MH (southwest of the 207-B Retention Basin) where the 24-in. VC pipe changes direction ~45° from north to northeast.	At the MH located directly east of the unrelated 241-B-361 Settling Tank.	At the MH (east of B Plant) where the pipeline converts from 24-in. CI pipe to 24-in. VC pipe and changes direction 90° from east to north.			Many other MHs are located along this pipeline that would be available for interior pipe sampling if necessary. This pipeline was not selected for exterior soil sampling.
				[B2L1P1]	[B2L1P2]	[B2L1P3]			
			CI	N/A	N/A	24 in. (via MH)			
			VC	24 in. (via MH)	24 in. (via MH)	24 in. (via MH)			
	216-A-25	200-E-127-PL (L2)		At MH #1, located near the downstream end of the overall pipeline length, where the pipe size is reduced from 42-in. to 30-in. CM pipe.	At MH #5, located near the midpoint of the overall pipeline length, where the pipe size is reduced from 42-in. to 36-in. CM pipe.	At MH #8, located near the upstream origin of the overall pipeline length, where the pipe size is reduced from 36-in. to 30-in. CM pipe.	At a point along the 36-in. CM pipe (near the midpoint of the overall pipeline length) where a contamination area occurs that is potentially associated with this pipeline and where a diversion point exists.	At a point along the 36-in. CM pipe (near the midpoint of the overall pipeline length, near MH #5) where another contamination area occurs that is potentially associated with this pipeline.	The interior pipe sampling locations will provide access to potential sediment accumulation areas (directly upstream from the MHs) along the pipeline because of the size reductions. Many other MHs are located along this pipeline that would be available for interior pipe sampling if necessary.
				[B2L2P1]	[B2L2P2]	[B2L2P3]	[B2L2S1] & [B2L2S2]	[B2L2S3] & [B2L2S4]	
			CM	30 in. & 42 in. (via MH)	36 in. & 42 in. (via MH)	30 in. & 36 in. (via MH)	36 in.	36 in.	

Table A-12. Sample Location Summary Information. (4 Pages)

Bin	Associated Waste Site	Pipeline Number(s)	Pipe Material at Sampling Location	Interior Pipe Sampling Locations [Sample Identification Numbers in Brackets]			Exterior Soil Sampling Locations Sample Identification Numbers in Brackets]		Comments
				Pipe Location 1 (P1)	Pipe Location 2 (P2)	Pipe Location 3 (P3)	Soil Locations 1 and 2 (S1/S2)	Soil Locations 3 and 4 (S3/S4)	
2 (B2) cont.	216-A-30	200-E-113-PL (L3)		**Alternate:** At an accessible point along the 16-in. Stl. pipeline west of the 216-A-30 Crib and east of the 216-A-42C Valve Box.	**Alternate:** At an accessible point along the 16-in. Stl. pipeline west of the 216-A-6 Crib and east of Canton Avenue.	**Alternate:** At an accessible point along the 16-in. Stl. pipeline at a pipe direction change location west of Canton Avenue.	**Alternate:** At a point along the 16-in. Stl. pipeline west of the 216-A-30 Crib at or near the 216-A-42C Valve Box where a contamination area occurs that is potentially associated with this pipeline.	**Alternate:** At a point along the 16-in. Stl. pipeline (west of the 216-A-42C Valve Box) where another contamination area occurs that is potentially associated with this pipeline.	All interior pipe sampling locations will require a "dig-and-cut" approach for pipeline access, and the exact points for this internal sampling should be determined based on clearance from nearby pipelines, structures/features, and contamination areas. This pipeline was selected as an alternate for both interior and exterior sampling.
				[B2L3P1] (Alt)	[B2L3P2] (Alt)	[B2L3P3] (Alt)	[B2L3S1] (Alt) & [B2L3S2] (Alt)	[B2L3S3] (Alt) & [B2L3S4] (Alt)	
			Stl.	16 in.	16 in.	16 in.	16 in.	16 in.	
	216-T-36	200-W-79-PL (L4)					At a point along the 4-in. VC pipe east of the 200-T-36 Crib where a contamination area occurs that is potentially associated with this pipeline.	At another point (east of S1/S2) along the 4-in. VC pipe east of the 200-T-36 Crib where another contamination area occurs that is potentially associated with this pipeline.	This pipeline was not selected for interior pipe sampling.
							[B2L4S1] & [B2L4S2]	[B2L4S3] & [B2L4S4]	
			VC				4 in.	4 in.	
3 (B3)	216-A-29	200-E-187-PL (L1)		**Alternate:** At the MH located where the newer 15-in. CS pipe changes direction ~45° from east to southeast.	**Alternate:** At the MH located where the older 12-in. VC pipe changes direction 90° from north to east.	**Alternate:** At the MH located where the older 12-in. VC pipe changes direction 90° from east to north.	**Alternate:** At a MH where the newer 15-in. CS pipeline direction changes from east to southeast (same location as P1).	**Alternate:** East of the MH where the older 12-in. VC pipeline changes direction from north to east (east of the MH selected for P2).	Many other MHs are located along this pipeline that would be available for interior pipe sampling if necessary. The three MHs were chosen because of direction changes in the pipeline and for accessibility. This pipeline was selected as an alternate for both interior and exterior sampling.
				[B3L1P1] (Alt)	[B3L1P2] (Alt)	[B3L1P3] (Alt)	[B3L1S1] (Alt) & [B3L1S2] (Alt)	[B3L1S3] (Alt) & [B3L1S4] (Alt)	
			CS	15 in. (via MH)	N/A	N/A	15 in. (at MH)	N/A	
			VC	N/A	12 in. (via MH)	12 in. (via MH)	N/A	12 in.	
	216-S-10	200-W-157-PL (L2)		At the MH located where the 12-in. VC pipe changes direction ~30° from west to west-southwest.	At the MH located where the 12-in. VC pipe changes direction 90° from south to west and where another 8-in. VC pipe joins with the 12-in. VC pipe.	At the MH located where two upstream 8-in. VC pipes connect to a downstream 12-in. VC pipe.	At a point along the 12-in. VC pipeline east-northeast of the now grout-filled MH where the pipeline discharged into the 216-S-10 Ditch.	At a MH where the 12-in. VC pipeline changes direction ~30° from west to west-southwest.	Many other MHs are located along this pipeline closer to the source facility (S Plant) that may be available for sampling if necessary. The three that were chosen were because of either direction changes in the pipeline or for accessibility.
				[B3L2P1]	[B3L2P2]	[B3L2P3]	[B3L2S1] & [B3L2S2]	[B3L2S3] & [B3L2S4]	
			VC	12 in. (via MH)	8 in. & 12 in. (via MH)	8 in. & 12 in. (via MH)	12 in.	12 in. (at MH)	
	216-B-63	200-E-188-PL (L3)		At MH #20, located where the 15-in. VC pipe changes direction ~45° from northeast to north (south of the 207-B Retention Basin).	At MH #19, located at the northeast end of a contamination area that is potentially associated with this pipeline.	At MH #16, located where the 15-in. VC pipe changes direction ~45° from north to northeast.	At a point along the 15-in. VC pipeline where a contamination area occurs that is potentially associated with this pipeline (southwest of MH #20).	At a point along the 15-in. VC pipeline where another contamination area occurs that is potentially associated with this pipeline.	MHs #19 and #20 are both located downstream of "underground radioactive material" areas that may be associated with this pipeline. Many other MHs are located along this pipeline that would be available for sampling if necessary. The three were chosen because of pipeline direction changes and/or proximity to contamination areas that may be associated with the pipeline.
				[B3L3P1]	[B3L3P2]	[B3L3P3]	[B3L3S1] & [B3L3S2]	[B3L3S3] & [B3L3S4]	
			VC	15 in. (via MH)	15 in. (via MH)	15 in. (via MH)	15 in.	15 in.	

Table A-12. Sample Location Summary Information. (4 Pages)

Bin	Associated Waste Site	Pipeline Number(s)	Pipe Material at Sampling Location	Interior Pipe Sampling Locations [Sample Identification Numbers in Brackets]			Exterior Soil Sampling Locations Sample Identification Numbers in Brackets]		Comments
				Pipe Location 1 (P1)	Pipe Location 2 (P2)	Pipe Location 3 (P3)	Soil Locations 1 and 2 (S1/S2)	Soil Locations 3 and 4 (S3/S4)	
4 (B4)	216-T-33	200-W-173-PL (L1)		At a point along the 8-in. VC pipeline east of the entry to the 216-T-33 Crib. Refer to comments for additional information.	At an accessible point along the 8-in. VC pipeline near the midpoint of the overall pipeline length.	At an accessible point along the 8-in. VC pipeline west of where the pipeline changes direction ~45° from southwest to west (south of building 2706-W).	At a point along the 8-in. VC pipeline east of the entry to the 216-T-33 Crib. Refer to comments for additional information.	At an accessible point along the 8-in. VC pipeline near the midpoint of the overall pipeline length.	All interior pipe sampling locations will require a "dig-and-cut" approach for pipeline access, and the exact points for this internal sampling should be determined based upon clearance from nearby pipelines, structures/features, and contamination areas. Sample locations P1 and S1/S2 were selected based on the potential presence of plugged "Y" fittings and a "double hub" fitting on the pipeline, based on an engineering drawing for this pipeline.
				[B4L1P1]	[B4L1P2]	[B4L1P3]	[B4L1S1] & [B4L1S2]	[B4L1S3] & [B4L1S4]	
			VC	8 in.	8 in.	8 in.	8 in.	8 in.	
	216-A-21	200-E-193-PL (L2)		At a point along the 6-in. VC pipeline north-northeast of the entry to the 216-A-21 Crib. Refer to comments for additional information.	At an accessible point along the 6-in. VC pipeline north-northeast of sample locations P1 and S1/S2.	At an accessible point along the 6-in. VC pipeline north-northeast of sample location P2.	At a point along the 6-in. VC pipeline north-northeast of the entry to the 216-A-21 Crib. Refer to comments for additional information.	At a point along the 6-in. VC pipeline south of the pipeline origin (Building 293-A) where the pipeline slightly changes direction from south to south-southwest.	All interior pipe sampling locations will require a "dig-and-cut" approach for pipeline access, and the exact points for this internal sampling should be determined based upon clearance from nearby pipelines, structures/features, and contamination areas. Sample locations P1 and S1/S2 were selected based on the potential presence of plugged "Y" fittings on the pipeline, based on an engineering drawing for this pipeline.
				[B4L2P1]	[B4L2P2]	[B4L2P3]	[B4L2S1] & [B4L2S2]	[B4L2S3] & [B4L2S4]	
			VC	6 in.	6 in.	6 in.	6 in.	6 in.	
	216-A-32	200-E-194-PL (L3)		**Alternate:** At an accessible point along the 6-in. VC pipeline south-southwest of the entry to the 216-A-32 Crib.	**Alternate:** At an accessible point along the 6-in. VC pipeline south-southwest of sample locations P1 and S1/S2.	**Alternate:** At an accessible point along the 6-in. VC pipeline north-northeast of the pipeline origin (PUREX).	**Alternate:** At an accessible point along the 6-in. VC pipeline south-southwest of the entry to the 216-A-32 Crib.	**Alternate:** At an accessible point along the 6-in. VC pipeline north-northeast of the pipeline origin (PUREX).	All interior pipe-sampling locations will require a "dig-and-cut" approach for pipeline access, and the exact points for this internal sampling should be determined based upon clearance from nearby pipelines, structures/features, and contamination areas. This pipeline was selected as an alternate for both interior and exterior sampling.
				[B4L3P1] (Alt)	[B4L3P2] (Alt)	[B4L3P3] (Alt)	[B4L3S1] (Alt) & [B4L3S2] (Alt)	[B4L3S3] (Alt) & [B4L3S4] (Alt)	
			VC	6 in.	6 in.	6 in.	6 in.	6 in.	
5 (B5)	216-T-26	200-W-175-PL (L1)		At an accessible point along the 3-in. Stl. pipeline east of where the pipeline changes direction 90° from south to east and where the pipe size is reduced from 4 in. to 3 in.	At an accessible point along the 4-in. Stl. pipeline just north of where the pipe size is reduced from 4 in. to 3 in. and where the pipeline changes direction 90° from south to east.	At an accessible point along the 3.5-in. Stl. pipeline north-northwest of the S3/S4 alternate exterior soil sampling locations.	**Alternate:** At a point (east of the TY Tank Farm) where the pipe size is reduced from 4 in. to 3 in. and where the pipeline changes direction 90° from south to east.	**Alternate:** At a point along the 3.5-in. pipeline (north of the TY Tank Farm) where the pipeline changes direction ~25° from south-southeast to southeast.	All interior pipe-sampling locations will require a "dig-and-cut" approach for pipeline access, and the exact points for this internal sampling should be determined based upon clearance from nearby pipelines, structures/features, and contamination areas. The pipeline from the TY Tank Farm (associated with sampling locations P2 and S1/S2) was disconnected in 1955. The portion of the pipeline associated with interior pipe sampling location P1 may be a likely area for sediment accumulation due to a pipe size reduction (noted under P1 sample location description). This pipeline was selected as an alternate for exterior sampling.
				[B5L1P1]	[B5L1P2]	[B5L1P3]	[B5L1S1] (Alt) & [B5L1S2] (Alt)	[B5L1S3] (Alt) & [B5L1S4] (Alt)	
			Stl.	3 in.	4 in.	3.5 in.	3 in. & 4 in.	3.5 in.	

Table A-12. Sample Location Summary Information. (4 Pages)

Bin	Associated Waste Site	Pipeline Number(s)	Pipe Material at Sampling Location	Interior Pipe Sampling Locations [Sample Identification Numbers in Brackets]			Exterior Soil Sampling Locations Sample Identification Numbers in Brackets]		Comments
				Pipe Location 1 (P1)	Pipe Location 2 (P2)	Pipe Location 3 (P3)	Soil Locations 1 and 2 (S1/S2)	Soil Locations 3 and 4 (S3/S4)	
5 (B5) cont.	216-B-9	200-E-195-PL (L2)		**Alternate:** At an accessible point along the 3.5-in. SS pipeline just southwest of the riser at the entry to the 216-B-9 Tile Field.	**Alternate:** At an accessible point along the 3.5-in. SS pipeline northeast of the S1/S2 exterior soil sample locations.	**Alternate:** At an accessible point along the 3.5-in. SS pipeline northeast of the Line-204 connection point (north of the unrelated 241-B-361 Settling Tank and west of the unrelated 216-B-5 Injection Well.	At the approximate midpoint of the 3.5-in. SS pipeline.	At a point on the 3.5-in. SS pipeline northeast of the Line-204 connection point where a slight change in the pipeline direction occurs (northwest of the 216-B-5 Injection Well).	All interior pipe-sampling locations will require a "dig-and-cut" approach for pipeline access, and the exact points for this internal sampling should be determined based upon clearance from nearby pipelines, structures/features, and contamination areas. This pipeline was selected as an alternate for interior pipe sampling.
				[B5L2P1] (Alt)	[B5L2P2] (Alt)	[B5L2P3] (Alt)	[B5L2S1] & [B5L2S2]	[B5L2S3] & [B5L2S4]	
			SS	3.5 in.	3.5 in.	3.5 in.	3.5 in.	3.5 in.	
	216-B-46*	200-E-114-PL (L3)		At an accessible point along the two 4-in. CS pipelines north of the B Tank Farms and just southeast of the connection point with the pipeline leading to the 216-B-51 French Drain.	At an accessible point along the two 4-in. CS pipelines east of the B Tank Farms.	At an accessible point along the two 4-in. CS pipelines just north of the BC Cribs.	At the connection point with the pipeline leading to the 216-B-51 French Drain (north of B Tank Farm) where the two 4-in. Stl. pipelines change direction ~45° and where a contamination area occurs that is potentially associated with this pipeline.	At a point (northeast of B Tank Farm) where the two 4-in. Stl. pipelines change direction ~30° and where a contamination area occurs that is potentially associated with this pipeline.	All interior pipe-sampling locations will require a "dig-and-cut" approach for pipeline access, and the exact points for this internal sampling should be determined based upon clearance from nearby pipelines, structures/features, and contamination areas. Sampling locations P1 and S1/S2 are located at or very near to the lowest elevation point of this pipeline. * NOTE: Because of its complex operational history, the 200-E-114-PL Pipeline can be associated with many liquid-waste disposal sites. The 216-B-46 Crib was selected as a disposal site that received the same waste stream as this pipeline.
				[B5L3P1]	[B5L3P2]	[B5L3P3]	[B5L3S1] & [B5L3S2]	[B5L3S3] & [B5L3S4]	
			CS	4 in. (x2)	4 in. (x2)	4 in. (x2)	4 in. (x2)	4 in. (x2)	

Pipe Types:
CI = cast iron.
CM = corrugated metal.
CS = carbon metal.
FRE = fiberglass-reinforced epoxy.
M-35 = carbon steel.
SS = stainless steel.
Stl = steel.

Other Abbreviations:
~ = approximately.
° = degree(s).
DP = diversion pit.
MH = manhole.
N/A = not applicable.
PUREX = Plutonium-Uranium Extraction Plant.
SP = sampler pit.
SST = single-shell tank.
VC = vitrified clay.
x2 = two pipes.

Figure A-5. Sample Location Map for the 200-E-192-PL Pipeline.

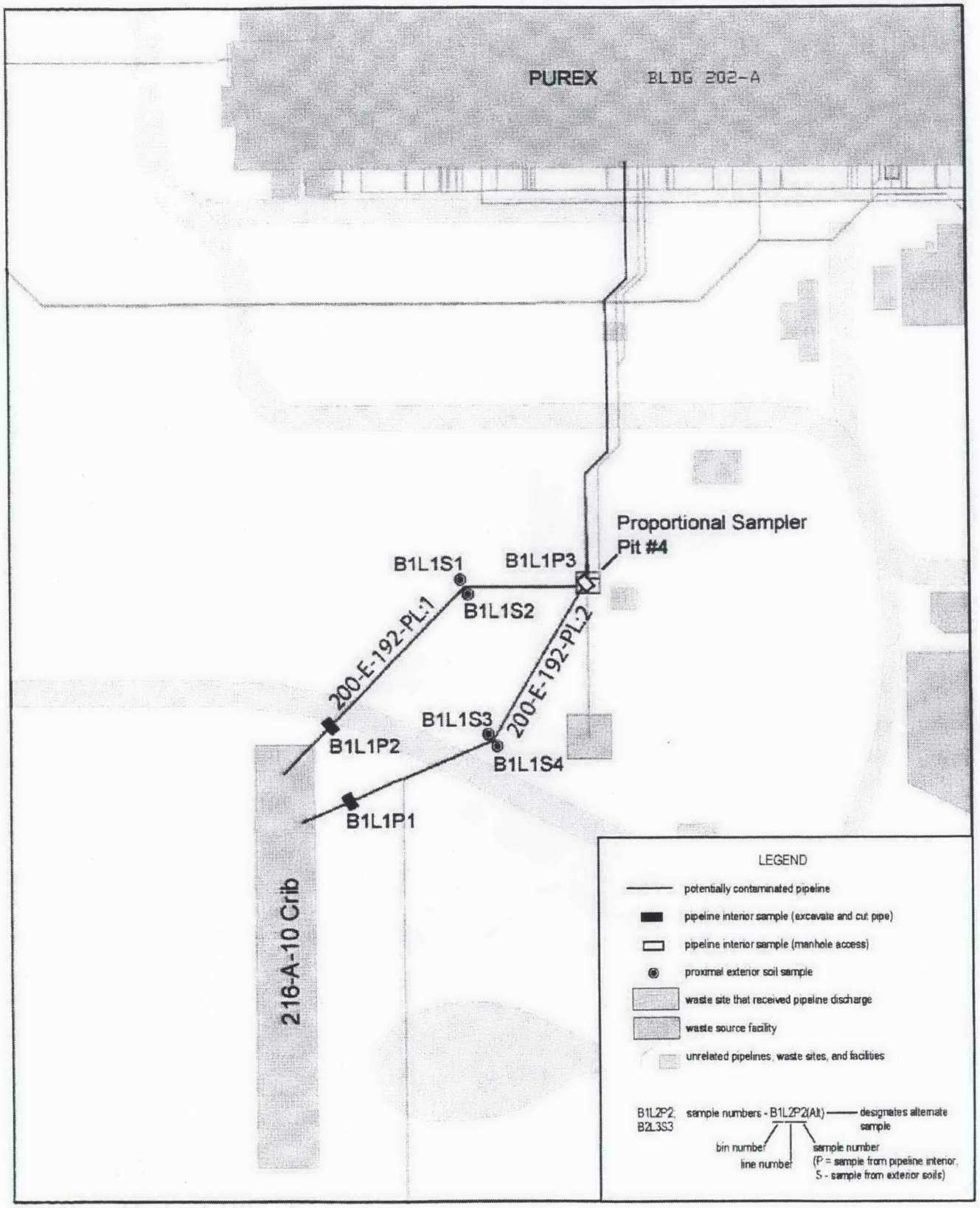


Figure A-6. Sample Location Map for the 200-W-174-PL Pipeline.

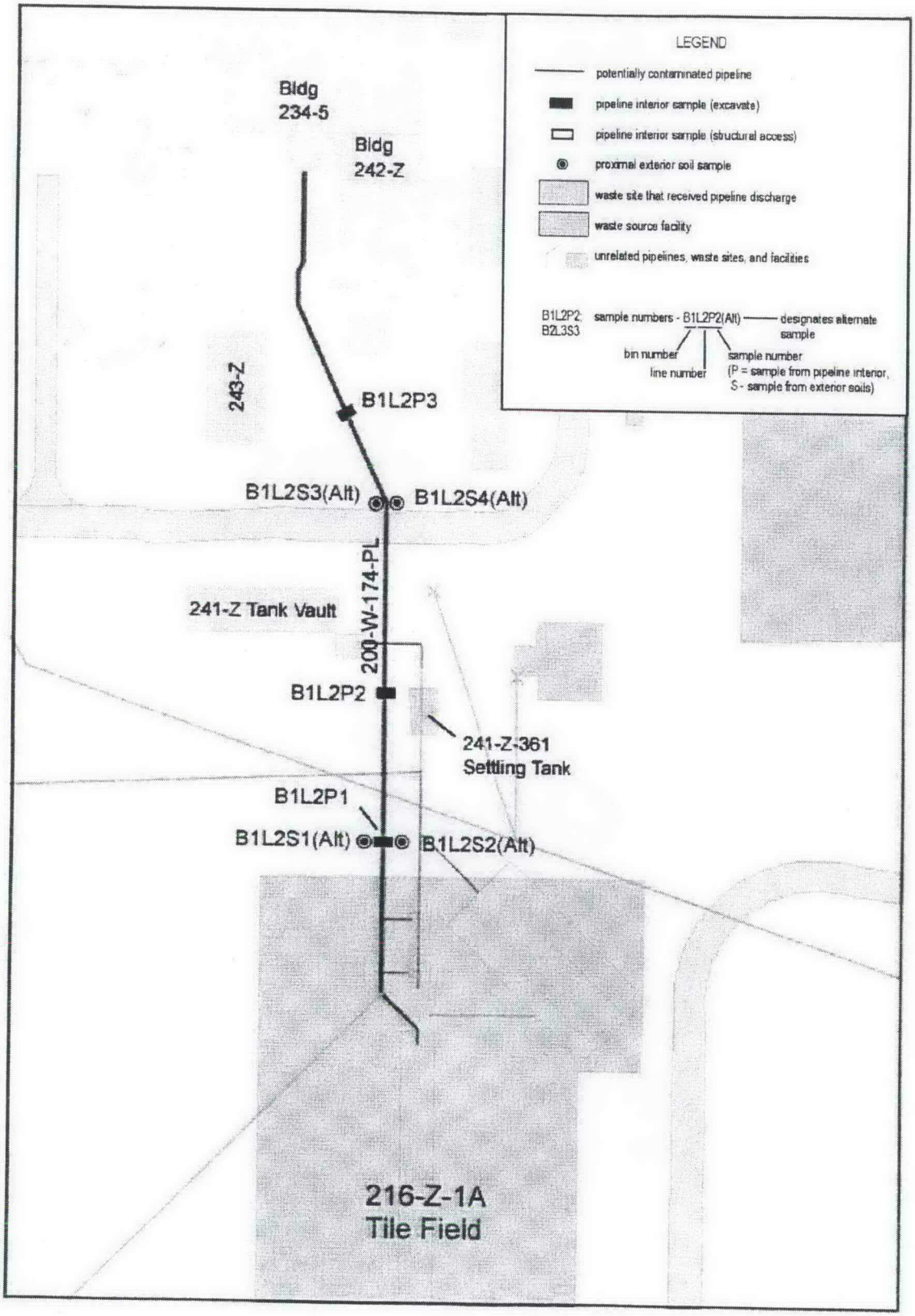


Figure A-7. Sample Location Map for the 200-E-160-PL and 200-E-162-PL Pipelines.

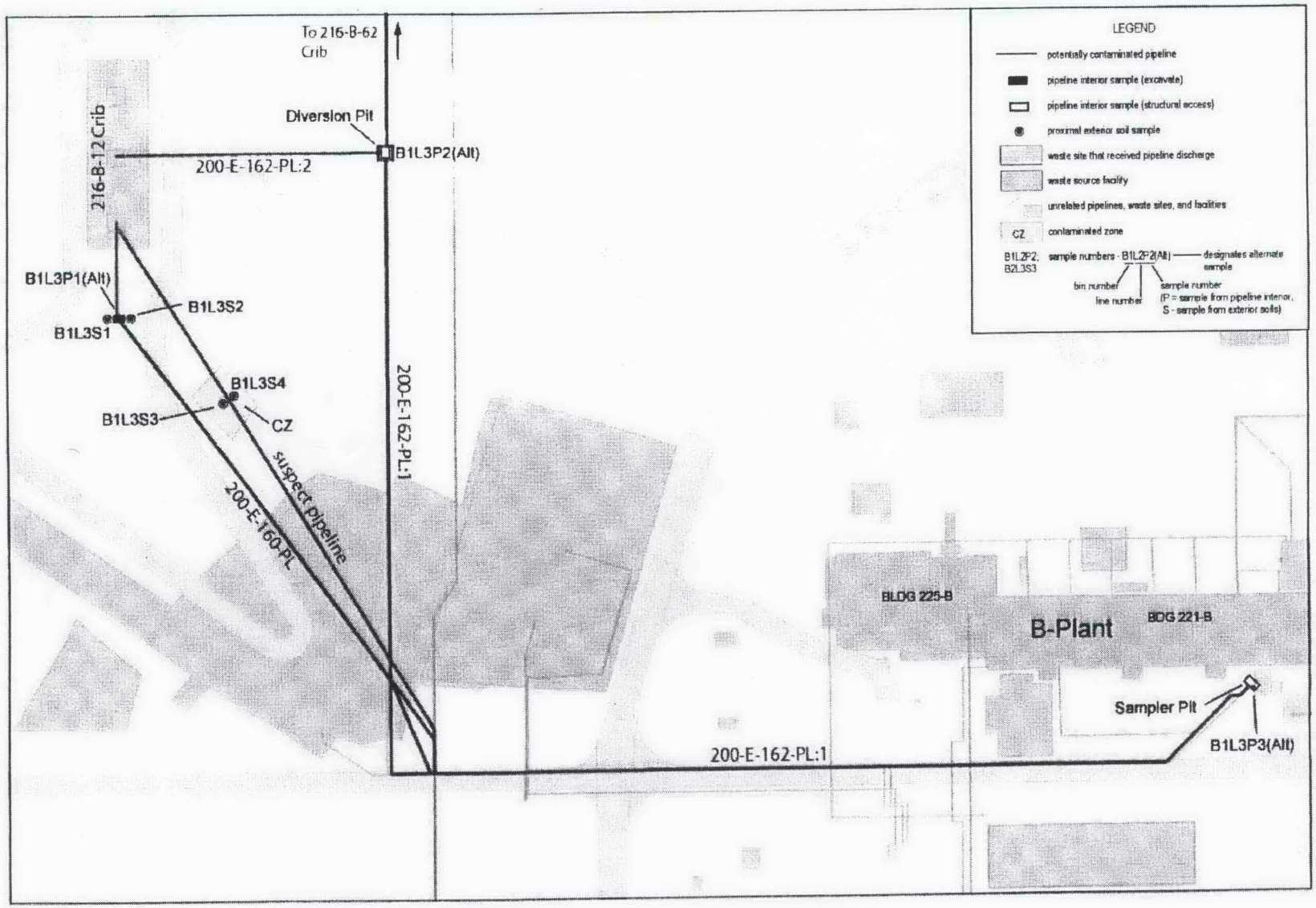


Figure A-8. Sample Location Map for the 200-E-112-PL Pipeline.

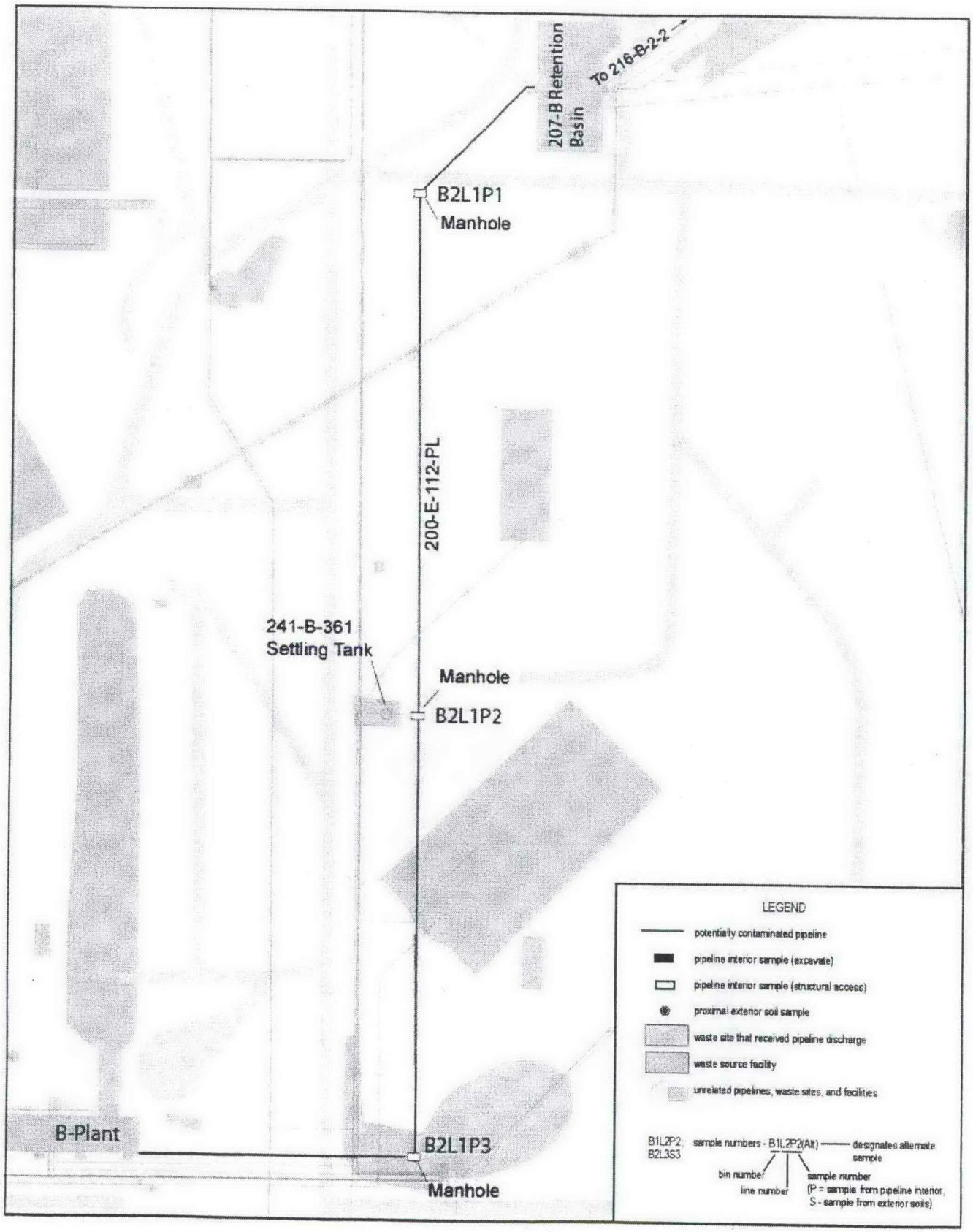


Figure A-9a. Sample Location Map for the 200-E-127-PL Pipeline. (Page 1 of 3)

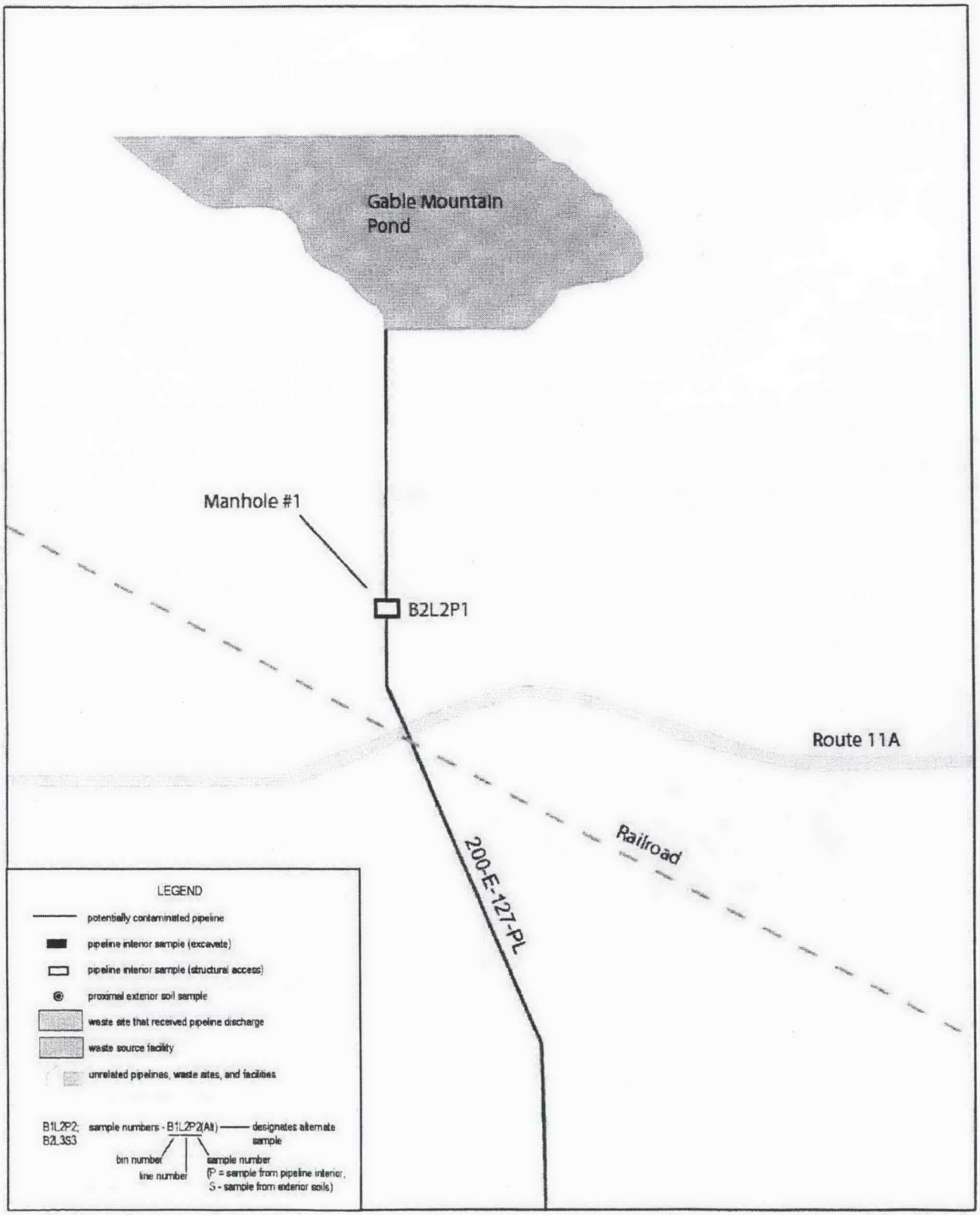


Figure A-9b. Sample Location Map for the 200-E-127-PL Pipeline. (Page 2 of 3)

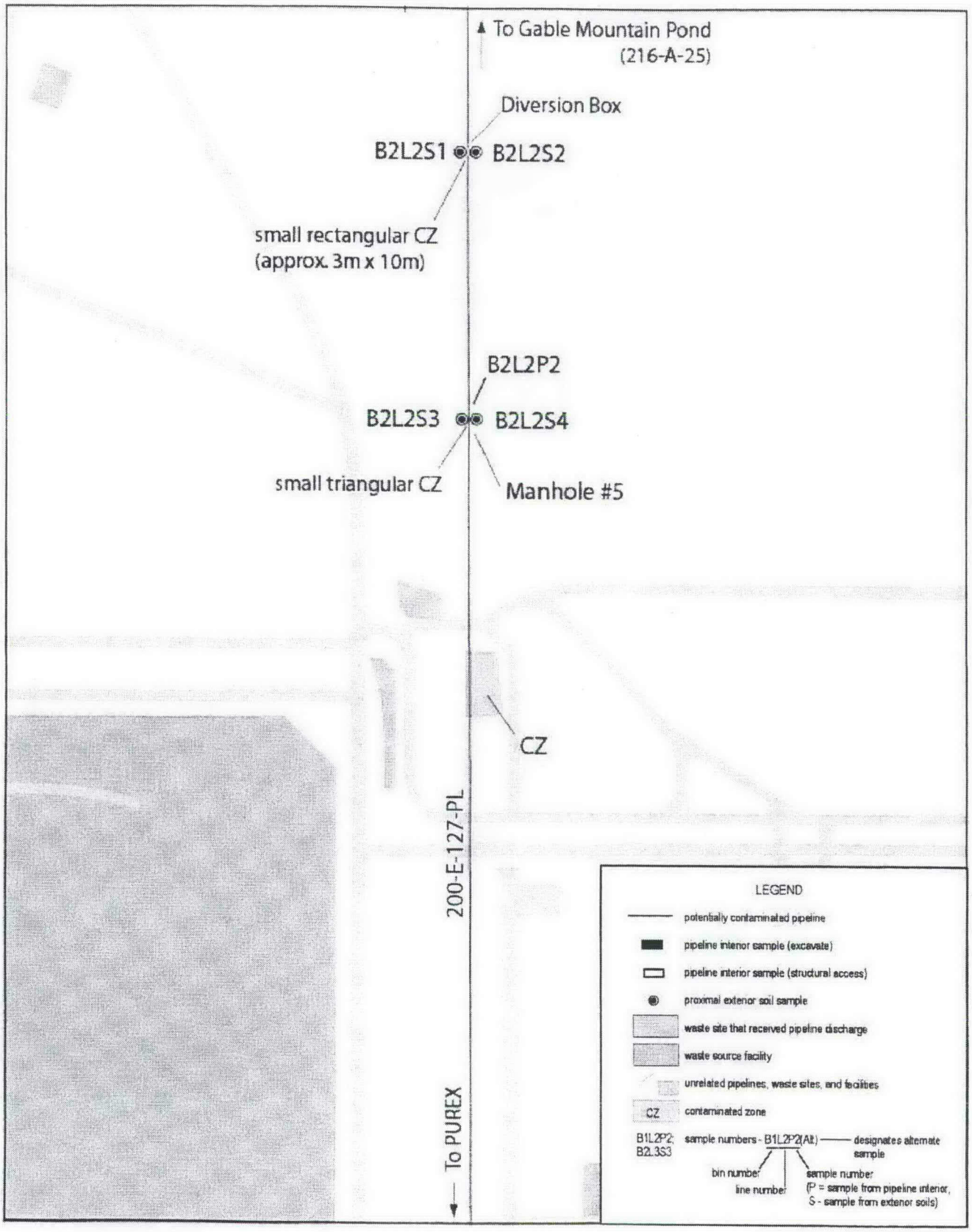


Figure A-9c. Sample Location Map for the 200-E-127-PL Pipeline. (Page 3 of 3)

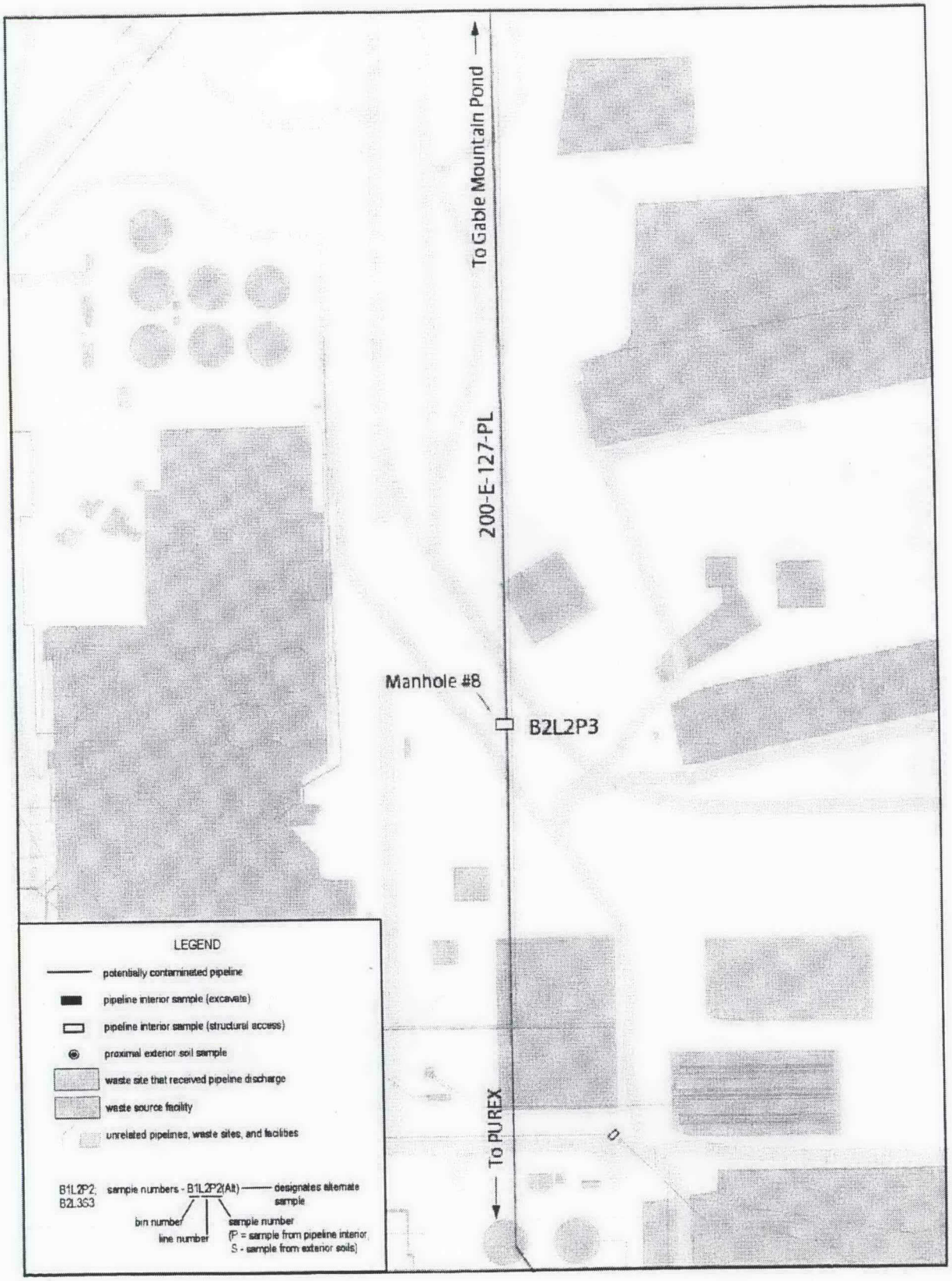


Figure A-10. Sample Location Map for the 200-E-113-PL Pipeline.

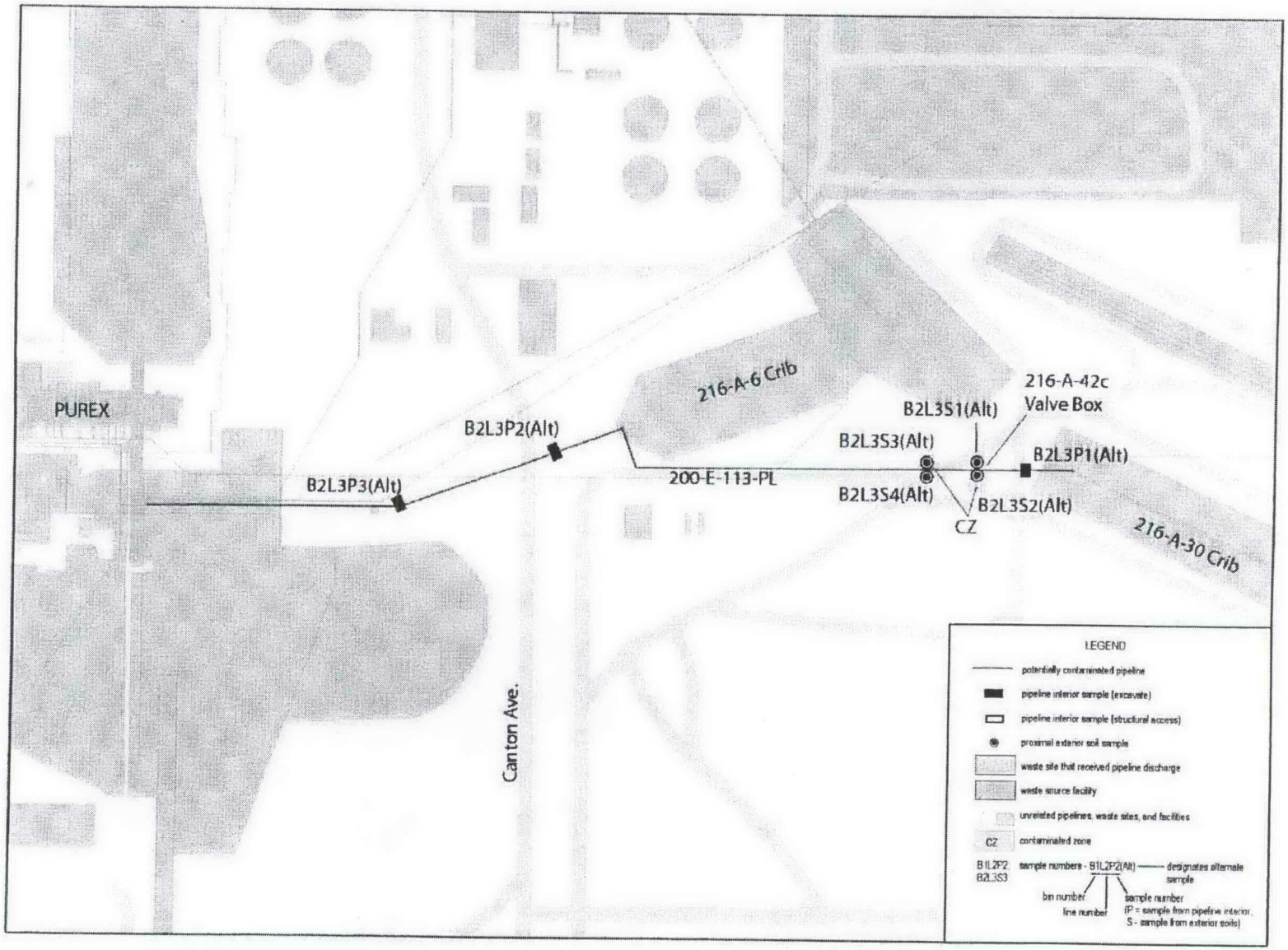


Figure A-11. Sample Location Map for the 200-W-79-PL Pipeline.

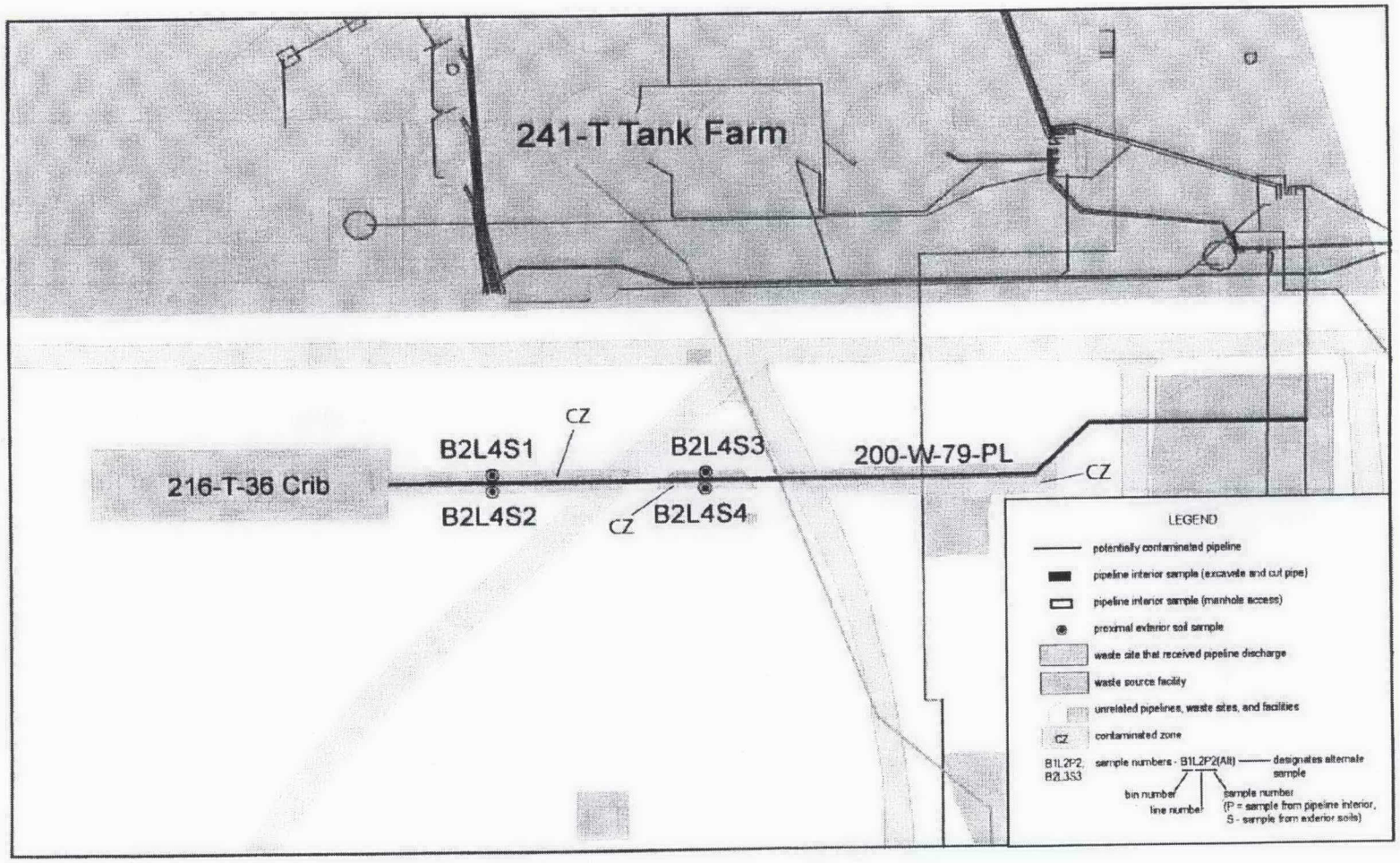


Figure A-12. Sample Location Map for the 200-E-187-PL Pipeline.

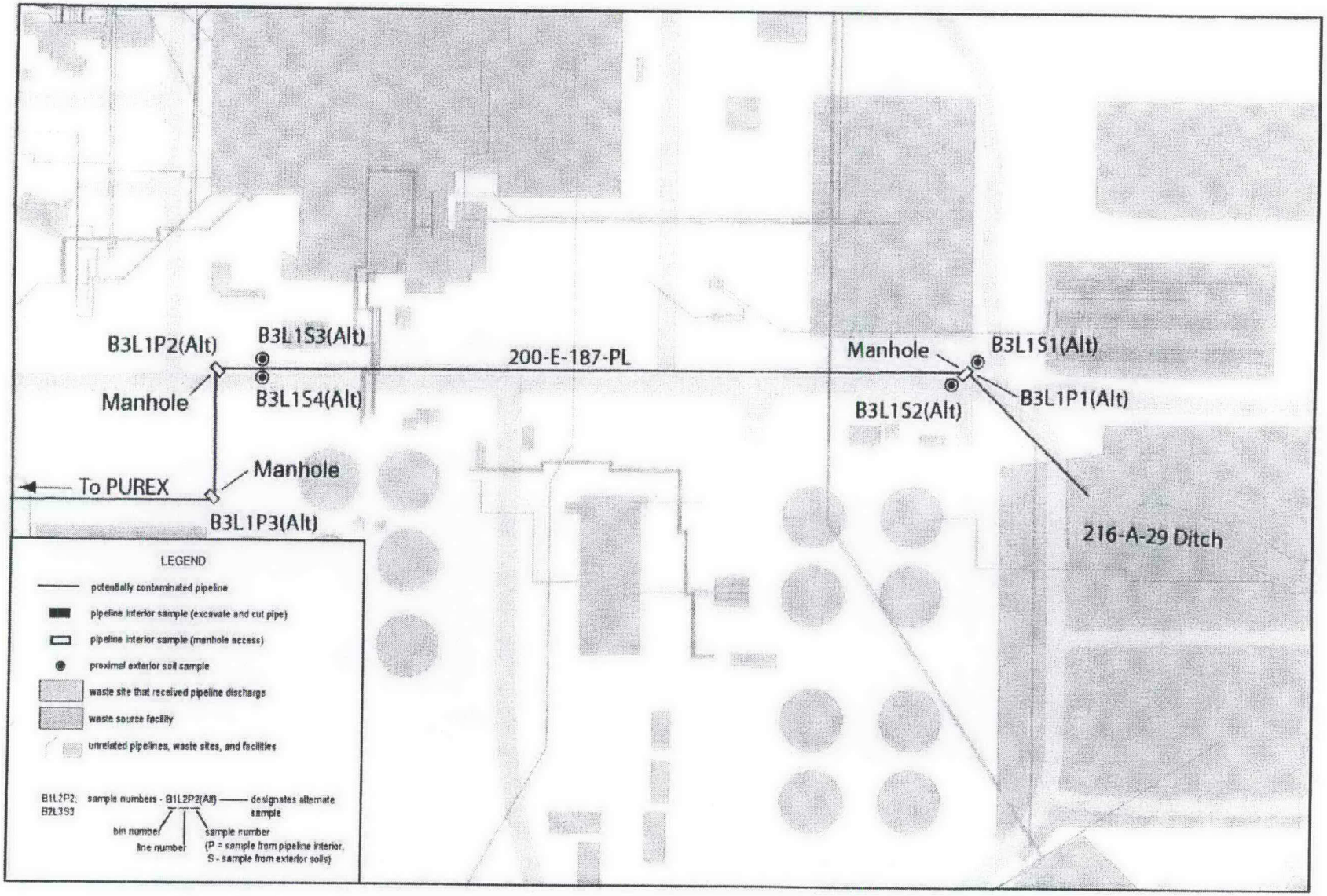


Figure A-13. Sample Location Map for the 200-W-157-PL Pipeline.

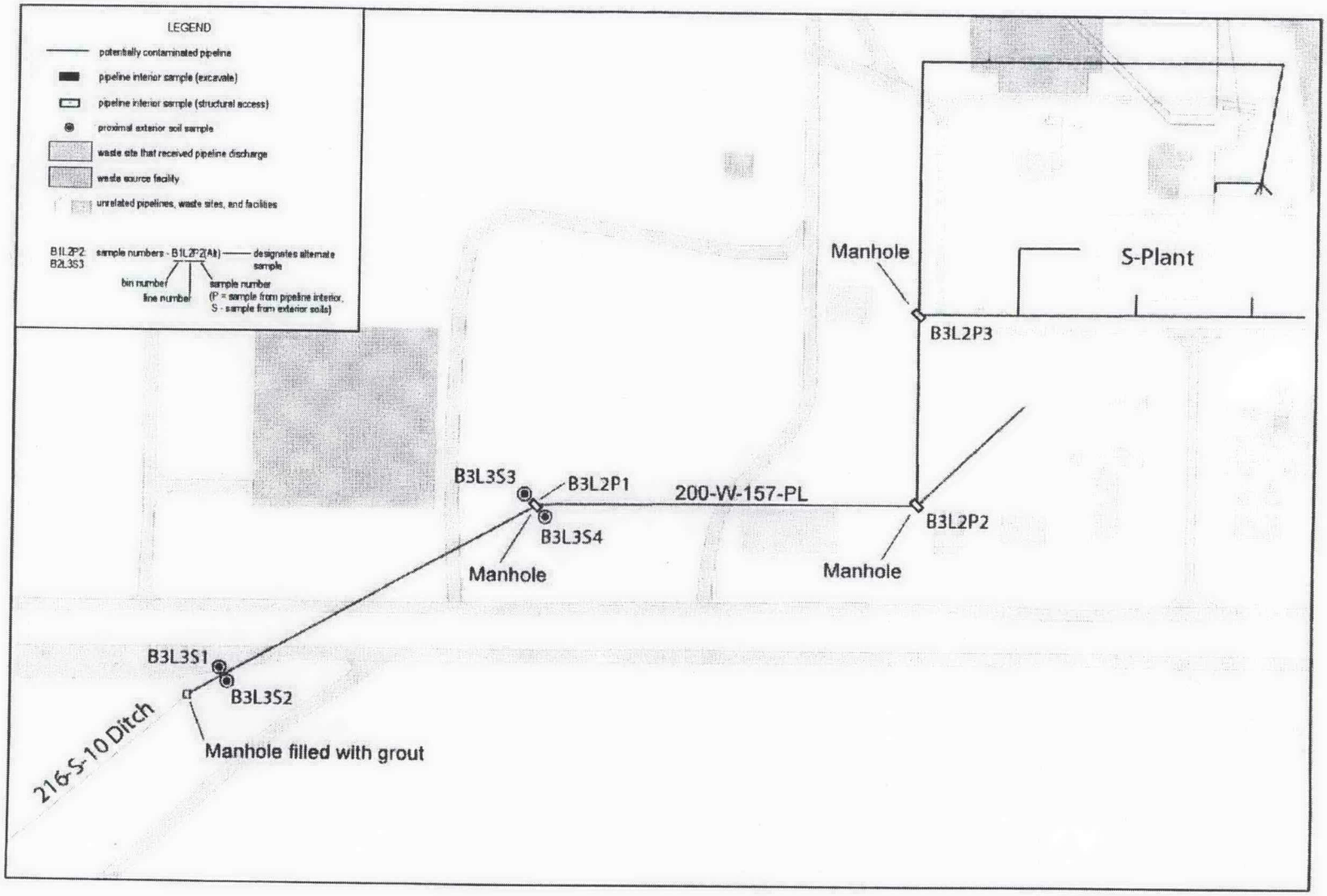


Figure A-14. Sample Location Map for the 200-E-188-PL Pipeline.

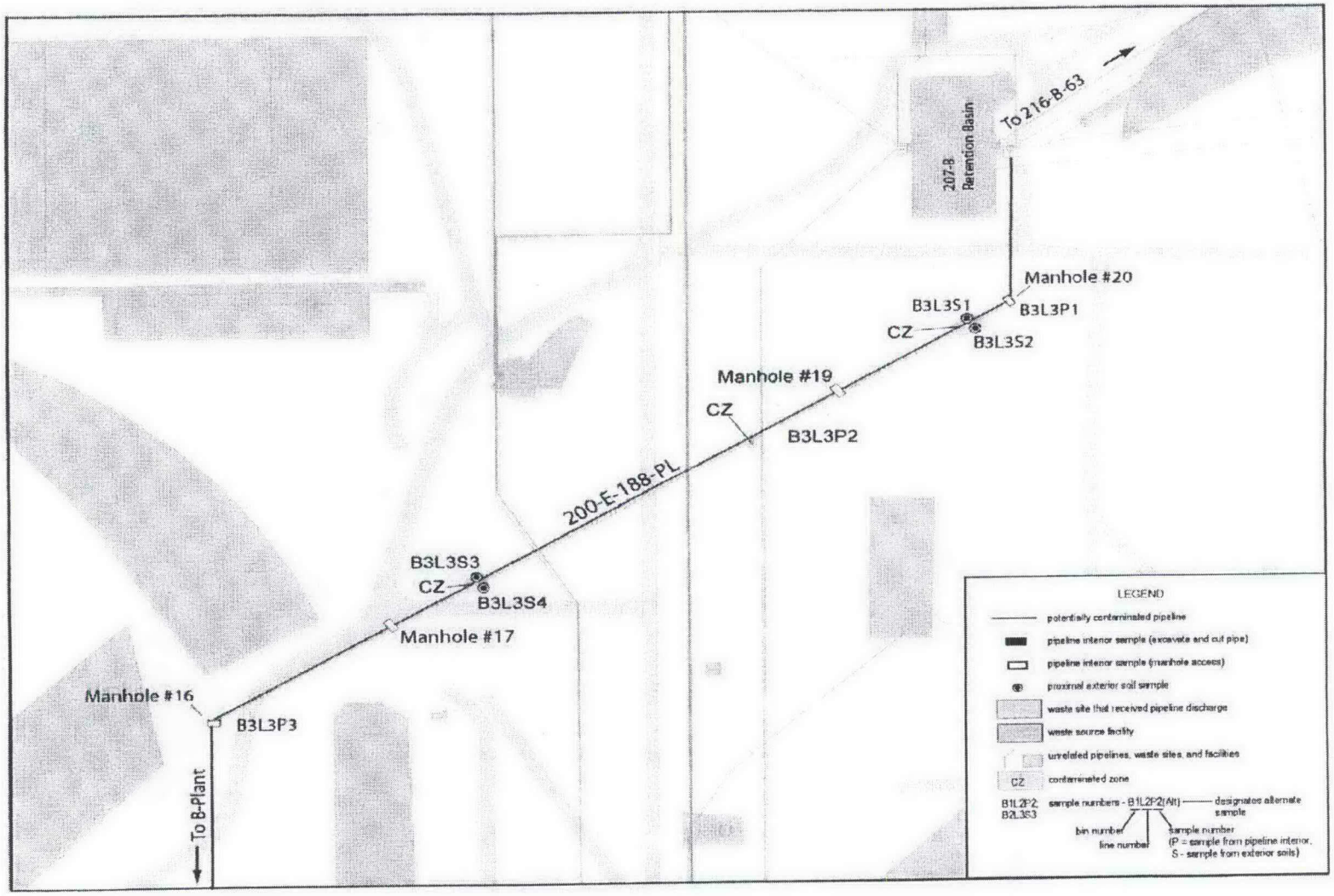


Figure A-15. Sample Location Map for the 200-W-173-PL Pipeline.

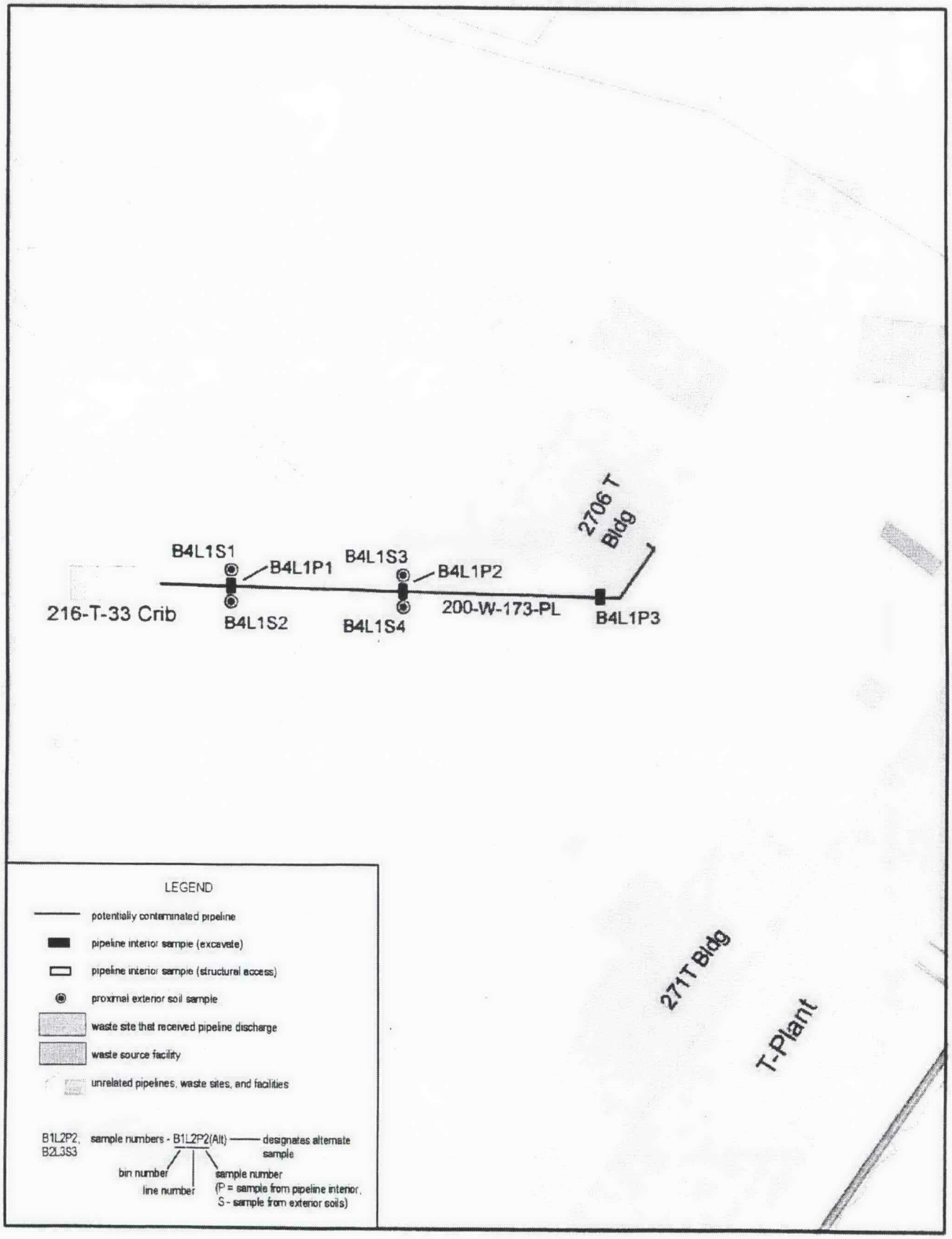


Figure A-16. Sample Location Map for the 200-E-193-PL Pipeline.

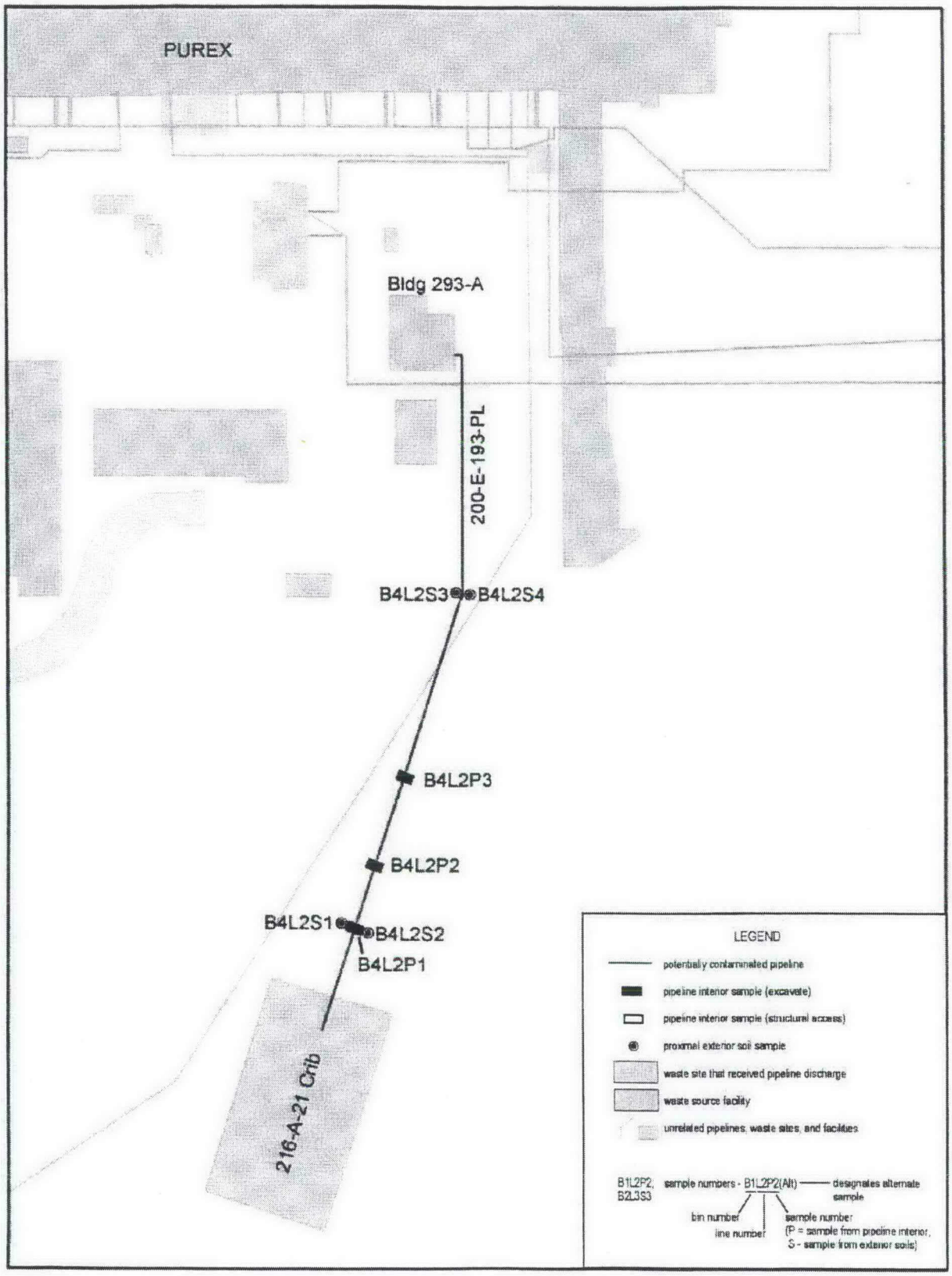


Figure A-17. Sample Location Map for the 200-E-194-PL Pipeline.

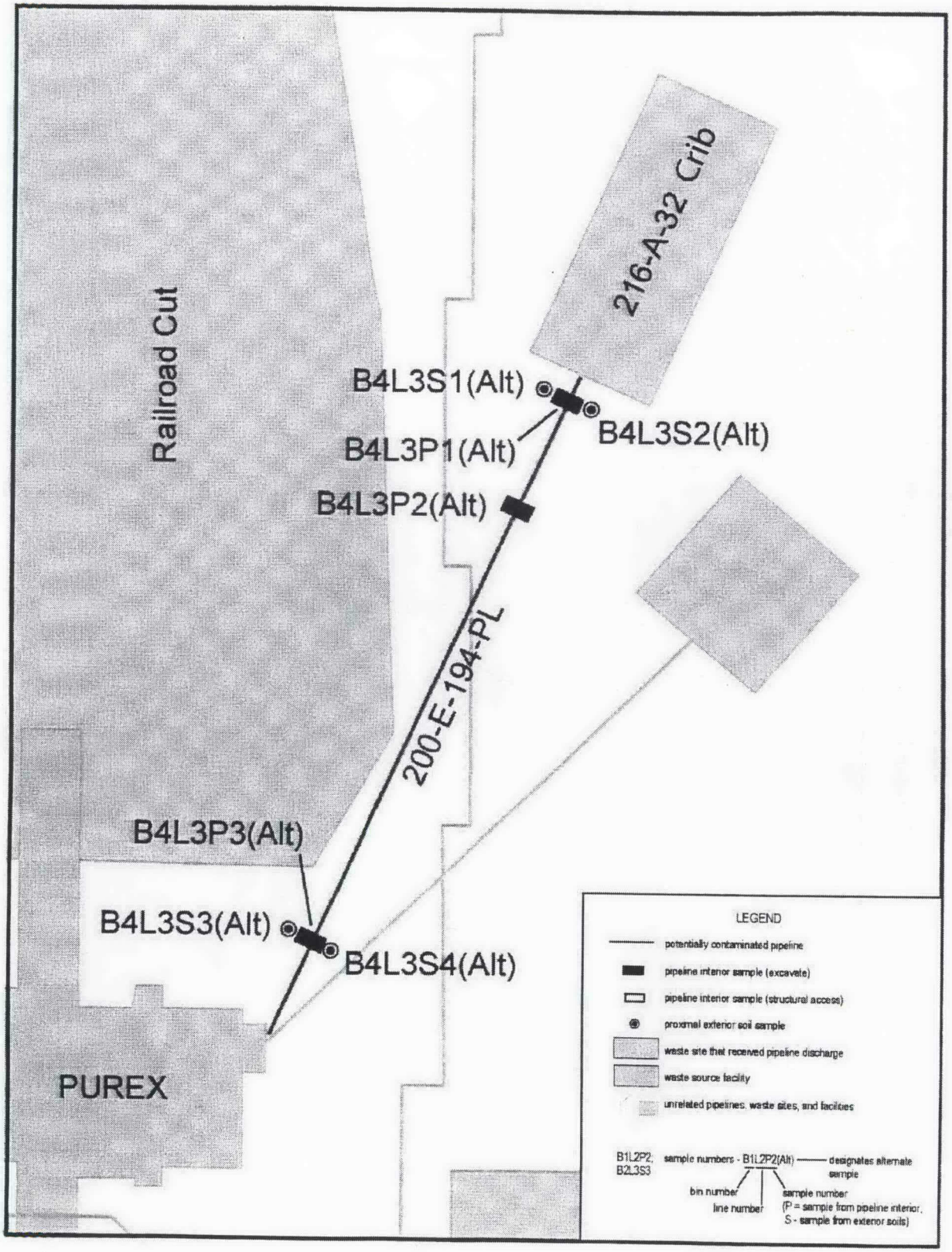


Figure A-18. Sample Location Map for the 200-W-175-PL Pipeline.

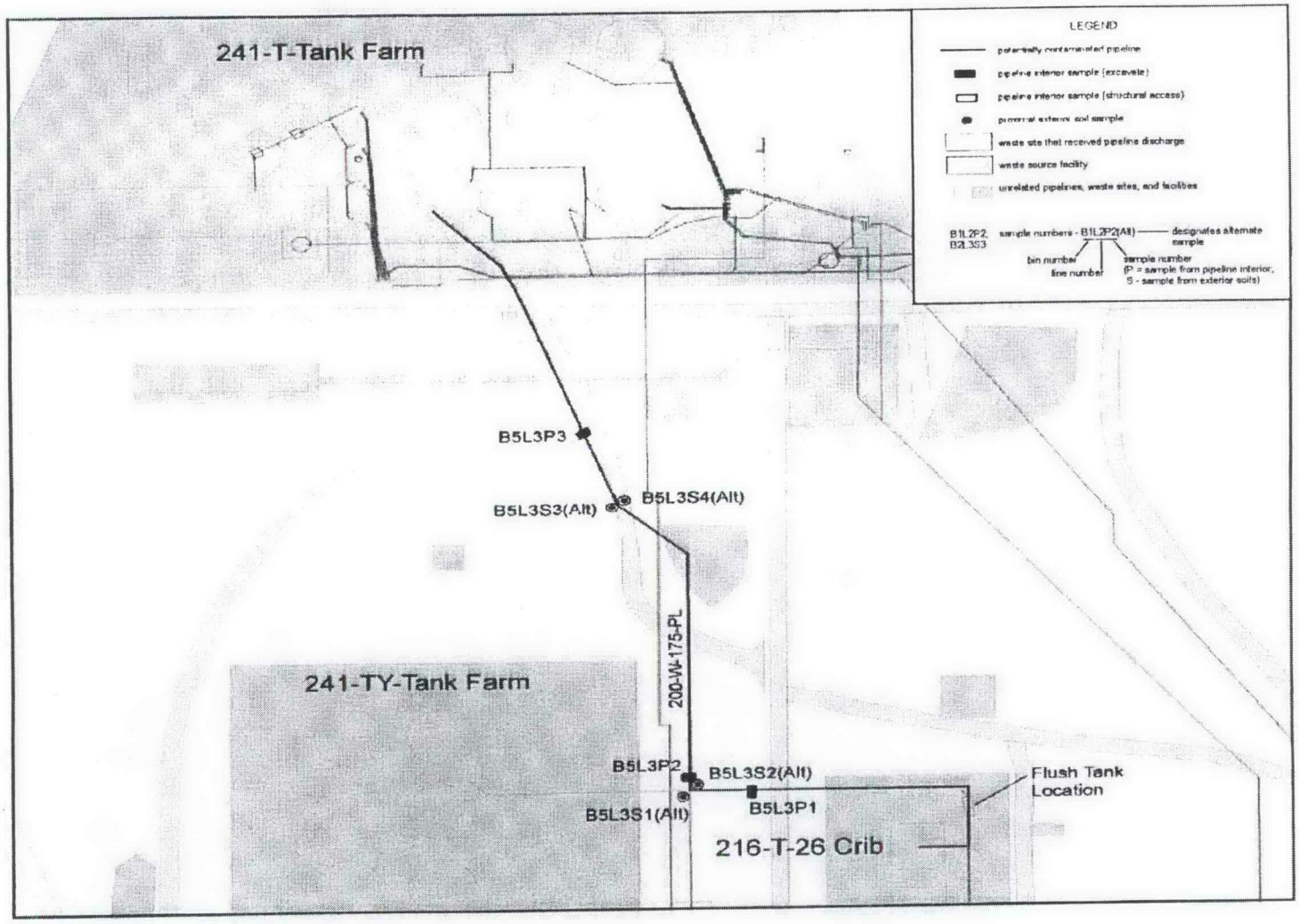


Figure A-19. Sample Location Map for the 200-E-195-PL Pipeline.

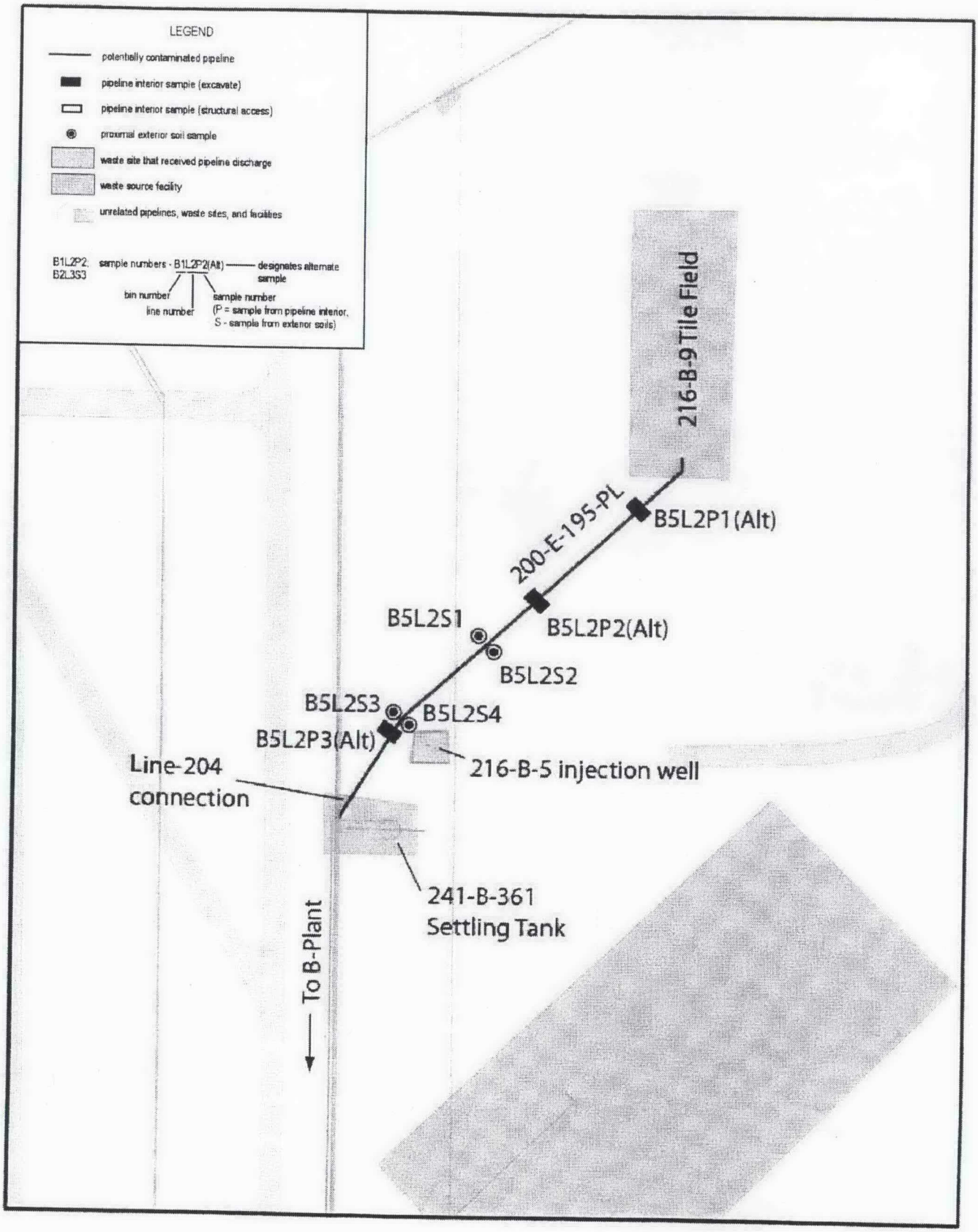


Figure A-20. Sample Location Map for the Northern Portion of the 200-E-114-PL Pipeline.

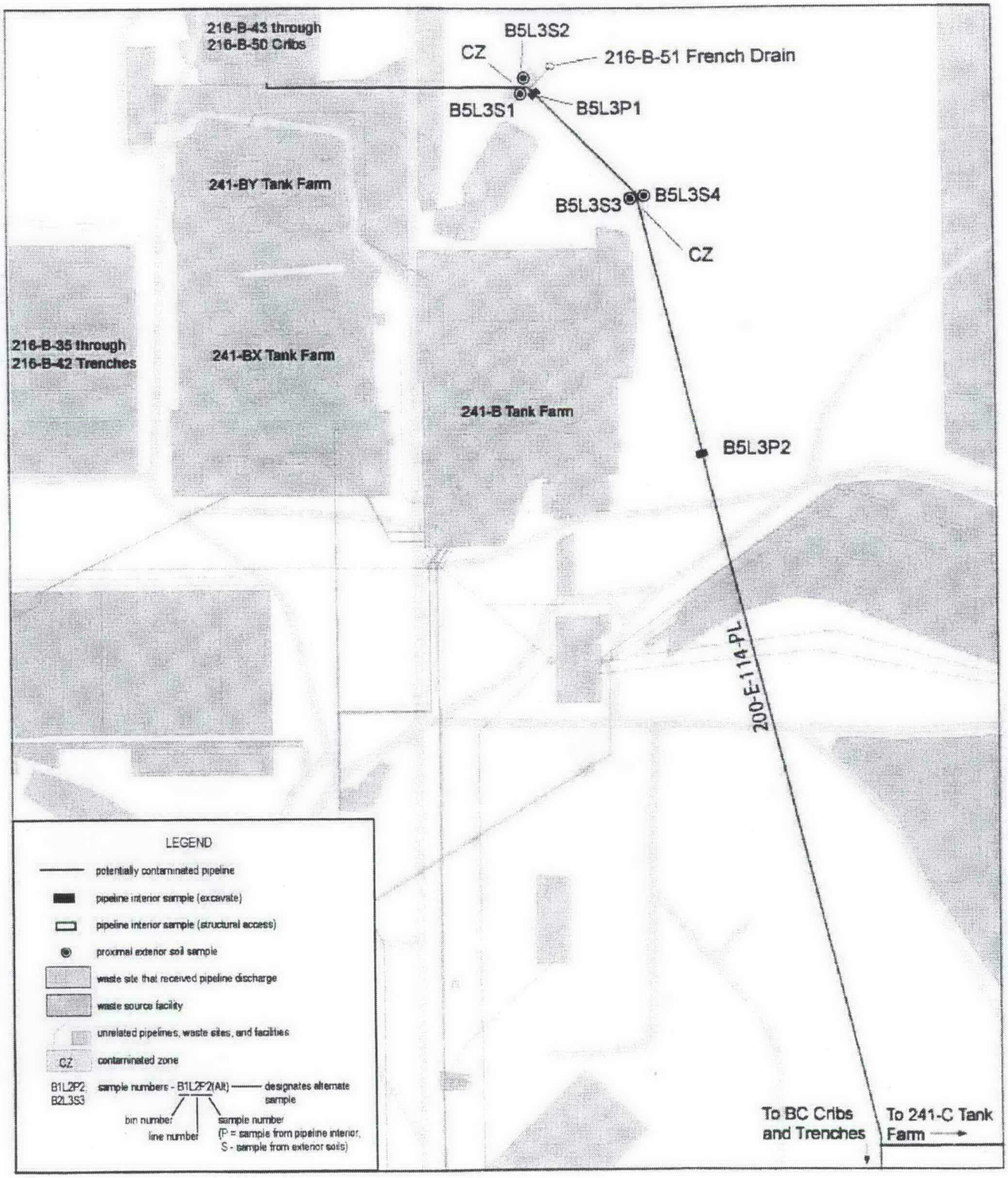
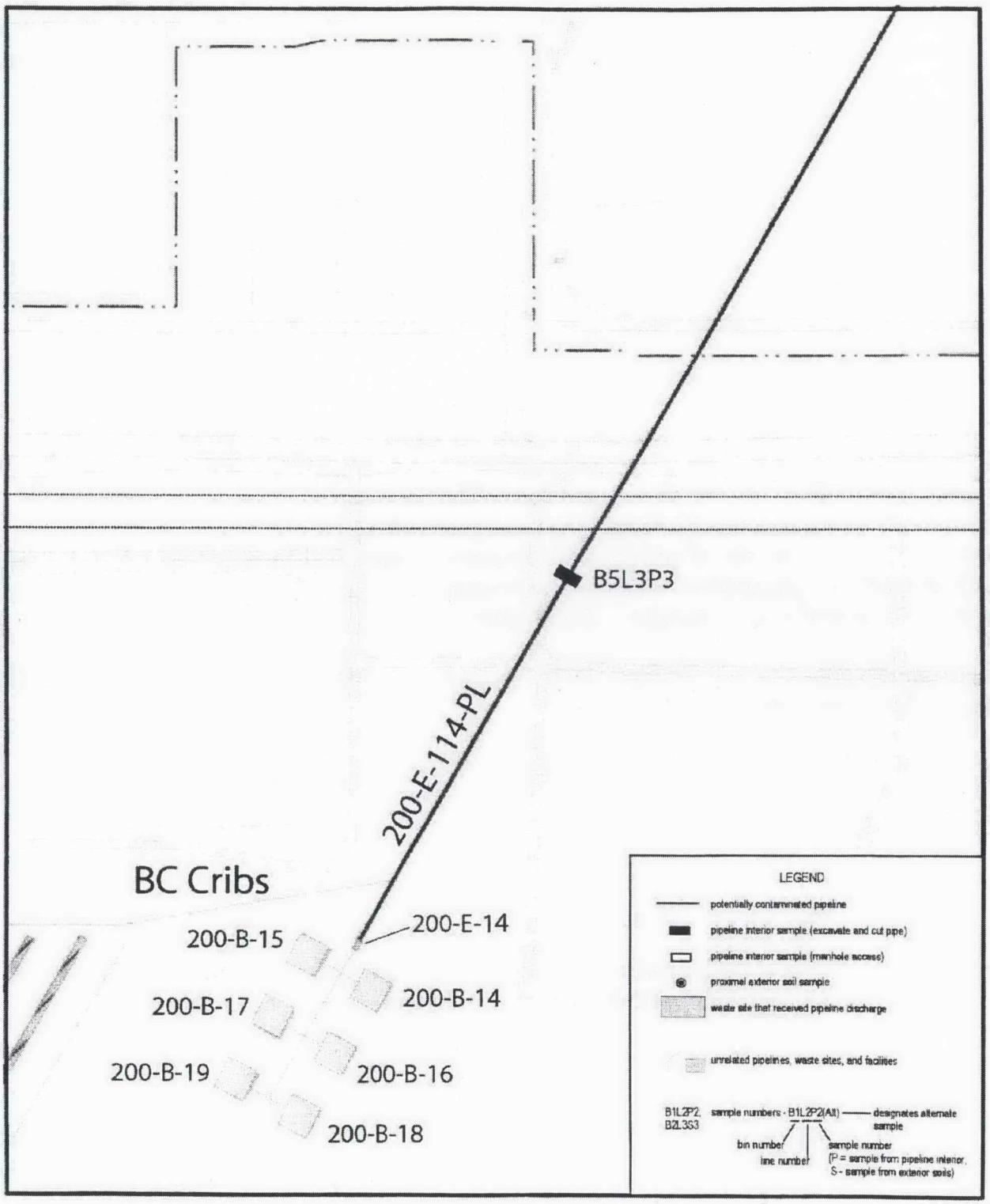


Figure A-21. Sample Location Map for the Southern Portion of the 200-E-114-PL Pipeline.



A2.2.2.5 Summary of Sampling Activities and Sample Numbers

Table A-13 provides a tabulation of all the investigative activities and number of samples to be collected at the primary-pipeline sample locations. Table A-14 lists alternate locations where investigative activities can be completed and samples collected if primary locations are not accessible. The field-screening analyses to be conducted for each pipeline are provided in Table A-15.

A2.2.2.6 Field Quality-Control Sample Requirements

Table A-16 lists the number of field QC samples that will be collected. As noted previously, because of the likely limited quantity of sample material available within the pipelines, these QC specifications may not be attainable.

A2.2.2.7 Sample Identification

The *Sample Data Tracking* database will be used to track the samples from the point of collection through the collection and 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 this project in accordance with onsite organizational procedures. 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.

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 and time
- Name or initials of person collecting the sample
- Analysis required
- Preservation method (if applicable).

Soil-gas measurements will be assigned a unique HEIS sample number. The HEIS number, collection location, and depth will be documented in the sampler's field logbook.

Table A-13. Summary of Activities at All Pipeline Sample Locations. (3 Pages)

Bin	Waste Site	Pipeline Number(s)	Sampling Location	Pipeline Interior Access Type	Surrounding Soils Sampling	Number of Direct-Push Locations for Radiological Logging[a]	Interior Pipe Sampling Activities: Number of Test Pits to Evaluate Pipeline[a]	Interior Pipe Sampling Activities: Number of Field Screening Samples to Evaluate Pipe Interior[a]	Interior Pipe Sampling Activities: Number of Pipeline Interior Samples for Laboratory Analysis[a]	Exterior Soil Sampling Activities: Number of Direct-Push Locations for Soil Sampling[a]	Exterior Soil Sampling Activities: Number of Driven Soil Samples for Field Screening[a]	Exterior Soil Sampling Activities: Number Driven Soil Samples for Laboratory Analysis[a]
1 (B1)	216-A-10	200-E-192-PL:1, 200-E-192-PL:2 (L1)	P1	test pit	--	2	1	1	1	--	--	--
			P2	test pit	--	2	1	1	1	--	--	--
			P3	sampler pit	--	none	none	1	1	--	--	--
			S1	--	X	1	--	--	--	1	4	1
			S2	--	X	1	--	--	--	1	4	1
			S3	--	X	1	--	--	--	1	4	1
			S4	--	X	1	--	--	--	1	4	1
	216-Z-1A	200-W-174-PL (L2)	P1[b]	test pit	--	2	1	1	1	--	--	--
			P2	test pit	--	2	1	1	1	--	--	--
			P3	test pit	--	2	1	1	1	--	--	--
			S1 (Alternate)[b]	--	X	See Table A-14.						
			S2 (Alternate)[b]	--	X							
			S3 (Alternate)	--	X							
			S4 (Alternate)	--	X							
	216-B-12	200-E-160-PL, 200-E-162-PL:1, 200-E-162-PL:2 (L3)	P1 (Alternate)[b]	test pit	--	See Table A-14						
			P2 (Alternate)	diversion pit	--							
			P3 (Alternate)	sampler pit	--							
			S1[b]	--	X	1	--	--	--	1	4	1
			S2[b]	--	X	1	--	--	--	1	4	1
			S3	--	X	1	--	--	--	1	4	1
			S4	--	X	1	--	--	--	1	4	1
2 (B2)	216-B-2-2	200-E-112-PL (L1)	P1	manhole	--	none	none	1	1	--	--	--
			P2	manhole	--	none	none	1	1	--	--	--
			P3	manhole	--	none	none	1	1	--	--	--
	216-A-25	200-E-127-PL (L2)	P1	manhole	--	none	none	1	1	--	--	--
			P2[d]	manhole	--	none	none	1	1	--	--	--
			P3	manhole	--	none	none	1	1	--	--	--
			S1	--	X	1	--	--	--	1	4	1
			S2	--	X	1	--	--	--	1	4	1
			S3[d]	--	X	1	--	--	--	1	4	1
			S4[d]	--	X	1	--	--	--	1	4	1
	216-A-30	200-E-113-PL (L3)	P1 (Alternate)	test pit	--	See Table A-14						
			P2 (Alternate)	test pit	--							
			P3 (Alternate)	test pit	--							
			S1 (Alternate)	--	X							
			S2 (Alternate)	--	X							
			S3 (Alternate)	--	X							
			S4 (Alternate)	--	X							
	216-T-36	200-W-79-PL (L4)	S1	--	X	1	--	--	--	1	4	1
			S2	--	X	1	--	--	--	1	4	1
			S3	--	X	1	--	--	--	1	4	1
			S4	--	X	1	--	--	--	1	4	1

Table A-13. Summary of Activities at All Pipeline Sample Locations. (3 Pages)

Bin	Waste Site	Pipeline Number(s)	Sampling Location	Pipeline Interior Access Type	Surrounding Soils Sampling	Number of Direct-Push Locations for Radiological Logging[a]	Interior Pipe Sampling Activities			Exterior Soil Sampling Activities		
							Number of Test Pits to Evaluate Pipeline[a]	Number of Field Screening Samples to Evaluate Pipe Interior[a]	Number of Pipeline Interior Samples for Laboratory Analysis[a]	Number of Direct-Push Locations for Soil Sampling[a]	Number of Driven Soil Samples for Field Screening[a]	Number Driven Soil Samples for Laboratory Analysis[a]
3 (B3)	216-A-29	200-E-187-PL (L1)	P1 (Alternate)[b]	manhole	--	See Table A-14						
			P2 (Alternate)	manhole	--							
			P3 (Alternate)	manhole	--							
			S1 (Alternate)[b]	--	X							
			S2 (Alternate)[b]	--	X							
			S3 (Alternate)	--	X							
			S4 (Alternate)	--	X							
	216-S-10	200-W-157-PL (L2)	P1[c]	manhole	--	none	none	1	1	--	--	--
			P2	manhole	--	none	none	1	1	--	--	--
			P3	manhole	--	none	none	1	1	--	--	--
			S1	--	X	1	--	--	--	1	4	1
			S2	--	X	1	--	--	--	1	4	1
			S3[c]	--	X	1	--	--	--	1	4	1
			S4[c]	--	X	1	--	--	--	1	4	1
	216-B-63	200-E-188-PL (L3)	P1	manhole	--	none	none	1	1	--	--	--
			P2	manhole	--	none	none	1	1	--	--	--
			P3	manhole	--	none	none	1	1	--	--	--
			S1	--	X	1	--	--	--	1	4	1
			S2	--	X	1	--	--	--	1	4	1
			S3	--	X	1	--	--	--	1	4	1
			S4	--	X	1	--	--	--	1	4	1
4 (B4)	216-T-33	200-W-173-PL (L1)	P1[b]	test pit	--	0[b, f]	1	1	1	--	--	--
			P2[d]	test pit	--	0[d, f]	1	1	1	--	--	--
			P3	test pit	--	2	1	1	1	--	--	--
			S1[b]	--	X	1	--	--	--	1	4	1
			S2[b]	--	X	1	--	--	--	1	4	1
			S3[d]	--	X	1	--	--	--	1	4	1
			S4[d]	--	X	1	--	--	--	1	4	1
	216-A-21	200-E-193-PL (L2)	P1[b]	test pit	--	0[b, f]	1	1	1	--	--	--
			P2	test pit	--	2	1	1	1	--	--	--
			P3	test pit	--	2	1	1	1	--	--	--
			S1[b]	--	X	1	--	--	--	1	4	1
			S2[b]	--	X	1	--	--	--	1	4	1
			S3	--	X	1	--	--	--	1	4	1
			S4	--	X	1	--	--	--	1	4	1
	216-A-32	200-E-194-PL (L3)	P1 (Alternate)[b]	test pit	--	See Table A-14						
			P2 (Alternate)	test pit	--							
			P3 (Alternate)[e]	test pit	--							
			S1 (Alternate)[b]	--	X							
			S2 (Alternate)[b]	--	X							
			S3 (Alternate)[e]	--	X							
			S4 (Alternate)[e]	--	X							

Table A-13. Summary of Activities at All Pipeline Sample Locations. (3 Pages)

Bin	Waste Site	Pipeline Number(s)	Sampling Location	Pipeline Interior Access Type	Surrounding Soils Sampling	Number of Direct-push Locations for Radiological Logging[a]	Interior Pipe Sampling Activities			Exterior Soil Sampling Activities		
							Number of Test Pits to Evaluate Pipeline[a]	Number of Field Screening Samples to Evaluate Pipe Interior[a]	Number of Pipeline Interior Samples for Laboratory Analysis[a]	Number of Direct-Push Locations for Soil Sampling[a]	Number of Driven Soil Samples for Field Screening[a]	Number Driven Soil Samples for Laboratory Analysis[a]
5 (B5)	216-T-26	200-W-175-PL (L1)	P1	test pit	--	2	1	1	1	--	--	--
			P2	test pit	--	2	1	1	1	--	--	--
			P3	test pit	--	2	1	1	1	--	--	--
			S1 (Alternate)	--	X	See Table A-14						
			S2 (Alternate)	--	X							
			S3 (Alternate)	--	X							
			S4 (Alternate)	--	X							
	216-B-9	200-E-195-PL (L2)	P1 (Alternate)	test pit	--	See Table A-14						
			P2 (Alternate)	test pit	--							
			P3 (Alternate)	test pit	--							
			S1	--	X	1	--	--	--	1	4	1
			S2	--	X	1	--	--	--	1	4	1
			S3	--	X	1	--	--	--	1	4	1
			S4	--	X	1	--	--	--	1	4	1
	216-B-46[g]	200-E-114-PL (L3)	P1	test pit	--	2	1	1	1	--	--	--
			P2	test pit	--	2	1	1	1	--	--	--
			P3	test pit	--	2	1	1	1	--	--	--
			S1	--	X	1	--	--	--	1	4	1
			S2	--	X	1	--	--	--	1	4	1
			S3	--	X	1	--	--	--	1	4	1
			S4	--	X	1	--	--	--	1	4	1
Total Numbers for Primary Sample Sites[a]						68	17	30*	30*	40	160	40

*Note – the number of samples indicated for interior pipeline sample collection is contingent on the amount of sample material available.
[a]Number of samples shown assumes that no alternative locations are selected.
[b]Pipeline sample location P1 is the same location as for soil samples S1 & S2.
[c]Pipeline sample location P1 is the same location as for soil samples S3 & S4.
[d]Pipeline sample location P2 is the same location as for soil samples S3 & S4.
[e]Pipeline sample location P3 is the same location as for soil samples S3 & S4.
[f]The direct-push locations for radiological logging that are associated with this internal pipe sample are the same as for the corresponding external soil sampling at this same general location along the pipeline.
[g]Because of its complex operational history, the 200-E-114-PL Pipeline has been associated with several liquid-waste disposal sites. The 216-B-46 Crib was selected as the best candidate for association with the northern portion of this pipeline being evaluated as part of this investigation.

-- = not applicable.

Table A-14. Summary of Activities for Alternate Sampling Locations. (2 Pages)

Bin	Waste Site	Pipeline Number	Sampling Location	Pipeline Interior Access Type	Surrounding Soils Sampling	Number of Direct-Push Locations for Radiological Logging[a]	Interior Pipe Sampling Activities			Exterior Soil Sampling Activities		
							Number of Test Pits to Evaluate Pipeline[a]	Number of Field Screening Samples to Evaluate Pipe Interior[a]	Number of Pipeline Interior Samples for Laboratory Analysis[a]	Number of Direct-Push Locations for Soil Sampling[a]	Number of Driven Soil Samples for Field Screening[a]	Number Driven Soil Samples for Laboratory Analysis[a]
1 (B1)	216-Z-1A	200-W-174-PL (L2)	S1 (Alternate)[b]	--	X	1	--	--	--	1	4	1
			S2 (Alternate)[b]	--	X	1	--	--	--	1	4	1
			S3 (Alternate)	--	X	1	--	--	--	1	4	1
			S4 (Alternate)	--	X	1	--	--	--	1	4	1
	216-B-12	200-E-160-PL, 200-E-162-PL:1, 200-E-162-PL:2 (L3)	P1 (Alternate)[c]	test pit	--	0[c, d]	1	1	1	--	--	--
			P2 (Alternate)	diversion pit	--	none	none	1	1	--	--	--
			P3 (Alternate)	sampler pit	--	none	none	1	1	--	--	--
2 (B2)	216-A-30	200-E-113-PL (L3)	P1 (Alternate)	test pit	--	2	1	1	1	--	--	--
			P2 (Alternate)	test pit	--	2	1	1	1	--	--	--
			P3 (Alternate)	test pit	--	2	1	1	1	--	--	--
			S1 (Alternate)	--	X	1	--	--	--	1	4	1
			S2 (Alternate)	--	X	1	--	--	--	1	4	1
			S3 (Alternate)	--	X	1	--	--	--	1	4	1
			S4 (Alternate)	--	X	1	--	--	--	1	4	1
3 (B3)	216-A-29	200-E-187-PL (L1)	P1 (Alternate)[e]	manhole	--	none	none	1	1	--	--	--
			P2 (Alternate)	manhole	--	none	none	1	1	--	--	--
			P3 (Alternate)	manhole	--	none	none	1	1	--	--	--
			S1 (Alternate)[e]	--	X	1	--	--	--	1	4	1
			S2 (Alternate)[e]	--	X	1	--	--	--	1	4	1
			S3 (Alternate)	--	X	1	--	--	--	1	4	1
			S4 (Alternate)	--	X	1	--	--	--	1	4	1

Table A-14. Summary of Activities for Alternate Sampling Locations. (2 Pages)

Bin	Waste Site	Pipeline Number	Sampling Location	Pipeline Interior Access Type	Surrounding Soils Sampling	Number of Direct-Push Locations for Radiological Logging[a]	Interior Pipe Sampling Activities			Exterior Soil Sampling Activities		
							Number of Test Pits to Evaluate Pipeline[a]	Number of Field Screening Samples to Evaluate Pipe Interior[a]	Number of Pipeline Interior Samples for Laboratory Analysis[a]	Number of Direct-Push Locations for Soil Sampling[a]	Number of Driven Soil Samples for Field Screening[a]	Number Driven Soil Samples for Laboratory Analysis[a]
4 (B4)	216-A-32	200-E-194-PL (L3)	P1 (Alternate)[c]	test pit	--	0[c, g]	1	1	1	--	--	--
			P2 (Alternate)	test pit	--	2	1	1	1	--	--	--
			P3 (Alternate)[f]	test pit	--	0[f, g]	1	1	1	--	--	--
			S1 (Alternate)[e]	--	X	1	--	--	--	1	4	1
			S2 (Alternate)[e]	--	X	1	--	--	--	1	4	1
			S3 (Alternate)[f]	--	X	1	--	--	--	1	4	1
			S4 (Alternate)[f]	--	X	1	--	--	--	1	4	1
5 (B5)	216-T-26	200-W-175-PL (L1)	S1 (Alternate)	--	X	1	--	--	--	1	4	1
			S2 (Alternate)	--	X	1	--	--	--	1	4	1
			S3 (Alternate)	--	X	1	--	--	--	1	4	1
			S4 (Alternate)	--	X	1	--	--	--	1	4	1
	216-B-9	200-E-195-PL (L2)	P1 (Alternate)	test pit	--	2	1	1	1	--	--	--
			P2 (Alternate)	test pit	--	2	1	1	1	--	--	--
			P3 (Alternate)	test pit	--	2	1	1	1	--	--	--
Total Numbers for Alternative Sample Sites[a]						34	10	15	15	20	80	20

[a]Number of samples shown assumes that all alternative locations are selected.
[b]Pipeline sample location P1 (see Table A-13) is the same location as for alternate soil sample locations S1 & S2.
[c]Alternate pipeline sample location P1 is the same location as for soil sample locations S1 & S2 (see Table A-13).
[d]Number of samples shown assumes that the corresponding soil sample locations (S1 & S2) for this pipeline (see Table A-13) also are selected.
[e]Alternate pipeline sample location P1 is the same location as for alternate soil sample locations S1 & S2.
[f]Alternate pipeline sample location P3 is the same location as for alternate soil sample locations S3 & S4.
[g]Number of samples shown assumes that the corresponding alternative soil sampling locations for this pipeline are also selected.

-- = not applicable.

Table A-15. Summary of Field Screening.

Bin	Associated Waste Site	Pipeline Number(s)	Nonradiological Screening Target Constituents							Radiological Screening Target Constituents		
			Hexavalent Chromium	Mercury	Nitrate (NO_3)	Poly-chlorinated Biphenyls[a]	Polyaromatic Hydro-carbons[b] (SVOCs)	Volatile Organic Compounds	Hydro-carbons[c]	Am-241	Pu-239/240	Cs-137
1	216-A-10	200-E-192-PL:1, 200-E-192-PL:2	--	--	--	--	✔	✔	✔	✔	✔	✔
	216-Z-1A	200-W-174-PL	✔	--	✔	--	✔	✔	--	✔	✔	✔
	216-B-12	200-E-160-PL, 200-E-162-PL:1, 200-E-162-PL:2	✔	--	✔	✔	✔	--	--	✔	✔	✔
2	216-B-2-2	200-E-112-PL	--	✔	✔	✔	✔	✔	✔	✔	✔	✔
	216-A-25	200-E-127-PL	✔	--	✔	--	✔	✔	--	✔	✔	✔
	216-A-30	200-E-113-PL	✔	--	✔	--	✔	✔	--	--	✔	✔
	216-T-36	200-W-79-PL	✔	--	✔	--	--	✔	--	--	✔	✔
3	216-A-29	200-E-187-PL	✔	✔	✔	✔	✔	✔	--	✔	✔	✔
	216-S-10	200-W-157-PL	✔	✔	✔	✔	✔	✔	--	✔	✔	✔
	216-B-63	200-E-188-PL	✔	--	✔	✔	--	✔		✔		✔
4	216-T-33	200-W-173-PL	✔	--	✔	✔	--	✔	✔	✔	✔	✔
	216-A-21	200-E-193-PL	--	--	✔	--	✔	✔	--	✔	✔	✔
	216-A-32	200-E-194-PL	✔	--	✔	--	✔	✔	--	✔	✔	✔
5	216-T-26	200-W-175-PL	✔	--	✔	--	✔	✔	--	✔	✔	✔
	216-B-9	200-E-195-PL	✔	--	✔	--	--	✔	--	✔	✔	✔
	216-B-46[d]	200-E-114-PL	✔	--	✔	--	✔	--	--	✔	✔	✔

[a]Method is aroclor specific; Aroclor-1254 is tested for because it was the most frequently detected aroclor. Aroclor is an expired trademark.
[b]A subgroup of SVOCs; includes most of the SVOCs reported in Table ATT-2.
[c]Total petroleum hydrocarbons; results reported in a prespecified range; used for identification of kerosene or diesel products.
[d]Because of its complex operational history, the 200-E-114-PL Pipeline has been associated with many liquid-waste disposal sites. The 216-B-46 Crib was selected as the best candidate for association with the northern portion of this pipeline being evaluated as part of this investigation.

-- = not applicable.
✔ = applicable screening method.
SVOC = semivolatile organic compound.

Table A-16. Summary of Field Quality Control Samples for Laboratory Analysis.

Bin	Associated Pipeline Number(s)	Field Duplicates	Field Splits	Equipment Rinsate Blanks	Field Blanks
1	200-E-192-PL, 200-W-174-PL, 200-E-160-PL, and 200-162-PL	1	1	1	1
2	200-E-112-PL, 200-E-127-PL, 200-E-113-PL, and 200-W-79-PL	1	1	1	1
3	200-E-187-PL, 200-W-157-PL, and 200-E-188-PL	1	1	1	1
4	200-W-173-PL, 200-E-193-PL, and 200-E-194-PL	1	1	1	1
5	200-W-175-PL, 200-E-195-PL, and 200-E-114-PL	1	1	1	1
Totals		5	5	5	5

A2.2.2.8 Field-Sampling Logbook

All information pertinent to field sampling and analysis will be recorded in field checklists and bound logbooks in accordance with existing sample-collection protocols. The sampling team will be responsible for recording all relevant sampling information. Entries made in the logbook will be dated and signed by the individual who made the entry. Program requirements for managing the generation, identification, transfer, protection, storage, retention, retrieval, and disposition of records within the Project Hanford Management Contract will be followed.

A2.2.2.9 Sample Custody

Sample custody will be maintained in accordance with existing Hanford Site protocols. The custody of samples will be maintained from the time the samples are collected until the ultimate disposal of the samples, as appropriate. A chain-of-custody record will be initiated in the field at the time of sampling and will accompany each set of samples shipped to any laboratory. Samples will be sent to the laboratory in accordance with applicable shipping procedures. The analyses requested for each sample will be indicated on the accompanying Chain-of-Custody Form. Custody tape will be used to provide indication of tampering with the samples. The custody tape will be inscribed with the sampler's initials and the date. Chain-of-custody procedures will be followed throughout sample collection, transfer, analysis, and disposal to ensure that sample integrity is maintained. Each time the responsibility changes for the custody of the sample, the new and previous custodians will sign the record and note the date and time. The shipper will make a copy of the signed record before sample shipment and will transmit the copy to Sample and Data Management within 48 hours of shipping.

A2.2.2.10 Sample Containers and Preservatives

Level I EPA pre-cleaned sample containers will be used for soil samples collected for chemical and radiological analysis. Container sizes may vary depending on laboratory-specific volumes/requirements for meeting analytical detection limits. If, however, the dose rate on the outside of a sample jar or the curie content within the sample exceeds levels acceptable by the laboratory, smaller volumes may be sent to the laboratory after consultation with Sample and Data Management to determine the acceptable volumes.

Soil-sample preservation, containers, and holding times for radiological and nonradiological analytes are provided in Table A-17.

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Table A-17. Sample Preservation, Container, and Holding Time Guidelines. (3 Pages)

Analytes	Matrices	Bottle		Amount Required[a,b,c] (min without lab QC to min including lab QC)	Preser-vation	Packing Require-ments	Holding Time
		Number	Type				
Radionuclides							
Americium-241	Soil/Sludge/Sediment/Scale	1	G/P	1 - 10 g	None	None	6 months
Carbon-14	Soil/Sludge/Sediment/Scale	1	G/P	1 - 10 g	None	None	6 months
Cesium-137	Soil/Sludge/Sediment/Scale	1	G/P	10 - 500 g	None	None	6 months
Cobalt-60	Soil/Sludge/Sediment/Scale						
Europium-152	Soil/Sludge/Sediment/Scale						
Europium-154	Soil/Sludge/Sediment/Scale						
Europium-155	Soil/Sludge/Sediment/Scale						
Niobium-94	Soil/Sludge/Sediment/Scale						
Radium-226	Soil/Sludge/Sediment/Scale						
Neptunium-237	Soil/Sludge/Sediment/Scale	1	G/P	1 – 10 g	None	None	6 months
Nickel-63	Soil/Sludge/Sediment/Scale	1	G/P	1 – 10 g	None	None	6 months
Plutonium-238	Soil/Sludge/Sediment/Scale	1	G/P	1 - 10 g	None	None	6 months
Plutonium-239/240	Soil/Sludge/Sediment/Scale						
Strontium-90	Soil/Sludge/Sediment/Scale	1	G/P	1 - 10 g	None	None	6 months
Technetium-99	Soil/Sludge/Sediment/Scale	1	G/P	5 - 10 g	None	None	6 months
Tritium (H-3)	Soil/Sludge/Sediment/Scale	1	G	25 - 125 g	None	None	6 months
Uranium-233/234	Soil/Sludge/Sediment/Scale	1	G/P	1 - 10 g	None	None	6 months
Uranium-235/236	Soil/Sludge/Sediment/Scale						
Uranium-238	Soil/Sludge/Sediment/Scale						
Chemicals							
IC anions, EPA Method 300.0 for nitrate and nitrite, formate, oxalate	Soil/Sludge/Sediment/Scale	1	G/P	5 - 25 g	None	Cool 4 °C	48 hours
IC anions, EPA Method 353.1 for N in nitrate/nitrite	Soil/Sludge/Sediment/Scale	1	G/P	5 - 25 g	None	Cool 4 °C	28 days
ICP metals, EPA Method 6010C ICP/MS metals, EPA Method 200.8	Soil/Sludge/Sediment/Scale	1	G/P	5 - 25 g	None	None	6 months
Chromium hex, EPA Method 7196	Soil/Sludge/Sediment/Scale	1	G/P	15 – 75 g	None	Cool 4 °C	30 days
Mercury, EPA Method 7471 (CVAA)	Soil/Sludge/Sediment/Scale	1	G	1 - 5 g	None	None	28 days
Total cyanide, EPA Method 9010	Soil/Sludge/Sediment/Scale	1	G	50 – 250 g	None	Cool 4 °C	14 days

Table A-17. Sample Preservation, Container, and Holding Time Guidelines. (3 Pages)

Analytes	Matrices	Bottle		Amount Required[a,b,c] (min without lab QC to min including lab QC)	Preser-vation	Packing Require-ments	Holding Time
		Number	Type				
pH (soil) – 9045	Soil/Sludge/Sediment/Scale	1	G/P	10 - 50 g	None	None	Within 24 h of lab receipt
SVOA – 8270A	Soil/Sludge/Sediment/Scale	1	AG	30 - 150 g	None	Cool 4 °C	14/40 days
VOA – 8260 Sampling method 5035	Soil/Sludge/Sediment/Scale	2 - 8	aG	10 - 40 g	Methanol (high level) Freeze (low level)	Methanol Cool 4 °C; Freeze < - 7 °C and > -20 °C	14 days
Dibutylphosphate	To be determined						
Glycolate (glycolic acid)	To be determined (with IC anions?)						
Monobutyl phosphate	To be determined						
Nonhalogenated VOA, EPA Method 8015M, GC modified for normal paraffin hydrocarbon	Soil/Sludge/Sediment/Scale	1	aG	50 - 250 g	None	Cool 4 °C	14 days
NWTPH – diesel, kerosene	Soil/Sludge/Sediment/Scale	1	G	50 - 250 g	None	Cool 4 °C	14 days
NWTPH – gasoline	Soil/Sludge/Sediment/Scale	1	G	50 - 250 g	None	Cool 4 °C	14 days
Oil & grease	Soil/Sludge/Sediment/Scale	1	G	20 - 100 g	None	Cool 4 °C	28 days
PCB Congeners EPA Method 1668	Soil/Sludge/Sediment/Scale	1	G	10 - 90g	None	Cool 4 °C	14 days
PCBs, EPA Method 8082	Soil/Sludge/Sediment/Scale	1	G	10 - 90g	None	Cool 4 °C	14 days

NOTE: Analytical priority will be based on site-specific conditions.

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

[b]Should samples be liquid rather than soils, the following volumes need to be collected:

Radionuclides – 4 L for all radionuclides (except C-14, tritium, and Tc-99, which require approximately 500 mL for each sample).

Chemicals – All liquid samples require the amount listed for soil samples. Preservation and holding times also are affected if liquid samples are collected. Consult Sample and Data Management staff for details.

[c]Mixed soil samples may be obtained and submitted to the analytical laboratory for analyses for specific analytes, including the following:

Radionuclides – 100 g of soil for all radionuclides (except C-14, tritium, and Tc-99, which require approximately 10 g for each sample).

Chemicals – A 10 g soil sample is required for all ICP analyses, 10 g soil sample for IC anion analysis, 5 g soil sample for hexavalent chromium analysis, 10 g soil sample for 9010 analysis, 10 g soil sample for 8015 analysis, and 125 g soil samples each for 8270 and TOC analysis.

For 4-digit EPA methods, see SW-846, *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, Third Edition; Final Update III-B*, as amended.

For EPA Methods 300.0 and 353.1, see EPA/600/4-79/020, *Methods of Chemical Analysis of Water and Wastes*.

For EPA Method 200.8, see EPA/600/R-94/111, *Methods for the Determination of Metals in Environmental Samples, Supplement 1*.

For NWTPH Methods, see Ecology 97-602, *Analytical Methods for Petroleum Hydrocarbons*.

Table A-17. Sample Preservation, Container, and Holding Time Guidelines. (3 Pages)

Analytes	Matrices	Bottle		Amount Required[a,b,c] (min without lab QC to min including lab QC)	Preser-vation	Packing Require-ments	Holding Time
		Number	Type				

aG = amber glass.
CVAA = cold vapor atomic absorption.
EPA = U.S. Environmental Protection Agency.
G = glass.
GC = gas chromatography.
IC = ion chromatography.
ICP = inductively coupled plasma.
ICP/MS = inductively coupled plasma/mass spectrometer.
NWTPH = Northwest total petroleum hydrocarbon.
P = plastic.
PCB = polychlorinated biphenyl.
SVOA = semivolatile organic analyte.
VOA = volatile organic analyte.

A2.2.2.11 Sample Shipping

The radiological control technician will measure the contamination levels on the outside of each sample jar and the dose rates on each sample jar. The radiological control technician also will measure the radiological activity on the outside of the sample container (through the container) and will document the highest contact radiological reading in millirem per hour. This information, along with other data, will be used to select proper packaging, marking, labeling, and shipping paperwork in accordance with U.S. Department of Transportation regulations (49 CFR, "Transportation") and to verify that the sample can be received by the analytical laboratory in accordance with the laboratory's acceptance criteria. Copies of the shipping documentation will be provided to Sample and Data Management within 48 hours of sample shipment. Based on the measured radiological activity, the samples will be shipped to the appropriate Hanford Site-approved laboratory.

A2.2.3 Analytical Methods

Tables A-6 and A-7 list applicable fixed-laboratory methods for analytes and target detection limits.

A2.2.4 Quality Control

Specifications for field and laboratory quality-control sample types are provided in the following sections.

A2.2.4.1 Field Quality Control

Field QC samples will be collected to evaluate the potential for cross-contamination and laboratory performance. Field QC for sampling in the 200-IS-1 OU process-waste pipeline systems will require the collection of field duplicates and equipment rinsate-blank and field-blank samples. If sufficient sample material is available, field duplicates should be collected from contaminated areas so that valid comparisons can be made between the samples. However, the samples should not be collected from zones that are expected to contain high levels of transuranic-contaminated soils because of the high cost and added handling requirements

associated with transuranic materials. Limited sample material is anticipated to be available in pipeline interiors. Because of this limitation, sufficient sample quantity may not be available for the collection of field QC samples, and the percentage frequency goals specified for each type of field QC sample may not be achievable. Available sample material always will be prioritized for use in the analysis of the primary analytical samples. The field QC sample types and the frequency goals for collection are described in the following subsections.

A2.2.4.1.1 Field Duplicates

Each field duplicate will be retrieved from the sample interval or location using the same equipment (e.g., collected from same split-spoon or sample mixing bowl) and sampling technique as the original sample. Field duplicates for soil are collected and homogenized before being divided into two samples in the field. If volatile organic analyte (VOA) samples are required, they should be collected before homogenization. The duplicate samples will be sent to the primary laboratory in the same manner as the routine site samples. Field duplicates provide information regarding the homogeneity of the sample matrix and can be used to evaluate the precision of the analysis process.

At least 5 percent of the total collected soil samples will be duplicated (one field duplicate will be collected for every 20 samples). At least one field duplicate will be collected from the samples taken for each of the pipeline bins investigated. The duplicate samples will be suitable for analysis by an offsite laboratory and will be analyzed for all of the COPCs listed in Tables A-6 and A-7.

A2.2.4.1.2 Field Splits

Field split samples will be collected at the same frequency as field duplicate samples. Each split sample will be retrieved from the same sample interval or location using the same equipment (e.g., collected from same one split-spoon or sample mixing bowl) and sampling technique as the original sample. Samples will be homogenized, split into two separate aliquots in the field, and sent to two independent laboratories. If VOA samples are required, they should be collected before homogenization. The splits will be used to verify the performance of the primary laboratory.

The split samples will be obtained from a sample medium that is expected to have some contamination and that is suitable for analysis in an offsite laboratory, and they will be analyzed for all of the COPCs listed in Tables A-6 and A-7.

A2.2.4.1.3 Equipment Rinsate Blanks

Equipment rinsate blanks are used to verify the adequacy of sampling-equipment decontamination procedures and will be collected for each sampling method or from each type of nondisposable equipment used. An equipment rinsate blank will be taken from each type of decontaminated sampling equipment used for the collection of samples. Rinsate blanks need only be collected from equipment that undergoes decontamination and is used for repeated sample collection. The field team lead can request that additional equipment blanks be taken. Equipment blanks will consist of deionized water washed through decontaminated sampling equipment and placed in containers identified in the Sampling Authorization Forms. Note that

the bottle and preservation requirements for water may differ from the requirements for soil. Equipment rinsate blanks will be analyzed for the following:

- Gross alpha
- Gross beta
- Metals (excluding hexavalent chromium and mercury)
- Anions (except cyanide)
- VOAs of interest.
- Semivolatile organic analytes (SVOA) of interest.

These analytes are considered the best indicators of decontamination effectiveness.

A2.2.4.1.4 Field Blanks

The volatile organic field blanks will constitute approximately 5 percent of all VOC samples. If applicable, at least one field blank will be collected for each of the pipeline bins. Field blanks will consist of laboratory-grade deionized water added to a clean sample container in the field during the time frame that the characterization samples are being collected. The field blanks will travel to the field with the associated bottle sets and will be returned to the laboratory with the samples. They will remain closed during subsequent transport and handling. Field blanks are prepared as a check for possible contamination originating from ambient conditions at the site during sample collection. The field blank will be analyzed for VOCs only.

A2.2.4.1.5 Prevention of Cross-Contamination

Special care should be taken to prevent cross-contamination of soil samples. Particular care will be exercised 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 them on or near potential contamination sources, such as uncovered ground
- Handling bottles or equipment with dirty hands
- Improperly decontaminating equipment before sampling or between sampling events.

A2.2.4.2 Laboratory Quality Control

The laboratory method blanks, duplicates, laboratory control sample/blank spike, and matrix spikes are defined in Chapter 1 of SW-846, *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, Third Edition; Final Update III-B*, as amended, and will be run at the frequency specified in Chapter 1 of SW-846. Because of anticipated limited sample quantity being available within the pipelines, sufficient material may not be available to perform both method analysis and associated laboratory QC. Available sample quantity always will be prioritized and allocated for completion of the method analysis. If insufficient sample is available for completion of laboratory QC analyses, the laboratory will be make note of the

condition in the data-package narrative, and the associated data results will have laboratory qualifiers added as appropriate.

A2.2.5 Instrument and Equipment Testing, Inspection, and Maintenance

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 or verify calibration of their equipment per manufacturer or other applicable guidelines. Maintenance requirements (such as parts lists and documentation of routine maintenance) will be included in the individual laboratory and the onsite organization quality assurance plan or operating procedures (as appropriate).

A2.2.6 Instrument and Equipment Calibration and Frequency

Calibration of laboratory instruments will be performed in a manner consistent with SW-846 or with auditable U.S. Department of Energy, Hanford Site-wide, and contractual requirements. Calibration of radiological field instruments will be performed as indicated in Section A2.2.2.3 for radiological field-instrumentation data. Nonradiological field screening instrumentation will be calibrated (or calibration verified) in accordance with manufacturer's specifications and other approved procedures. Results of all calibrations will be recorded.

A2.2.7 Inspection and Acceptance of Supplies and Consumables

Supplies and consumables used in support of sampling and analysis activities are procured in accordance with internal work requirements and processes that describe the acquisition system and the responsibilities and interfaces necessary to ensure that structures, systems, and components, or other items and services procured/acquired, meet the specific technical and quality requirements. The procurement process ensures that purchased items and services comply with applicable procurement specifications. Supplies and consumables are checked and accepted by users before use. Supplies and consumables obtained by the analytical laboratories are procured, checked, and used in accordance with the laboratory's quality-assurance plan.

A2.2.8 Nondirect Measurements

Data obtained from existing (1) process-waste inventory records and (2) analytical results for disposal sites associated with the pipelines being evaluated in this SAP were used to identify target constituents appropriate for field screening. From an investigation of historical sources, including process documents, logbooks, original plant technical manuals, and interviews of plant operators, a master list of potential contaminants was identified during the DQO process and was used in determining the analytical requirements.

A2.2.9 Data Management

Data generated as a result of sampling and data analysis activities will follow requirements outlined in this SAP and will be managed and stored in accordance with applicable programmatic requirements governing data-management procedures. At the direction of the task lead, all analytical data packages will be subject to final technical review by qualified personnel before being included in reports. Electronic data access, when appropriate, will be via a database (e.g., HEIS, project-specific database). Where electronic data are not available, hard copies will be provided in accordance with Section 9.6 of the *Hanford Federal Facility Agreement and Consent Order* (Ecology et al., 1989).

Data will be cross-referenced between laboratory analytical data and radiation measurements to facilitate interpreting the investigation results. Errors reported by the laboratories are reported to the Sample and Data Management Project coordinator, who initiates a Sample Disposition Record or Issue Resolution Form in accordance with Project Hanford Management Contractor procedures. This process is used to document sampling and analysis errors and to establish their resolution with the project task lead. Data anomalies will be documented using a Request for Data Review. A Request for Data Review may require the laboratory to check analytical calculations or reanalyze a sample to address the anomalous analytical data. New or revised analytical data will be evaluated by the project data reviewers. Based on their evaluation, the original analytical data may be replaced with the new or revised data, or a data quality qualifier may be applied to the original analytical data. Tracking and documentation of Request for Data Reviews will be performed in accordance with Project Hanford Management Contractor procedures.

A2.3 ASSESSMENT AND OVERSIGHT

Routine evaluation of the data quality described for this project will be documented and filed along with the data in the project file.

A2.3.1 Assessments and Response Action

The Fluor Hanford Compliance and Quality Programs group may conduct random surveillance and assessments to verify compliance with the requirements outlined in this SAP, project work packages, the project quality management plan, procedures, and regulatory requirements.

Deficiencies identified by these assessments will be reported in accordance with existing programmatic requirements. The central quality-assurance group coordinates the corrective actions/deficiencies in accordance with the Project Hanford Management Contractor Quality Assurance Program. When appropriate, corrective actions will be taken by the task lead.

A2.3.2 Reports to Management

Management will be made aware of all deficiencies identified by self-assessments. Identified deficiencies will be reported to the Project Waste Site Remediation Manager, as appropriate.

A2.3.3 Changes in Workscope

Changes to the workscope detailed in the SAP may be required because of unexpected field conditions, new information, health and safety concerns, or other anomalies. Minor changes that have no adverse effect on the DQOs or project schedule can be made in the field with the approval of the project manager or assigned task lead and then documented in the daily field logbook and/or field summary reports. Changes that affect the DQOs will require concurrence by RL and the lead regulatory agency and can be documented through unit managers' meetings. Alternatively, if substantial changes are required, this SAP can be revised and reissued, requiring RL and regulator approval.

A2.4 DATA VERIFICATION, VALIDATION, AND USABILITY

A2.4.1 Data Review, Verification, and Validation

Data review and verification activities include checking completeness of laboratory analytical data packages (e.g., laboratory QC documentation is complete, all data results are present, data narrative summary is complete, all report pages are present). Data verification is defined as confirming that the required deliverables have been provided, comparing requested versus reported analyses, and identifying any transcription errors. Data validation is defined as the evaluation and qualification of results based on holding time, method blanks, matrix spikes, laboratory control samples, laboratory duplicates, and chemical and tracer recoveries, as appropriate to the methods used. No other validation or calculation checks will be performed.

A2.4.2 Verification and Validation Methods

Verification activities will be completed by qualified Soil and Groundwater Remediation Project Sample and Data Management personnel. Validation will be performed on completed data packages by qualified Soil and Groundwater Remediation Project Sample and Data Management personnel or by a qualified independent contractor. Validation requirements identified in this section are consistent with Level C validation, as defined in data-validation procedures. Level C data validation as defined in the contractor's validation procedures, which are based on EPA functional guidelines (Bleyler, 1988a, *Laboratory Data Validation Functional Guidelines for Evaluating Inorganics Analyses*; Bleyler, 1988b, *Laboratory Data Validation Functional Guidelines for Evaluating Organics Analyses*), will be performed on at least 5 percent of all data. The goal is to cover the various analyte groups and matrices during the validation. When outliers or illogical results are identified in the data-quality assessment, additional data validation will be performed. The additional validation will be up to 5 percent of the statistical outliers and/or illogical 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. All data validation will be documented in data-validation reports. With the exception of "R" qualified or rejected data, all data will be used. No validation will be performed for physical data.

A2.4.3 Reconciliation with User Requirements

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. EPA/240/B-06/002, *Data Quality Assessment: A Reviewers Guide*, EPA QA/G-9R, identifies five steps for evaluating the 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 quality assurance/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, including an evaluation of the distribution of the data.

Step 3. Select the Statistical Test. Using the data evaluated in Step 2, select an appropriate statistical hypothesis test and justify the selection of this test.

Step 4. Verify the Assumptions. Assess the validity of the data analyses 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, return to Step 3.

Step 5. Draw Conclusions from the Data. The statistical hypothesis test is applied in this step (if applicable to the sample design). If the statistical hypothesis test rejects the null hypothesis, the data should be analyzed further. If the statistical test fails to reject the null hypothesis, the overall performance of the sampling design should be evaluated by performing a statistical power calculation to assess the adequacy of the sampling design.

A3.0 FIELD-SAMPLING PLAN

A3.1 SAMPLING OBJECTIVES

The primary objective of the field-sampling plan is to identify and describe sampling- and field-measurement activities that will be conducted to resolve the DRs (identified in Chapter A2.0). The field-sampling plan describes pertinent elements of the sampling program. Sample methods, procedures, locations, and frequencies are identified in this section.

This plan specifies a variety of field-sampling methods. The combination of methods that will be used are specified for both the interior of the pipelines and the surrounding soil. Initially, surface radiological surveys and surface geophysical surveys will be conducted at any location where an intrusive activity will performed. Surface geophysical surveys will be performed to identify subsurface anomalies, locate underground piping, and assist in determining the exact locations for subsurface sampling.

Installation of small-diameter casing using direct-push equipment will be used for vadose-zone investigations to facilitate in situ radiological-logging measurements and for collection of discrete soil samples. Down-hole logging for gamma-emitting radionuclides, plutonium, and moisture content will be performed before soil samples are collected. Soil samples will be collected in a separate direct-push hole at specified depths from the vadose zone for field screening (Table A-15) and full-suite laboratory analysis (Tables A-6 and A-7). A split-spoon sampler or soil liner will be the primary sampling device used to collect soil samples. The following subsections describe the specific methodologies used at each location included in this SAP. The planned sampling locations are shown in Figures A-5 through A-20. Sampling design features are discussed in Chapter A2.0 and summarized in Table A-12.

Problems with accessing the interior of pipelines, direct-push installations, sample collection, sample custody, or data acquisition that affect the quality of data or impair the ability to acquire data because of failure to meet contract requirements, or failure to follow procedures, will be documented. When a problem is encountered with performing field measurements or conducting sampling, cognizant field personnel will communicate the problem to the task lead for evaluation and resolution.

A3.2 CHARACTERIZATION APPROACH

The following discussion outlines the approach that will be used to optimize data collection and determine which samples will be selected for laboratory analyses. The investigation of the pipelines and collection of data will completed using a systematic sequence of steps. Data results will be reviewed at selected points in the process to determine the subsequent actions to be taken. Integration of the activities associated with collection of data and samples in the interior of the pipelines and in the surrounding soil is included in this approach. Following this overview of the characterization approach, descriptions of the various data-collection activities is provided in subsequent sections. A description of the data-collection steps is presented below.

Site Investigation Steps

1. Conduct surface geophysical surveys at the proposed pipeline-investigation location if needed to verify the position and burial depth of the pipeline and documented buried utilities. These surveys also will determine whether undocumented buried utilities or subsurface geophysical anomalies are present in the immediate area. Approximate sample locations are shown in Figures A-5 through A-20 and described in Table A-12.

2. Identify and stake the locations adjacent to the buried pipeline where the direct-push installations will occur. All pipeline locations where intrusive activities will be conducted will have two direct-push installations completed. The direct-push locations will be positioned as close to the pipeline as possible, with a lateral distance not to exceed 3.0 m (10 ft) away from each side of the pipeline. Specific conditions such as interfering buried utilities or high-exposure hazards may warrant adjusting locations in some instances.

3. Geophysical logging will be conducted at each direct-push location. The logging suite will consist of gross gamma, spectral gamma, passive neutron, and active neutron. Logging results should be reviewed before any subsequent activities are initiated. Radiological-logging data will be used for several purposes depending on the location:

    - At pipeline locations requiring excavation to gain access for interior pipe sampling, logging results should be reviewed before excavating soil and exposing pipelines for collection of interior samples. Dose and radiological levels determined by logging will be reviewed to determine potential worker level of protection, site controls, and waste-handling requirements. Alternate sampling locations can be used if existing site conditions restrict proposed subsequent activities

    - At pipeline locations identified for soil sampling, logging results will provide information on the vertical distribution of radionuclide activity and concentration data for major gamma-emitter radionuclides (e.g., Cs-137) within proposed sample intervals. These results will be used in determining the sample interval to be selected for laboratory analysis. Dose and radiological levels obtained by logging will be reviewed to determine potential worker level of protection, site controls, and waste-handling requirements. Alternate sampling locations can be used if existing site conditions restrict proposed subsequent activities.

4. Conduct soil sampling at designated locations along the pipeline. A direct-push dual-tube sampling system will be used to collect samples from designated intervals. Soil sample material will be used primarily to conduct field-screening analyses. Target constituents or classes of compounds (e.g., nitrate, mercury, polyaromatic hydrocarbons, PCBs, hydrocarbons, VOCs) identified for field screening are based on available process information and analytical results (if available) for the pipeline and the disposal site connected to the pipeline. All designated sample intervals will have samples analyzed by field-screening techniques. At a minimum, one sample per sampling location will be used for laboratory analyses. Field-screening results will be used to select the sample

interval for laboratory analysis. The sample interval with the overall largest number of positive detections by field screening at the highest levels will be used for laboratory analysis of COPCs. Based on the results of field screening and as directed by the remediation task lead or designated field personnel, additional samples may be obtained for laboratory analysis.

5. Perform interior-pipeline sample collection at locations that do not require excavation for access. Initially, locations with easier access, such as manholes and sampler pits, will be evaluated. Limited sampling material (sediment, sludge, or scale) may be available. If sufficient material is available for using field-screening test kits and laboratory analysis, both will be performed. If not, only instrument screening will be conducted (i.e., radiological meters and organic vapor analyzers). If radiological-screening levels (gamma, beta, and/or alpha) are greater than three times background (a screening level that is generally indicative of radiological contamination), available sample material will be allocated to radiological constituents. In the second tier of screening assessment, if VOC screening results are greater than 1 ppm (a screening level used for worker protection in the breathing zone that often is indicative VOC contamination) as measured with a hand-held organic vapor anaylzer, additional material will be used for analysis of organic constituents (VOCs, SVOCs, and other organics). If VOC levels are less than 1 ppm, available sample material will be used for inorganic analysis (e.g., metals, nitrates).

6. Pipelines requiring excavation to gain access for interior sample collection will be investigated last. These locations potentially pose the greatest logistical concerns. Test-pit excavations to expose the pipe section may involve using sloping, shoring, or trench boxes. The specific configuration of pipe location and anticipated hazards will be considered in the selected technique. Excavated soil will be field screened with radiological instrumentation and an organic vapor analyzer during the removal process to determine if contamination is present. Additional field screening analyses may be performed (e.g., using test kits) based on results of instrument screening and visual observations (e.g., soil discoloration or staining).

7. Initially, exposed pipelines may be screened remotely to determine radiological activity, with instrumentation attached to equipment and configured in a manner to limit worker exposure. Liquid waste could be present inside pipelines at some locations selected for sampling. An opening in the top of the exposed pipe will be completed to assess whether liquid is present before the pipe sections are removed. A plan for handling released liquids, including a notification to regulatory authorities within 24 hours, will be developed before the field program is implemented. Pipe sampling may need to be conducted outside of the excavation to limit worker risks during this operation. A section or sections of pipe, not to exceed a total length of approximately 3.0 m (10 ft), will be removed from the excavation and accessed to acquire sample material. This sample-collection process will be modified as needed to accommodate logistical or hazard restrictions and to ensure the safety of personnel involved with the task. When limited sample material is available, the process described in Step 5 will be followed.

A3.3 FIELD INVESTIGATIONS

Planned field investigations include both surface and subsurface evaluations. Surface measurements will include radiation and geophysical surveys. Subsurface investigations include using direct-push installations to conduct geophysical logging and soil-sample collection. Test-pit excavations will be completed to expose buried pipelines. A description of these activities is provided below.

A3.3.1 Surface Measurements

Surface measurements include surface radiation surveys and surface geophysical surveys.

A3.3.1.1 Surface Radiation Surveys

A surface radiation survey will be performed at each pipeline location to be investigated to document existing surface conditions. This information will be used in preparing the supporting health and safety documents and in finalizing sample-point locations. The surface radiation surveys will be conducted by qualified radiological control technicians in accordance with applicable procedures. A survey report will be prepared for each site. Surveys will be performed in accordance with applicable approved procedures. A survey will be performed at the conclusion of field work at each sampling site to ensure that sampling activities have not contributed to surface contamination.

A3.3.1.2 Surface Geophysical Surveys

Surface geophysical surveys will be used to verify the location of pipelines, other underground utilities, and subsurface anomalies. The survey results also will be used to determine the exact location for direct-push logging and soil sampling. Subsurface anomalies indicative of liquid releases will be delineated. Two different geophysical-survey techniques will be used: ground-penetrating radar and electromagnetic induction.

A3.3.2 Subsurface Measurements – Direct-Push Logging

Direct-push single-wall casing will be installed using the GeoProbe 5400[3] hydraulic ram system (or other comparable equipment) at selected locations to provide access for geophysical logging probes. Small-diameter gross-gamma, spectral-gamma, passive-neutron, and active-neutron logging probes (Table A-8) will be used to detect the presence of radiological contamination and support development of radiological-contamination profiles. Decontamination of the sampling equipment will be performed between each soil-probe location logging. Decontamination procedures will be conducted in accordance with current Hanford Site field operating

[3] GeoProbe is a registered trademark of GeoProbe Systems, Salina, Kansas.

procedures. Vertical casing will be installed up to 25 ft below ground surface (bgs). Soil conditions may limit the ability of the direct push to reach the desired depth. Several attempts will be made to drive the casing to the target depth by relocating to adjacent locations in the immediate area. If unsuccessful, one of the designated alternate locations will be used (see Tables A-12 and A-14). Detectors will be lowered to the total depth of the push rods to measure in situ levels of potential radioactive contaminants including detection of elevated neutron activity, characteristic of the presence of alpha constituents (e.g., transuranic radionuclides). Radiological contaminant profiles will be plotted for each location and used to determine regions of potential contamination. The radiological data also will support the selection of sample intervals for laboratory analyses.

The direct-push installations will be decommissioned upon completion of the data-collection activities in accordance with the requirements discussed in WAC 173-160, "Minimum Standards for Construction and Maintenance of Wells." If a variance(s) is required, approval will be obtained from Ecology for comparable alternative specifications. All installations that are decommissioned shall have a continuous seal and be constructed to prevent/eliminate preferential pathways for contamination. Before installation, applicable requirements in WAC 173-160-420, "What are the General Construction Requirements for Resource Protection Wells?," concerning a notice of intent to construct or decommission, will be met.

A3.3.3 Direct-Push Soil Sampling

A duel tube sampling system (GeoProbe 5400 hydraulic ram equipment or other comparable equipment) will be used to facilitate (provide access for) sample collection with small-diameter, split-spoon, or soil-liner samplers. The dual-tube system permits driving the outer casing rods to a specified depth and collecting a discrete sample interval. Four sample intervals are designated for collection of sample material. Soil samples will be collected from the following intervals: 1.5 to 3.0 m (5 to 10 ft) bgs, 3.0 to 4.6 m (10 to 15 ft) bgs, 4.6 to 6.1 m (15 to 20 ft) bgs, and 6.1 to 7.6 m (20 to 25 ft) bgs. The sampling intervals were selected to encompass potential leak locations directly above, lateral to, and below the pipeline. Most pipelines have a burial depth of approximately 4.6 to 6.1 m (15 to 20 ft) bgs. A 1.5 m (5-ft) sample interval should provide sufficient material for the analyses. If engineering drawings and/or geophysical data indicate that a pipeline being investigated is buried deeper than 6.1 m (20 ft), the sample intervals will be shifted downward so that sample material is collected above, lateral to, and below the pipeline.

The soil samples will be collected in a split-spoon or soil-liner sampler. The outer casing will be driven to the top of the desired depth interval with the solid drive tip in place. The drive tip then will be removed and the sampler will be driven to the bottom of the interval to obtain the sample material. Depending on the sampler length, multiple pushes may be needed to complete the collection of soil in each 1.5 m (5-ft) interval. If poor recovery occurs and additional material is required for analysis of COPCs from the selected depth interval, installation of an adjacent drive probe may be required. If sufficient sampling material cannot be obtained at the location, one of the designated alternate sampling locations will be used. Decontaminated sampling equipment will be used for each soil-probe location.

Except for the VOC samples, soil will be transferred to a decontaminated, stainless-steel mixing bowl, homogenized, then containerized as required in the sampling procedure. Material obtained for use in laboratory analyses of VOCs will be collected as a discrete sample. This sample material will be taken from the middle of each sample interval. The analytes of interest for the Phase 1 sampling are presented in Tables A-6 and A-7.

The IDW generated during this activity will be handled according to the procedures listed in Chapter A5.0 and the waste control plan (to be prepared/approved before the start of field activities).

The direct-push installations will be decommissioned upon completion of the data-collection activities in accordance with the requirements discussed in WAC 173-160. If a variance(s) is required, approval will be obtained from Ecology for comparable alternative specifications. All installations that are decommissioned shall have a continuous seal and be constructed to prevent/eliminate preferential pathways for contamination. Before installation, applicable requirements in WAC 173-160-420, concerning a notice of intent to construct or decommission, will be met.

A3.3.4 Soil Field Screening

Field screening will be performed on all soil samples. Screening techniques include using handheld radiological instruments to measure dose and count rates. Screening for alpha, beta/gamma, and gamma levels will be conducted. Potential radiological-screening instruments are listed in Table A-8 with their respective detection limits. Gamma measurements can be converted to equivalent concentrations of Cs-137 when spectral data are collected (using a multichannel analyzer). Soil-vapor measurements will be taken with an organic vapor analyzer to measure concentrations of VOCs. A simple headspace analysis will be performed by placing sample material in a sealed mason jar (approximately ½ full) for approximately 30 minutes and allowed to reach room temperature (or higher). The top of the jar will be covered with a sheet of aluminum foil and a lid. To make the measurement, gases in the headspace will be withdrawn and analyzed using an organic vapor analyzer, and the VOC levels will be recorded. Immunoassay and/or colorimetric tests can be performed for a number of constituents. Nonradiological field-screening tests are listed in Table A-9. Table A-15 indicates those field-screening analyses to be performed at each pipeline sampling location.

The radiological control technician or other qualified personnel will field screen all soil samples and cuttings from the samplers for evidence of radioactive contamination. The radiological control technician will record all field measurements, noting the depth of the sample and the instrument reading.

Before driving casing or excavating, a local-area background reading will be taken using the field-screening instruments at a site to be selected in the field. Field screening will be used to provide real-time information on contaminant levels and assist in selecting samples for laboratory analysis. Field-screening data also will be used in determining sample shipping requirements and to support worker health and safety monitoring.

Field-screening instruments will be used, maintained, decontaminated (if applicable), and calibrated (or calibration verified) in accordance with the manufacturer's specifications and other approved procedures. Specific instrumentation information and field-screening results are recorded by the radiological control technician or other qualified personnel. The field geologist also will record field-screening results on the Field Activity Report form. Results are documented in the waste-site characterization summary report prepared by the field geologist.

A3.3.5 Test-Pit Excavations

The test-pit excavations will be used to expose and gain access to buried pipelines at selected locations. Test-pit excavations will be completed in a manner that minimizes dust generation. To minimize dust during backhoe operations, water will be sprayed on the site before and during the activity. This contamination-control measure is necessary to prevent the release of contamination to the air and to stabilized areas within the site boundary. If visible emissions cannot be controlled, the activity will be postponed. Waste generated during this activity will be handled according to procedures described for the use of test pits and in the waste control plan (to be prepared).

A3.3.6 Preshipment Sample Screening

A representative portion of each sample will be shipped to the Waste Sampling and Characterization Facility or other suitable onsite laboratory for total-activity analysis before it is shipped. Total radiological activities or other analysis as required by the shipping subject-matter expert will be used for sample-shipping characterization. Samples that slightly exceed the offsite laboratory criterion may be reduced in volume to reduce total activity and allow offsite shipment. Onsite and offsite laboratories will be identified before field activities are initiated and will be mutually acceptable to the Fluor Hanford Sample and Data Management organization and the task lead.

A3.4 SURVEYING

The location of all direct-push installations and interior-pipeline sampling locations will be surveyed after sampling and site-reclamation activities are completed. Data will be recorded in NAVD88, *North American Vertical Datum of 1988*, and the Washington State Plane (South Zone) NAD83, *North American Datum of 1983*, with the 1991 adjustment for horizontal coordinates. All survey data will be recorded in meters and feet. Global Positioning System survey instrumentation will be used.

A3.5 WASTE-MANAGEMENT SAMPLING

A waste-designation DQO process will be performed immediately before the characterization activities, to ensure that the proper information is collected during the field sampling to support the designation of all project IDW. Any additional sampling requirements or analytes needed to support waste-designation activities will be identified and implemented through the waste-designation DQO summary report that will be prepared at that time.

A4.0 HEALTH AND SAFETY

All field operations will be performed in accordance with health and safety requirements and procedures. In addition, documentation will be prepared that will further control site operations. This documentation will consist of an activity hazard analysis, a site-specific health and safety plan, and applicable work permits. Work will be performed in accordance with these site-specific health and safety plans and applicable work permits. The sampling procedures and associated activities will take into consideration exposure-reduction and contamination-control techniques that will minimize the sampling team's exposure.

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A5.0 MANAGEMENT OF INVESTIGATION-DERIVED WASTE

The IDW generated by characterization activities will be managed in accordance with existing approved Fluor Hanford waste-management documents that identify the requirements and responsibilities for containment, labeling, and tracking of IDW. Procedures have been prepared to implement the requirements found in Ecology et al. 1995, "Strategy for Management of Investigation Derived Waste." Management of IDW, minimization practices, and the waste types applicable to 200-IS-1 OU waste control will be described in the waste control plan.

Unused samples and associated laboratory waste from offsite laboratory analysis will be dispositioned in accordance with the laboratory contract, which in most cases will allow the laboratory to dispose of this material. Unused sample material from onsite laboratories will be returned to the project for disposal.

A waste-designation DQO process will be completed before characterization activities are initiated, to ensure that information necessary to support designation of all project IDW is collected during the field activities. During the IDW DQO activities, any listed waste issues will be resolved. Additional sampling or analysis required to support designation activities will be identified in the waste-designation DQO summary report.

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A6.0 REFERENCES

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APPENDIX A

ATTACHMENT

SUPPORTING INFORMATION

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APPENDIX A

ATTACHMENT

SUPPORTING INFORMATION

Table ATT-1. Engineering Drawing References for Pipelines. (3 Pages)

Bin	Waste Site	Pipeline Number	Drawing Number	Sheet(s)
1	216-Z-1A Tile Field	200-E-192-PL	H-2-24924	1, 2
			H-2-26093	1
	216-A-10 Crib	200-W-174-PL	H-2-44501	48
			H-2-53093	
			H-2-55099	
			H-2-55576	
			H-2-56045	
			H-2-56049	
			H-2-56050	
			H-2-56057	
	216-B-12 Crib	200-E-160-PL and 200-E-162-PL	H-2-34524	
			H-2-36574	1, 2
			H-2-43029	
			H-2-43079	
			H-2-44501	86, 97, 98
			H-2-60330	
			H-2-60332	
			H-2-71678	
			H-13-000199	2, 3
2	216-B-2-2 Ditch	200-E-112-PL	H-2-2021	1, 2
			H-2-32262	
			H-2-32266	
			H-2-33115	
			H-2-33119	
			H-2-44500	5
			H-2-44501	96, 97, 107, 117, 118, 128, 129
			M-2904-E-28	
			W-73636	
	216-A-25 Gale Mountain Pond	200-E-127-PL	H-2-3325	1
			H-2-3326	1
			H-2-3327	1
			H-2-3328	1
			H-2-3329	1
			H-2-3330	1
			H-2-3331	1
			H-2-3332	1

Table ATT-1. Engineering Drawing References for Pipelines. (3 Pages)

Bin	Waste Site	Pipeline Number	Drawing Number	Sheet(s)
			H-2-3333	1
			H-2-36494	1, 2
			H-2-55900	
			H-2-56014	1
			H-2-66018	1
			H-6-450	1
	216-A-30 Crib	200-E-113-PL	no drawings available	
	216-T-36 Crib	200-W-79-PL	H-2-3019	
			H-2-33472	
			H-2-44511	126
			H-13-000273	2
			SK-2-21661	
3	216-A-29 Ditch	200-E-187-PL	H-2-44501	48, 57, 58, 59
			H-2-46778	
			H-2-55057	
			H-2-55074	
			H-2-55075	
			H-2-55547	
			H-2-55900	
			H-2-70301	
			H-2-75597	
			H-2-827316	
			H-2-827317	1
			H-2-90437	1
			H-2-90438	4
	216-B-63 Ditch	200-E-188-PL	H-2-33115	
			H-2-33119	
			H-2-35495	1
			H-2-44500	5, 6
			H-2-44501	85, 86, 96, 97, 107, 117, 118, 127, 128
			H-2-66430	
			H-2-94130	
			H-13-000270	1, 2
	216-S-10 Ditch	200-W-157-PL	H-2-44510	7
			H-2-44511	6, 7, 13, 14, 20, 21, 22, 28, 29
			H-2-5307	1, 2
			H-2-5962	
			H-2-72904	
			H-2-82714	
			H-2-82715	

Table ATT-1. Engineering Drawing References for Pipelines. (3 Pages)

Bin	Waste Site	Pipeline Number	Drawing Number	Sheet(s)
			H-2-82722	1
			H-2-82723	1
			H-2-95217	
			H-6-466	7, 18
4	216-T-33 Crib	200-W-173-PL	H-2-32096	
			H-2-44511	140
	216-A-21 Crib	200-E-193-PL	H-2-44501	37
			H-2-57042	
	216-A-32 Crib	200-E-194-PL	H-2-44501	47
			H-2-57110	
5	216-T-26 Crib	200-W-175-PL	H-2-2670	
			H-2-2733	
			H-2-2735	
			H-2-3019	
			H-2-3020	
			H-2-44511	118, 126, 134
	216-B-9 Crib	200-E-195-PL	H-2-432	
			H-2-1031	
			H-2-44501	96, 107
			W-72902	
	216-B-46 Crib*	200-E-114-PL	H-2-2900	
			H-2-2901	
			H-2-2902	
			H-2-2903	
			H-2-2904	
			H-2-2905	
			H-2-2906	
			H-2-2908	
			H-2-2909	

*Because of its complex operational history and its multibranched layout, the 200-E-114-PL Pipeline can be associated with many liquid waste disposal sites. The 216-B-46 Crib was selected as a disposal waste site that would have received the same process waste stream that the northern portion of this pipeline received.

Table ATT-2. Summary of Data Indicating Primary Constituents for Field Screening. (14 Pages)

Bin	Area/ Associated Facility	Pipeline Number (PL)	Associated Waste Site Number	Primary Inventory Constituents Sent to Waste Site (SIMS Data)[a]		Primary Chemical Constituents in Waste Stream (Based on Point-of-Origin Process Operations)[b]		Primary Constituents Detected in Samples Collected at Liquid Waste Disposal Site (Remedial Investigation or Other Data)[c]		Target Constituents for Field Screening[d]
				Constituent	kg or Ci	Verified[e]	Suspected[f]	Constituent	mg/kg or pCi/g	
1	200 W/ PFP	200-W-174	216-Z-1A	Am-241	3885			Am-241	2,590,000	Am-241
				Pu-240	957			Pu-239/240	38,200,000	Pu-239/240
				Pu-239	3,188					
				Pu-241	14,379					
				U-238	0					
				Cs-137	1			Cs-137	23	Cs-137
				Sr-90	<1					
				H-3	0					
				U total	<1					
				chromium	93		chromium	chromium	22	Hex Cr
				Hg	140,891			Hg	ND or <background	
				nitrate	1,319,897	nitrates		nitrate	250	nitrates
				ammonia	170	ammonia				
				PCBs	NR		PCBs			
				TBP	31,693	TBP				
				other SVOCs	NR			SVOCs (phenol)	<1	PAHs
				carbon tet	306,501	carbon tet		carbon tet	7	VOCs
				other VOCs	NR		VOCs (including acetone, butanol, chloroform, cis-1,2-dichloroethylene, DCA, methylene chloride, toluene, trichloroethane, trichloroethylene, and xylene)	VOCs (chloroform, methylene chloride; DCA, cis-1,2-dichlorothylene, MEK, MIBK, trichloroethylene, tetrachloroethylene, toluene, xylenes; others)	chloroform 3.6, methylene chloride 20; others ND to <1	

Table ATT-2. Summary of Data Indicating Primary Constituents for Field Screening. (14 Pages)

Bin	Area/ Associated Facility	Pipeline Number (PL)	Associated Waste Site Number	Primary Inventory Constituents Sent to Waste Site (SIMS Data)[a]		Primary Chemical Constituents in Waste Stream (Based on Point-of-Origin Process Operations)[b]		Primary Constituents Detected in Samples Collected at Liquid Waste Disposal Site (Remedial Investigation or Other Data)[c]		Target Constituents for Field Screening[d]
				Constituent	kg or Ci	Verified[e]	Suspected[f]	Constituent	mg/kg or pCi/g	
1	200 E/ PUREX	200-E-192-PL1, 200-E-192-PL2	216-A-10	Am-241	75			Am-241	1,320	Am-241
				Pu-238	3			Pu-238	316	
				Pu-240	13			Pu-239/240	7,110	Pu-239/240
				Pu-239	56					
				U-238	<1			U-238	1	
				Cs-137	28			Cs-137	2,950	Cs-137
				Sr-90	18			Sr-90	45	
1	200 E/ PUREX (cont)	200-E-192-PL1, 200-E-192-PL2 (cont)	216-A-10 (cont)	H-3	57,768			H-3	835	
				U total	358			U total	ND or <background	
				chromium	0			chromium	ND or <background	
				nitrate	1,918,945	nitrates		nitrate	ND or <background	
				ammonia	0	ammonia		ammonia	ND or <background	
				PCBs	NR			PCBs	ND	
				O/G	NR			O/G	59,400	HC
				TBP	0	TBP		TBP	2,000	
				other SVOCs	NR		SVOCs (including benzo(a)anthracene, benzo(a)pyrene, and benzo(ghi)perylene)	other SVOCs	ND	
				carbon tet	0			carbon tet	ND	VOCs
				other VOCs	NR		VOCs (including butanol, MEK, MIBK, TCA, trichloroethane, and tetrachloroethylene)	VOCs (MEK, acetone, toluene; others)	ND to <1	
1	200 E/ B Plant	200-E-160, 200-E-162-PL1, 200-E-162-PL2	216-B-12	Am-241	<1			Am-241	2	Am-241
				Pu-240	<1			Pu-239/240	4	Pu-239/240
				Pu-239	<1					
				U-238	5			U-238	12	
				Cs-137	326			Cs-137	61,900	Cs-137
				Sr-90	120			Sr-90	12,700	

Table ATT-2. Summary of Data Indicating Primary Constituents for Field Screening. (14 Pages)

Bin	Area/ Associated Facility	Pipeline Number (PL)	Associated Waste Site Number	Primary Inventory Constituents Sent to Waste Site (SIMS Data)[a]		Primary Chemical Constituents in Waste Stream (Based on Point-of-Origin Process Operations)[b]		Primary Constituents Detected in Samples Collected at Liquid Waste Disposal Site (Remedial Investigation or Other Data)[c]		Target Constituents for Field Screening[d]
				Constituent	kg or Ci	Verified[e]	Suspected[f]	Constituent	mg/kg or pCi/g	
				H-3	2,340			H-3	8	
				U total	15,112			U - total	28	
				chromium	561	chromium		chromium	30	Hex Cr
				nitrate	2,860,615	nitrates		nitrate as N	165	nitrates
				ammonia	54	ammonia		ammonia	404	
				PCBs	NR			Aroclor-1254	<1	PCBs
				NPH	17	NPH (kerosene)		NPH	ND	
1	200 E/ B Plant (cont)	200-E-160; 200-E-162-PL1; 200-E-162-PL2 (cont)	216-B-12 (cont)	TBP	0			TBP	2	PAHs
				carbon tet	0			carbon tet	ND	
				other VOCs	NR		VOCs (including acetone, benzene, MEK, MIBK, and trichloroethane)	other VOCs	ND	
2	200 E/ PUREX	200-E-127	216-A-25	Am-241	3			Am-241	<1	Am-241
				Pu-240	9			Pu-239/240	<1	Pu-239/240
				Pu-239	29					
				U-238	4			U-238	ND or <background	
				Cs-137	7,263			Cs-137	7,180	Cs-137
				Sr-90	183			Sr-90	59	
				H-3	875			H-3	ND or <background	
				U total	12,193			U total	ND or <background	
				chromium	5	chromium		chromium	24	Hex Cr
				nitrate	163,958	nitrates		nitrate	500	nitrates
				ammonia	5	ammonia		ammonia as N	77	
				PCBs	NR			PCBs	ND	
				TBP	0	TBP				
				other SVOCs	NR		SVOCs (including benzo(a)anthracene, benzo(a)pyrene, and benzo(ghi)perylene)	other SVOCs (bis(2-ethylhexyl)phthalate, dibutyl-benzlphthalate, chloromethane, diethylphthalate, and di-n-butylphthalate)	ND to 1.8	PAHs

Table ATT-2. Summary of Data Indicating Primary Constituents for Field Screening. (14 Pages)

Bin	Area/ Associated Facility	Pipeline Number (PL)	Associated Waste Site Number	Primary Inventory Constituents Sent to Waste Site (SIMS Data)[a]		Primary Chemical Constituents in Waste Stream (Based on Point-of-Origin Process Operations)[b]		Primary Constituents Detected in Samples Collected at Liquid Waste Disposal Site (Remedial Investigation or Other Data)[c]		Target Constituents for Field Screening[d]
				Constituent	kg or Ci	Verified[e]	Suspected[f]	Constituent	mg/kg or pCi/g	
				carbon tet	2,199					
				other VOCs	NR		VOCs (including acetone, benzene, butanol, MEK, MIBK, TCA, trichloroethane, and tetrachloroethylene)	VOCs (including acetone, 2-butanone, chloromethane, methylene chloride, toluene, xylenes, and 1,1,2-trichlorethane)	ND to <1	VOCs
2	200 E/ B Plant	200-E-112	216-B-2-2	Am-241	12			Am-241	1	Am-241
				Pu-240	5			Pu-239/240	<1	Pu-239/240
				Pu-239	19					
				U-238	2,788			U-238	ND or <background	
				Cs-137	402			Cs-137	721	Cs-137
				Sr-90	134			Sr-90	12,100	
				H-3	99			H-3	ND or <background	
				U total	20,132			U total	ND or <background	
				chromium	1,409	chromium		chromium	ND or <background	
				Hg	279	Hg		Hg	<1	Hg
				nitrate	293,537	nitrates		nitrate	330	nitrates
				ammonia	75	ammonia		ammonia	ND or <background	
				PCBs	NR			Aroclor-1260	9	PCBs
				NPH	37,548	NPH (kerosene)				HC[h]
				TBP	0			TBP	ND	
				other SVOCs	NR			SVOCs (benzo(a)anthracene, benzo(a)pyrene, benzo(ghi)perylene, benzo(b)fluoranthene, benzo(k)perylene; others)	ND to 2	PAHs
				carbon tet	4,676					

Table ATT-2. Summary of Data Indicating Primary Constituents for Field Screening. (14 Pages)

Bin	Area/ Associated Facility	Pipeline Number (PL)	Associated Waste Site Number	Primary Inventory Constituents Sent to Waste Site (SIMS Data)[a]		Primary Chemical Constituents in Waste Stream (Based on Point-of-Origin Process Operations)[b]		Primary Constituents Detected in Samples Collected at Liquid Waste Disposal Site (Remedial Investigation or Other Data)[c]		Target Constituents for Field Screening[d]
				Constituent	kg or Ci	Verified[e]	Suspected[f]	Constituent	mg/kg or pCi/g	
				other VOCs	NR		VOCs (including acetone, benzene, MEK, MIBK, and trichloroethane)	VOCs (acetone methylene chloride)	ND to <1	VOCs
2	200 E/ PUREX	200-E-113	216-A-30	Am-241	0			no data	no data	
				Pu-240	11					Pu-239/240
				Pu-239	31					
				U-238	656					
				Cs-137	3					Cs-137
				Sr-90	1					
				H-3	<1					
				U total	<1					
				chromium	6,045					Hex Cr
				nitrate	208,226	nitrates				nitrates
				ammonia	<1	ammonia				
				PCBs	NR					
				TBP	0	TBP				
				other SVOCs	NR		SVOCs (including benzo(a)anthracene, benzo(a)pyrene, and benzo(ghi)perylene)			PAHs
				carbon tet	0					
				other VOCs	NR		VOCs (including butanol, MEK, MIBK, TCA, trichloroethane, and tetrachloroethylene)			VOCs

Table ATT-2. Summary of Data Indicating Primary Constituents for Field Screening. (14 Pages)

Bin	Area/ Associated Facility	Pipeline Number (PL)	Associated Waste Site Number	Primary Inventory Constituents Sent to Waste Site (SIMS Data)[a]		Primary Chemical Constituents in Waste Stream (Based on Point-of-Origin Process Operations)[b]		Primary Constituents Detected in Samples Collected at Liquid Waste Disposal Site (Remedial Investigation or Other Data)[c]		Target Constituents for Field Screening[d]
				Constituent	kg or Ci	Verified[e]	Suspected[f]	Constituent	mg/kg or pCi/g	
2	200 W/ T Plant	200-W-79	216-T-36	Am-241	0			no data	no data	
				Pu-240	6					Pu-239/240
				Pu-239	17					
				U-238	172					
				Cs-137	<1					Cs-137
				Sr-90	<1					
				H-3	0					
				U total	0					
				chromium	212	chromium				Hex Cr
				nitrate	4,953	nitrates				nitrates
				ammonia	0	ammonia				
				PCBs	NR					
				TBP	0					
				carbon tet	0					
				other VOCs	NR		VOCs (including acetone, benzene, butanol, MEK, MIBK, methylene chloride, toluene, and trichloroethane)			VOCs

Table ATT-2. Summary of Data Indicating Primary Constituents for Field Screening. (14 Pages)

Bin	Area/ Associated Facility	Pipeline Number (PL)	Associated Waste Site Number	Primary Inventory Constituents Sent to Waste Site (SIMS Data)[a]		Primary Chemical Constituents in Waste Stream (Based on Point-of-Origin Process Operations)[b]		Primary Constituents Detected in Samples Collected at Liquid Waste Disposal Site (Remedial Investigation or Other Data)[c]		Target Constituents for Field Screening[d]
				Constituent	kg or Ci	Verified[e]	Suspected[f]	Constituent	mg/kg or pCi/g	
3	200 E/ PUREX	200-E-187	216-A-29	Am-241	no data			Am-241	145	Am-241
				Pu-240				Pu-239/240	667	Pu-239/240
				Pu-239						
				U-238				U-238	ND or <background	
				Cs-137				Cs-137	98	Cs-137
				Sr-90				Sr-90	<1	
				H-3				H-3	7	
				U total				U total	ND or <background	
				chromium				chromium	37	Hex Cr
				Cr^{+6}				Cr^{+6}	9	
				Hg				Hg	5	Hg
				nitrate		nitrates		nitrate as N	210	nitrates
				ammonia		ammonia		ammonia	34	
				PCBs				Aroclor-1254	9	PCBs
				TBP		TBP		TBP	<1	
				other SVOCs			SVOCs (including benzo(a)anthracene, benzo(a)pyrene, and benzo(ghi)perylene)	SVOCs (benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene; others)	ND to <1	PAHs
				carbon tet				carbon tet	ND	
				other VOCs			VOCs (including butanol, MEK, MIBK, TCA, trichloroethane, and tetrachloroethylene)	VOCs (tetrachloroethylene; others)	trichloroethylene <1; others[c]	VOCs

Table ATT-2. Summary of Data Indicating Primary Constituents for Field Screening. (14 Pages)

Bin	Area/ Associated Facility	Pipeline Number (PL)	Associated Waste Site Number	Primary Inventory Constituents Sent to Waste Site (SIMS Data)[a]		Primary Chemical Constituents in Waste Stream (Based on Point-of-Origin Process Operations)[b]		Primary Constituents Detected in Samples Collected at Liquid Waste Disposal Site (Remedial Investigation or Other Data)[c]		Target Constituents for Field Screening[d]
				Constituent	kg or Ci	Verified[e]	Suspected[f]	Constituent	mg/kg or pCi/g	
3	200 E/ B Plant	200-E-188	216-B-63	Am-241	<1			Am-241	<1	Am-241
				Pu-240	0					
				Pu-239	<1					
				U-238	<1			U-238[e]	ND or <background	
				Cs-137	<1			Cs-137	4	Cs-137
				Sr-90	<1			Sr-90	30	
				H-3	130					
				U total	178			U total	ND or <background	
				chromium	14	chromium		chromium	22	Hex Cr
				nitrate	3,137	nitrates		nitrate as N	188	nitrates
				ammonia	0	ammonia		ammonia	ND	
				PCBs	NR			Aroclor-1254	<1	PCBs
				NPH	387	NPH (kerosene)		NPH	ND	
				TBP	0			TBP	ND	
				carbon tet	0			carbon tet	ND	
				other VOCs	NR		VOCs (including acetone, benzene, MEK, MIBK, and trichloroethane)	VOCs (acetone, benzene, methylene chloride, toluene; others)	ND to <1	VOCs

Table ATT-2. Summary of Data Indicating Primary Constituents for Field Screening. (14 Pages)

Bin	Area/ Associated Facility	Pipeline Number (PL)	Associated Waste Site Number	Primary Inventory Constituents Sent to Waste Site (SIMS Data)[a]		Primary Chemical Constituents in Waste Stream (Based on Point-of-Origin Process Operations)[b]		Primary Constituents Detected in Samples Collected at Liquid Waste Disposal Site (Remedial Investigation or Other Data)[c]		Target Constituents for Field Screening[d]
				Constituent	kg or Ci	Verified[e]	Suspected[f]	Constituent	mg/kg or pCi/g	
3	200 W/ S Plant	200-W-157	216-S-10	Am-241	53			Am-241	<1	Am-241
				Pu-240	5			Pu-239/240	3	Pu-239/240
				Pu-239	15					
				U-238	512			U-238	ND or <background	
				Cs-137	35			Cs-137	9	Cs-137
				Sr-90	<1			Sr-90	<1	
				H-3	3					
				U total	1			U total	ND or <background	
				chromium	2,981	chromates		chromium	815	Hex Cr
				Cr^{+6}	NR			Cr^{+6}	14	
				Hg	120		Hg	Hg	4	Hg
				nitrate	45,361	nitrates		Nitrate as N	18.2	nitrates
				ammonia	<1	ammonia		ammonia	ND or <background	
				PCBs	NR			Aroclor-1254	4	PCBs
				TBP	0		TBP	TBP	ND	
				other SVOCs	NR			SVOCs (acenaphthene, anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene; benzo(ghi)perylene, benzo(k)fluoranthene, chrysene, fluorene, di benz[a,h]anthracene, phenanthrene; others)	ND to <1	PAHs
				carbon tet	0			carbon tet	ND	
				other VOCs	NR		VOCs (including benzene and trichloroethane)	VOCs (acetone, methylene chloride; others)	ND to <1	VOCs

Table ATT-2. Summary of Data Indicating Primary Constituents for Field Screening. (14 Pages)

Bin	Area/ Associated Facility	Pipeline Number (PL)	Associated Waste Site Number	Primary Inventory Constituents Sent to Waste Site (SIMS Data)[a]		Primary Chemical Constituents in Waste Stream (Based on Point-of-Origin Process Operations)[b]		Primary Constituents Detected in Samples Collected at Liquid Waste Disposal Site (Remedial Investigation or Other Data)[c]		Target Constituents for Field Screening[d]
				Constituent	kg or Ci	Verified[e]	Suspected[f]	Constituent	mg/kg or pCi/g	
4	200 W/ T Plant	200-W-173	216-T-33	Am-241	<1			Am-241	2	Am-241
				Pu-240	<1			Pu-239/240	63	Pu-239/240
				Pu-239	2					
				U-238	60			U-238	ND or <background	
				Cs-137	<1			Cs-137	33	Cs-137
				Sr-90	<1			Sr-90	49	
				H-3	<1			H-3	< 1	
				U total	<1			U total	ND or <background	
				chromium	22	chromium		chromium	34	Hex Cr
				nitrate	1,267	nitrate		nitrate	254	nitrates
				ammonia	<1	ammonia		ammonia	ND or <background	
				PCBs	NR			Aroclor-1254, -1260	9, 4	PCBs
				O/G	NR			O/G	842	HC
				TBP	0			TBP	ND	
				carbon tet	0			carbon tet	ND	
				other VOCs	NR		VOCs (including acetone, benzene, MEK, MIBK, and trichloroethane)	VOCs (acetone)	<1	VOCs
4	200 E/ PUREX	200-E-194	216-A-32	Am-241	<1			no data	no data	Am-241
				Pu-240	<1					Pu-239/240
				Pu-239	<1					
				U-238	<1					
				Cs-137	<1					Cs-137
				Sr-90	<1					
				H-3	<1					
				U total	<1					
				chromium	<1					Hex Cr
				nitrate	1	nitrate				nitrates
				ammonia	<1	ammonia				
				PCBs	NR					

Table ATT-2. Summary of Data Indicating Primary Constituents for Field Screening. (14 Pages)

Bin	Area/ Associated Facility	Pipeline Number (PL)	Associated Waste Site Number	Primary Inventory Constituents Sent to Waste Site (SIMS Data)[a]		Primary Chemical Constituents in Waste Stream (Based on Point-of-Origin Process Operations)[b]		Primary Constituents Detected in Samples Collected at Liquid Waste Disposal Site (Remedial Investigation or Other Data)[c]		Target Constituents for Field Screening[d]
				Constituent	kg or Ci	Verified[e]	Suspected[f]	Constituent	mg/kg or pCi/g	
4 (cont)	200 E/ PUREX (cont)	200-E-194 (cont)	216-A-32 (cont)	TBP	0	TBP				
				other SVOCs	NR		SVOCs (including benzo(a)anthracene, benzo(a)pyrene, and benzo(ghi)perylene)			PAHs
				carbon tet	0					
				other VOCs	NR		VOCs (including butanol, MEK, MIBK, phenol, TCA, tetrachloroethene and trichloroethane)			VOCs
4	200 E/ PUREX		216-A 21	Am-241	5			no data	no data	Am-241
				Pu-240	1					Pu-239/240
				Pu-239	5					
				U-238	195					
				Cs-137	60					Cs-137
				Sr-90	6					
				H-3	0					
				U total	49					
				chromium	0					
				nitrate	320,299	nitrate				nitrates
				ammonia	66,324	ammonia				
				PCBs	NR					
				TBP	0	TBP				
				other SVOCs	NR		SVOCs (including benzo(a)anthracene, benzo(a)pyrene, and benzo(ghi)perylene)			PAHs
				carbon tet	0					
				other VOCs	NR		VOCs (including butanol, MEK, MIBK, phenol, TCA, tetrachloroethene and trichloroethane)			VOCs

Table ATT-2. Summary of Data Indicating Primary Constituents for Field Screening. (14 Pages)

Bin	Area/ Associated Facility	Pipeline Number (PL)	Associated Waste Site Number	Primary Inventory Constituents Sent to Waste Site (SIMS Data)[a]		Primary Chemical Constituents in Waste Stream (Based on Point-of-Origin Process Operations)[b]		Primary Constituents Detected in Samples Collected at Liquid Waste Disposal Site (Remedial Investigation or Other Data)[c]		Target Constituents for Field Screening[d]
				Constituent	kg or Ci	Verified[e]	Suspected[f]	Constituent	mg/kg or pCi/g	
5	200 W/ T Plant	200-W-175	216-T-26	Am-241	1	no data	no data	Am-241	227	Am-241
				Pu-240	3			Pu-239/240	6,320	Pu-239/240
				Pu-239	37					
				U-238	<1			U-238	21	
				Cs-137	481			Cs-137	47,900	Cs-137
				Sr-90	454			Sr-90	49,100	
				H-3	3			H-3	2,650	
				U total	633			U total	61	
				chromium	1,157			chromium	94	Hex Cr
				Cr^{+6}	NR			Cr^{+6}	4	
				nitrate	375,263			nitrate as N	693	nitrates
				ammonia	<1			ammonia	95	
				fluoride	48,187			fluoride	168	
				PCBs	NR					
				TBP	0			TBP	91	
				carbon tet	0			carbon tet	ND	
				other VOCs	NR			VOCs (acetone, xylenes; others)	ND to <1	VOCs
5	200 E/ B Plant	200-E-114	216-B-46[g]	Am-241	11	no data	no data			Am-241[h]
				Pu-240	<1			Pu-239/240	227[g]	Pu-239/240
				Pu-239	5					
				U-238	<1			U-238	6.94	
				Cs-137	235			Cs-137	364,000[g]	Cs-137
				Sr-90	897			Sr-90	353,000[g]	
				H-3	42			H-3	53[g]	
				U total	208			U total	44[g]	
				chromium	1,152			chromium	30[g]	Hex Cr
				nitrate	1,330,702			nitrate and N/N as N	5,470[g]	nitrates
				ammonia	<1					

Table ATT-2. Summary of Data Indicating Primary Constituents for Field Screening. (14 Pages)

Bin	Area/ Associated Facility	Pipeline Number (PL)	Associated Waste Site Number	Primary Inventory Constituents Sent to Waste Site (SIMS Data)[a]		Primary Chemical Constituents in Waste Stream (Based on Point-of-Origin Process Operations)[b]		Primary Constituents Detected in Samples Collected at Liquid Waste Disposal Site (Remedial Investigation or Other Data)[c]		Target Constituents for Field Screening[d]
				Constituent	kg or Ci	Verified[e]	Suspected[f]	Constituent	mg/kg or pCi/g	
5	200 E/ B Plant (cont)	200-E-114 (cont)	216-B-46 (cont)	PCBs	NR					
				TBP	0			TBP	19[g]	PAHs
				carbon tet	0					
				Other VOCs	NR					
5	200 E/ B Plant	200-E-195	216-B-9	Am-241	<1			no data	no data	Am-241
				Pu-240	<1					Pu-239/240
				Pu-239	8					
				U-238	12					
				Cs-137	12					Cs-137
				Sr-90	11					
				H-3	<1					
				U total	0					
				chromium	641	chromium				Hex Cr
				nitrate	170,505	nitrates				nitrates
				ammonia	0	ammonia				
				PCBs	NR					
				TBP	0					
				carbon tet	0					
				Other VOCs	NR		VOCs (including acetone, benzene, MEK, MIBK, and trichloroethane)			VOCs

Aroclor is an expired trademark.

[a]RPP-26744, *Soil Inventory Model, Rev. 1.*
[b]Sources summarized in Table ATT-3.
[c]Except as specifically footnoted, references for these columns are as follows:
- for 216-Z-1A, DOE/RL-2006-51, Draft A, *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.*
- for 216-A-10 and 216-B-12, DOE/RL-2004-25, *Remedial Investigation Report for the 200-PW-2 Uranium-Rich Process Waste Group and the 200-PW-4 General Process Condensate Group Operable Units.*
- for 216-A-25 and 216-B-2-2, DOE/RL-2000-35, *200-CW-1 Operable Unit Remedial Investigation Report.*
- for 216-A-29, 216-B-63, and 216-S-10, DOE/RL-2004-17, Draft A, *Remedial Investigation Report for the 200-CS-1 Chemical Sewer Group Operable Unit.*
- for 216-T-33, 216-A-21, and 216-A-32, DOE/RL-2005-62, Draft A, *Remedial Investigation Report for the 200-MW-1 Miscellaneous Waste Group Operable Unit.*
- for 216-T-26, DOE/RL-2002-42, Draft A, *Remedial Investigation Report for the 200-TW-1 and 200-TW-2 Operable Units.*

[d]See "Description of criteria used for presentation of data shown in Table ATT-2" below for explanation of selection process.

Table ATT-2. Summary of Data Indicating Primary Constituents for Field Screening. (14 Pages)

Bin	Area/ Associated Facility	Pipeline Number (PL)	Associated Waste Site Number	Primary Inventory Constituents Sent to Waste Site (SIMS Data)[a]		Primary Chemical Constituents in Waste Stream (Based on Point-of-Origin Process Operations)[b]		Primary Constituents Detected in Samples Collected at Liquid Waste Disposal Site (Remedial Investigation or Other Data)[c]		Target Constituents for Field Screening[d]
				Constituent	kg or Ci	Verified[e]	Suspected[f]	Constituent	mg/kg or pCi/g	

[e]Verified chemicals are directly referenced in a technical manual, process flow diagram, or other facility document.
[f]Suspected chemicals are referenced in a generic document (documents are listed in Table ATT-3).
[g]Sample results reported are for 216-B-46 (DOE/RL-2002-42, above). Because of its complex operational history, the 200-E-114-PL Pipeline has been associated with many liquid-waste disposal sites. The 216-B-46 Crib was selected for review of waste-site information associated with this pipeline.
[h]The sample analysis did not include this constituent, but because it was reported in the site inventory, it is selected for field screening.

Description of criteria used for presentation of data shown in Table ATT-2:

1. Table includes information for pipelines to be sampled, including alternate pipelines.
2. The constituents shown are a subset of those constituents reported in the Soil Inventory Model (SIM) (RPP-26744), process operational records, and disposal site analytical results. Constituents were selected as follows:
   a. Radionuclides, total uranium, nitrate, chromium, and ammonia because of their contamination potential and their generally high SIM inventory levels.
   b. Tritium (H-3) because of its groundwater contamination potential.
   c. PCBs, carbon tetrachloride, and TBP because of their contamination potential. Because carbon tetrachloride and TBP were the only EPA Method 8260/8270 constituents (SW-846, *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, Third Edition; Final Update III-B*, as amended) reported in SIM, they are listed apart from the other SVOCs and VOCs.
   d. Other SVOC or VOC not included in SIM, if process operations information reported them to be present and they are listed in Table A-7 (identified for analysis using EPA Method 8260 for VOCs, or EPA Method 8270 for SVOCs).
   e. Fluorine, Pu-241, NPH, and mercury (Hg) for individual waste site(s) when their inventory value was high.
   f. Other constituents reported with a relatively high maximum concentration in a remedial investigation report (i.e., Pu-238 and O/G for 216-A-10 and hexavalent chromium for 216-A-29).
3. For "Primary Chemical Constituents" information:
   a. Does do not include information for radionuclides
   b. "Primary Chemical Constituents" list was compared to the chemicals in the "Primary Inventory" column. For non-SVOCs/VOCs, those constituents that matched were included as either 'verified' or 'suspected,' where
      i. "Verified" chemicals are directly referenced in a technical manual, process flow diagram, or other facility document
      ii. "Suspected" chemicals are referenced in a generic document
   c. Those EPA Method 8270/8260 SVOCs/VOCs constituents that were identified as 'suspected' are listed in parentheses.
4. "Primary [Sample] Constituents" data:
   a. Primary [Sample] Constituents list was compared to the chemicals in the "Primary Inventory" column. For non-SVOCs/VOCs, those constituents that matched were included.
   b. Those constituents reported using EPA Method 8270(SVOCs)/8260(VOCs) are listed in parentheses.
5. "Target Constituents for Field Screening" selection was based on the presence or absence of a constituent, as noted in the three data sources, and on field-screening capabilities. For those constituents for which field-screening capabilities are available (Am-241, Pu-239/240, Cs-137, hexavalent chromium, mercury, nitrate, PCB, SVOC [PAH], VOC, and HC), the constituent was selected as a target if it was detected at a concentration above background in the sampling analytical data. If no sampling data were available, the constituent was selected if it was reported as being present in the waste stream in SIM or it was identified in point-of-origin process operations documentation.

List of Constituents:

DCA = 1,1- or 1,2-dichloroethane.
HC = total petroleum hydrocarbons.
MEK = methyl ethyl ketone.
MIBK = methyl iso butyl ketone.
N/N = nitrate/nitrite.
NPH = normal paraffin hydrocarbon (kerosene).
PAH = polyaromatic hydrocarbon(specific SVOCs).
O/G = oil & grease.
PCB = polychlorinated biphenyl.
SVOC = semivolatile organic compound.
TBP = tributyl phosphate.
TCA = 1,1,1-trichloroethane.
VOC = volatile organic compound.

Other Abbreviations:

NR = no data reported for this constituent.
PFP = Plutonium Finishing Plant.
PUREX = Plutonium-Uranium Extraction Plant.
SIMS = Soil inventory model (see footnote "a" above).

Table ATT-3. List of References Used in Point of Origin Process Operations Information for Chemical Constituents. (3 Pages)

Facility/ Area	Referenced Documents
B Plant	ARH-564, 1968, *B Plant Recovery of Cesium from Current Acid Wastes by Phosphotungstate Precipitation*, Atlantic Richfield Hanford Company.
	BHI-00179, 1995, *B Plant Aggregate Area Management Study Technical Baseline Report*, Bechtel Hanford, Inc.
	BNWL-B-102, 1971, *Engineering Scale Development of a Process for Strontium Fluoride Production*, Battelle Northwest Laboratories.
	BNWL-B-142, 1971, *Cesium Chloride Flowsheet Development Studies for the Waste Packaging Program*, Battelle Northwest Laboratories.
	HW-10475, *Hanford Engineer Works Technical Manual (T/B Plants)*, DuPont
	HW-23043, 1951, *Flow Sheets & Flow Diagrams of Precipitation Separations Process*, General Electric
	HW-69011, 1961, Project Number *CGC-897 Title 1 Design Fission Product Storage in B Plant*, General Electric
	ISO-986, 1967, *B-Plant Phase III Flowsheets*, ISOCHEM
C Plant	HW-22956-PT2, 1952, *Hot Semiworks Manual Part II REDOX Operating Procedure [for the REDOX Separation Process]*, General Electric
	HW-27886, 1953, *Design Scope Conversion of Hot Semiworks to PUREX Process*, General Electric
	HW-44776, 1956, *Semi Works Operation of the RECUPLEX Facility*, 2 vols., General Electric
	HW-71089, 1961, *Process Engineering for Additional Storage, Loadout and Waste Facilities Hot Semiworks*, General Electric
	HW-72666, 1963, *Hot Semiworks Strontium-90 Recovery Program*, General Electric
	WHC-SD-EN-ES-019, 1992, *Semiworks Aggregate Area Management Study Technical Baseline Report*, Westinghouse Hanford Company
Z Plant	DOE/RL-91-58, 1992, *Z Plant Source Aggregate Area Management Study Report*, DOE-RL
	HNF-EP-0924, 1997, *History & Stabilization of the Plutonium Finishing Plant (PFP) Complex Hanford Site*, Fluor Daniel
	HNF-SD-CP-OCD-044, 1997, *Basis Document for PFP Plutonium Nitrate Ion Exchange Process in Room 228A*, Babcock & Wilcox Hanford Co.
	HW-22604, 1951, *RECUPLEX Process Chemical Flowsheets RECUPLEX HW #1 and HW #2*, General Electric
	HW-23344, 1952, *The RECUPLEX Process*, General Electric
	HW-23633, 1952, *Flow Sheet - Preliminary RM Task 1 on PU IV] Oxalate*, General Electric
	HW-33964, 1954, *RECUPLEX Preliminary Flowsheets*, General Electric
	HW-35030, 1955, *RECUPLEX Operating Manual*, General Electric
	HW-40617, 1955, *Flowsheet for RECUPLEX Operation*, General Electric
	HW-47655, 1957, *RMC Line Flowsheet - Tasks I, II, and III*, General Electric
	HW-57288, 1958, *Plutonium Recovery from Contaminated Materials [PROJECT CGC-813] Process Design*, General Electric

Table ATT-3. List of References Used in Point of Origin Process Operations Information for Chemical Constituents. (3 Pages)

Facility/ Area	Referenced Documents
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	HW-65727, 1960, *Removal of Plutonium from 234-5 Sump Wastes and from RECUPLEX Extraction Wastes*, General Electric
	HW-66916, 1960, *Design Scope of the Z Plant Plutonium Reclamation Facility Project CAC-880*, General Electric
	HW-67010, 1960, *Design Scope of the Waste Treatment Facility, Z Plant Project CGC-912*, General Electric
	HW-75675, 1962, *Flowsheet and Bases for Equipment Specifications New Leach Hood*, General Electric
A Plant	ARH-2127, 1977, *PUREX Process Operation and Performance 1970 THORIA Campaign*, Atlantic Richfield Hanford Company
	BHI-00178, 1995, *PUREX Plant Aggregate Area Management Study Technical Baseline Report*, Bechtel Hanford, Inc.
	H-2-65013, 1976, *Figure 12 PUREX Flowsheet Neptunium Purification*, Atlantic Richfield Hanford Company
	H-2-65483, 1983, *Process Flow Diagram*, Vitro Engineering Corporation
	H-2-75643, 1983, *Process Flow Diagram*, [PUREX Oxide Conversion Facility] Kaiser Hanford Company
	H-2-98743, 1991, *Process Flow Diagram*, [Neptunium Oxide Glove Box] ICF Kaiser Hanford Company
	HW-31000, 1955, *PUREX Technical Manual*, General Electric
	RL-SEP-267 PT1, 1965, *Engineering Study Thorium Processing - PUREX Part II- Flowsheet*, General Electric
	SK-2-23947, 1995, *Figure 1 PUREX Flowsheet 6 Percent Plutonium 240 1st Decontamination & Partition Cycle & 2nd Uranium Cycle*, Westinghouse Hanford Company
	SK-2-23948, 1995, *Figure 2 PUREX Flowsheet 6 Percent Plutonium 240 1st Decontamination & Partition Cycle & 2nd Uranium Cycle*, Westinghouse Hanford Company
	SK-2-23949, 1995, *Figure 3 PUREX Flowsheet 6 Percent Plutonium 240 Backcycle Waste Concentration & 2nd Neptunium Cycle Phase 1*, Westinghouse Hanford Company
	SK-2-23950, 1995, *Figure 4 PUREX Flowsheet 6 Percent Plutonium 240 Waste Concentration & Acid Recovery*, Westinghouse Hanford Company
	SK-2-23951, 2002, *Figure 5 PUREX Flowsheet Solvent Treatment*, Rockwell Hanford Corporation
	SK-2-52421, 1970, *Thorium Process Flow Sketch 1970 Campaign*, Atlantic Richfield Hanford Company
	SK-2-56348, 1995, *Figure 3A PUREX Flowsheet 6 Percent Plutonium 240 Backcycle Waste Concentration & 2nd Neptunium Cycles Phases II & III*, Westinghouse Hanford Company
S Plant	BHI-01142, 1998, *REDOX Facility Safety Analysis Report*, Bechtel Hanford, Inc.
	DOE/RL-91-60, 1993, *S Plant Aggregate Area Management Study Report*, Westinghouse Hanford Company, DOE-RL
	HW-10733, 1948, *REDOX Process Waste Streams Approximate Quantities & Compositions*, General Electric
	HW-18700, 1951, *REDOX Technical Manual*, General Electric

Table ATT-3. List of References Used in Point of Origin Process Operations Information for Chemical Constituents. (3 Pages)

Facility/ Area	Referenced Documents
	HW-34163, 1954, *REDOX E Cell Oxonization*, General Electric
	HW-68730, 1961, *REDOX Plutonium Ozonator Information Manual*, General Electric
	ISO-335, 1966, *REDOX Chemical Flowsheet HW Number 9*, Isochem
Generic Reference	DOE/RL-96-82, 1996, *Hanford Facility Dangerous Waste Closure Plan for 241Z Treatment & Storage Tanks*, U.S. Department of Energy, Richland Operations Office
	DOE/RL-99-36 Rev. 1, 1999, *Phase 1 RCRA Facility Investigation Corrective Measures Study Work Plan for SST Waste Management Areas*
	HNF-8735, 2001, *241Z361 Tank Characterization Report*, Fluor Hanford
	LA-UR-96-3860, 1997, *Hanford Tank Chemical & Radionuclide Inventories of HDW Model Rev 4*, Lockheed Martin Hanford Corporation, Los Alamos National Laboratory
	RHO-ST-44, 1982, *216Z12 Transuranic Crib Characterization*, Rockwell Hanford Operations
	RPP-7455, Rev. 0, 2001, *Data Quality objectives Report for Waste Management Areas T & TX-TY*, CH2M HILL Hanford Group, Inc.
	WHC-EP-0172, Rev. 1, 1988, *Inventory of Chemicals Used at Hanford Production Plants & Support Operations 1944-1980*, CH2M HILL Hanford Group, Inc.
	WHC-MR-0517, Rev. 0, 1996, *Listed Waste History at Hanford Facility TSD Units*, Westinghouse Hanford Company
	WHC-SD-EN-TI-248, 1994, *1994 Conceptual Model of Carbon Tetrachloride in the 200W Area at Hanford Site*, Westinghouse Hanford Company

APPENDIX B

PHASE 1 SAMPLING AND ANALYSIS PLAN FOR 200-IS-1 OPERABLE UNIT TANK FARM PIPELINES (PUBLISHED SEPARATELY AS RPP-PLAN-31715 BY CH2M HILL HANFORD GROUP, INC.)

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PHASE 1 SAMPLING AND ANALYSIS PLAN FOR 200-IS-1 OPERABLE UNIT TANK FARM PIPELINES

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Key Words: 200-IS-1, phase 1, operable unit, sampling and analysis, sampling, analysis, tank farm, pipeline, soil

Abstract: Requirements for sampling and analysis of a number of tank farm pipelines and surrounding soil within the 200-IS-1 operable unit are specified. Data obtained based upon this sampling and analysis plan will be used to support development of the Remedial Investigation/Feasibility Study for the operable unit.

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PHASE 1 SAMPLING AND ANALYSIS PLAN FOR 200-IS-1 OPERABLE UNIT TANK FARM PIPELINES

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CH2M HILL Hanford Group, Inc.

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CH2MHILL
Hanford Group, Inc.

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TABLE OF CONTENTS

1.0 SAMPLING AND ANALYSIS OBJECTIVES 6

2.0 BACKGROUND 6

3.0 SCOPE 6

4.0 SAMPLING REQUIREMENTS 8
- 4.1 SAMPLING AND ANALYSIS APPROACH 8
- 4.2 SAMPLING METHODS 15
  - 4.2.1 Pipeline Sampling 15
  - 4.2.2 Soil Sampling and Survey Methods 16
  - 4.2.3 Surface Geophysical Techniques for Pipeline Evaluations 16
- 4.3 SAMPLE CUSTODY 18

5.0 LABORATORY ANALYSIS REQUIREMENTS 19
- 5.1 SAMPLE HANDLING REQUIREMENTS 19
- 5.2 METHODS AND REQUIREMENTS FOR ANALYSIS 19

6.0 QUALITY ASSURANCE AND QUALITY CONTROL 26
- 6.1 FIELD QUALITY CONTROL 26
- 6.2 QUALITY ASSURANCE/QUALITY CONTROL REQUIREMENTS FOR LABORATORY ANALYSIS 28
  - 6.2.1 Quality Control Requirements 28
  - 6.2.2 Target Detection Limits 30

7.0 DATA REPORTING 37

8.0 CHANGE CONTROL 37

9.0 REFERENCES 38

A-1.0 PROJECT MANAGEMENT 40
- A-1.1 PROJECT/TASK ORGANIZATION 40
- A-1.2 PROBLEM DEFINITION/BACKGROUND 42
- A-1.3 PROJECT/TASK DESCRIPTION 43
- A-1.4 QUALITY OBJECTIVES AND CRITERIA 43
- A-1.5 SPECIAL TRAINING/CERTIFICATION 43
- A-1.6 DOCUMENTS AND RECORDS 43

A-2.0 DATA GENERATION AND ACQUISITION 44
- A-2.1 SAMPLING PROCESS DESIGN 44
- A-2.2 SAMPLING METHODS 44
- A-2.3 SAMPLE HANDLING AND CUSTODY 44
- A-2.4 ANALYTICAL METHODS 44
- A-2.5 QUALITY CONTROL 44

A-2.5.1 Quality Assurance Objective 44
A-2.5.3 Sample Preservation, Containers, and Holding Times 45
A-2.5.4 Sample Collection Requirements 47
A-2.6 INSTRUMENT/EQUIPMENT TESTING, INSPECTION, AND MAINTENANCE48
A-2.6 INSTRUMENT/EQUIPMENT CALIBRATION AND FREQUENCY 48
A-2.7 INSPECTION/ACCEPTANCE OF SUPPLIES AND CONSUMABLES 49
A-2.8 NON-DIRECT MEASUREMENTS 49
A-2.9 DATA MANAGEMENT 49

A-3.0 ASSESSMENT AND OVERSIGHT 50
A-3.1 ASSESSMENT AND RESPONSE ACTIONS 50
A-3.2 REPORTS TO MANAGEMENT 50

A-4.0 DATA VALIDATION AND USABILITY 51
A-4.1 DATA REVIEW, VERIFICATION, AND VALIDATION 51
A-4.2 VERIFICATION AND VALIDATION METHOD 51
A-4.3 RECONCILIATION WITH USER REQUIREMENTS 51

A-5.0 QUALITY ASSURANCE PROJECT PLAN REFERENCES 52

LIST OF TABLES

Table 4-1. Pipeline and Sample Location Attributes 11

Table 5-1. Chemical, Radiological, and Physical Analytical Requirements for Samples 21

Table 5-2. Primary Organic Analytes 24

Table 6-1. Quality Control Parameters for Primary Analytes 29

Table 6-2. Target Detection Limits for Primary Radionuclides 30

Table 6-3. Target Detection Limits for Primary Chemicals 32

Table A-1. Sample Preservation, Container, and Holding Time Guidelines 46

LIST OF FIGURES

Figure 4-1. Phase 1 Tank Farm Pipeline Sample Locations 10

Figure 4-2. Conceptualization of Residual Waste in Process Pipelines 14

Figure A-1. Project Organization 41

LIST OF TERMS

CH2M HILL	CH2M HILL Hanford Group, Inc.
CFR	*Code of Federal Regulations*
DOE	U.S. Department of Energy
DQO	data quality objective
Ecology	Washington State Department of Ecology
EMI	electromagnetic induction
EPA	U.S. Environmental Protection Agency
GPR	ground penetrating radar
HFFACO	*Hanford Federal Facility Agreement and Consent Order*
IC	ion chromatography
ICP/AES	inductively coupled plasma/atomic emissions spectroscopy
OU	operable unit
PCB	polychlorinated biphenyl
QA	quality assurance
QC	quality control
RCRA	Resource Conservation and Recovery Act
RPP	River Protection Project
SAP	sampling and analysis plan
SST	single-shell tank
SVOA	semivolatile organic analysis
SVOC	semivolatile organic compound
TIC	tentatively identified compound
PSAP	Pipeline sampling and analysis plan
VOA	volatile organic analysis
VOC	volatile organic compound
WIDS	Waste Information Data System
WMA	Waste Management Area

1.0 SAMPLING AND ANALYSIS OBJECTIVES

The primary objective for sampling and analysis of the pipelines and contaminated soil in the 200-IS-1 Tanks/Lines/Pits/Waste Group Operable Unit (OU) is to provide characterization data for remedial investigation/feasibility study and remediation decision-making.

Sampling and analysis requirements were defined using a data quality objective (DQO) process. The Washington State Department of Ecology (Ecology), the U.S. Department of Energy (DOE) and its contractors participated in the DQO process. Results of the DQO process are documented in the *Data Quality Objectives Summary Report for the 200-IS-1 Operable Unit Pipelines and Appurtenances* (D&D-30262).

This sampling and analysis plan (SAP) summarizes the DQO requirements and provides additional direction and clarification for field screening, sampling, laboratory analysis, and data reporting for meeting the requirements. Specifically, the SAP covers the DQO requirements for chemical and radiological characterization. Operational sampling and analysis requirements will be documented in pipeline and associated soil sampling and analysis plans (PSAPs). A PSAP will be prepared for an individual pipeline (or a group of pipelines) and associated areas of contaminated soil in accordance with approved CH2M HILL Hanford Group, Inc. (CH2M HILL) procedures. The PSAPs will meet requirements in this SAP.

2.0 BACKGROUND

The 200-IS-1 OU consists of *Resource Conservation and Recovery Act* (RCRA) (EPA 1976) past-practice waste sites and treatment, storage, and disposal units. The OU designation and waste site assignments are defined in DOE/RL-96-81, *Waste Site Grouping for 200 Areas Soil Investigations*, and DOE/RL-98-28, *200 Areas Remediation Investigation/Feasibility Study Implementation Plan – Environmental Restoration Program*. The OU includes an extensive network of pipelines, diversion boxes, catch tanks, valve pits, related infrastructures, and associated unplanned releases. The systems were used to transport waste or process materials from separation facilities to the single-shell and double-shell tanks and to control or divert flow to disposal waste sites that received liquid waste streams. The process-waste pipeline systems are located primarily within the industrial 200 Areas of the Hanford's Central Plateau.

3.0 SCOPE

The scope of this SAP is limited to the 200-IS-1 OU pipelines and contaminated soil. Sampling and analysis of other equipment in the OU will be addressed at a later date. Also, this SAP is applicable only to the approximately 300 individual pipelines that are being managed by CH2M HILL for the U. S. Department of Energy. These pipelines are located outside tank farms (e.g., facility to diversion box, tank farm to tank farm, etc.). They do not include those located within tank farm fences. Identification of pipelines has been performed by examining drawings and other documentations. Pertinent information for these pipelines are entered into the Waste

Information Data System (WIDS) (Fluor 2007). Additional pipelines may be identified by future field walk-downs or excavations. A separate SAP is used to address characterization needs for facility process pipelines within the 200-IS-1 OU that are managed by Fluor Hanford, Inc.

In accordance with the DQO (D&D-30262), characterization of the pipelines will be performed in two phases. In Phase 1, data will be collected for piping and soil where existing knowledge indicates contamination is likely present. The goal of Phase 1 sampling is to determine whether or not contamination is above preliminary cleanup levels. In addition, data will be collected in Phase 2 to support remediation decision making including a no-action decision. It is expected that Phase 2 would require a much larger data set. This SAP only addresses Phase 1 sampling. Additional Phase 1 sampling may be required after reviewing the results for the sampling outlined in this SAP prior to moving to Phase 2.

4.0 SAMPLING REQUIREMENTS

4.1 SAMPLING AND ANALYSIS APPROACH

The approximately 300 tank farm pipelines comprise of over 400,000 ft of pipes. Levels of contamination are expected to be different among individual pipelines and could vary significantly within a pipeline. Therefore, direct characterization of the 400,000 ft of piping is not practical. A sampling approach has been developed to take maximum advantage of existing knowledge and waste sample data to optimize pipeline sampling.

The pipelines were used to transfer waste or process materials from facilities such as the Plutonium-Uranium Extraction Plant (PUREX), Reduction-Oxidation Plant (REDOX), B Plant, T Plant, U Plant, tank farm evaporators (242-B, 242-T, 241-S, and 242-A), processing vaults (244-AR, 244-BXR, 244-CR, etc.) and Hot Semiworks. Wastes generating from many of these facilities are well known based on knowledge of facility operations. The wastes were transferred for storage primarily in the Hanford tank farms. Wastes stored in the tank farms are relatively well characterized by extensive sampling and thorough review of waste generating and transfer history. However, little or no sampling has been performed on the residual waste that may be present in the transfer lines. Also, a review of existing documentation to develop process knowledge for the pipelines is still ongoing. Presently, little is known about past duties (i.e., what wastes was transferred through which pipelines) of many pipelines.

Therefore, characterization of contamination in the pipelines will be needed to support RI/FS and remediation decision-making. As discussed previously, the primary objective of Phase 1 sampling is to determine whether or not contamination in a pipeline and in surrounding soil is above preliminary cleanup level. Secondary objectives include:

- Evaluate and demonstrate sampling and field measurement methods and technologies.
- Evaluate process history associated with these pipelines.
- Refine current conceptualization of waste associated with the pipelines, associated encasements, and soils.
- Collect data that may be used to develop sampling approach for Phase 2.

To achieve the above objectives, it is desirable that pipelines selected for Phase 1 sampling have the following attributes:

1. The pipelines experienced failures such as leaking or plugging. Contamination in the pipe or surrounding soil likely exceeds preliminary cleanup levels.
2. The selected pipelines represent both direct-bury pipelines and encased pipelines. These conditions present different challenges for sampling. Selection of these pipelines will allow demonstration of sampling methods for different conditions.
3. The pipelines were constructed from pipes made of different material (e.g., a stainless steel pipe welded to a carbon steel pipe). The mismatch of construction increases the likelihood

that a leak may have occurred and, therefore, the pipe and surrounding soil may have elevated levels of contamination.

4. The pipelines were used to transfer waste known to have high level of contamination. This increases the likelihood that contamination in the pipe exceeds cleanup levels.
5. The pipelines represent a group of lines used to transfer the same waste. Because composition of the waste transferred through a group of lines generally can be developed based on process knowledge and existing tank sample data, sample data obtained for one or two pipelines in a group will provide information regarding contamination in the other pipelines. This information may be used to guide additional Phase 1 sampling or to optimize Phase 2 sampling.

Each pipeline selected for Phase 1 will be sampled at a minimum of three locations. Both pipe and surrounding soil will be sampled at the selected locations. Contamination measurements at three different locations in a pipeline will provide information on the distribution of contamination along the length of a pipeline.

In addition to the pipelines having the attributes discussed above, the lines will be sampled at locations where contamination is most likely to accumulate. Examples of these types of location are listed below:

1. Low point in the line,
2. At the end of a long run with low slope,
3. Point where a leak occurred,
4. A transition point (e.g., bend, elbow, etc.), and
5. Point where there is a mismatch of pipe-construction materials.

Also, many of the pipelines can be accessed for sampling only by significant excavation; therefore, it is desirable that multiple pipelines be accessible at an excavation location. Each sample location will have one or more of the attributes.

Two pipelines that satisfy the above desired attributes are selected for Phase 1 sampling: V108/812 and V108/8653/8618. Pipeline V108/812 is a 3-inch diameter, carbon steel, direct buried transfer line. Pipeline V108/8653/8618 is a 3-inch diameter, stainless steel, encased line. The lines are 1420 and 6840 ft long, respectively. V108/812 was used to transfer primarily PUREX supernatant or PUREX sludge supernatant from the 244-AR Vault to the 241-C-151 diversion box. V108/8653/8618 was used to transfer PUREX acid sludge from the 244-CR Vault to the 221-B Plant. A leak was known to occur in 1971, likely near where the lines are welded together. Additional details on the pipelines can be found in the Waste Information Data System (WIDS), Site Codes 200-E-153-PL and 200-E-111-PL, respectively.

Sample locations for these two pipelines are shown in Figure 4-1. Note that samples to be taken at location 1 will be used for both pipelines. The desired attributes associated with each sample location are shown in Table 4-1. The selected sample locations may not be accessible because of unexpected radiation level or equipment configuration encountered in the field. In that event, alternate sample locations will be selected after a discussion with Ecology personnel. Changes to the sample locations will be documented in the appropriate PSAP.

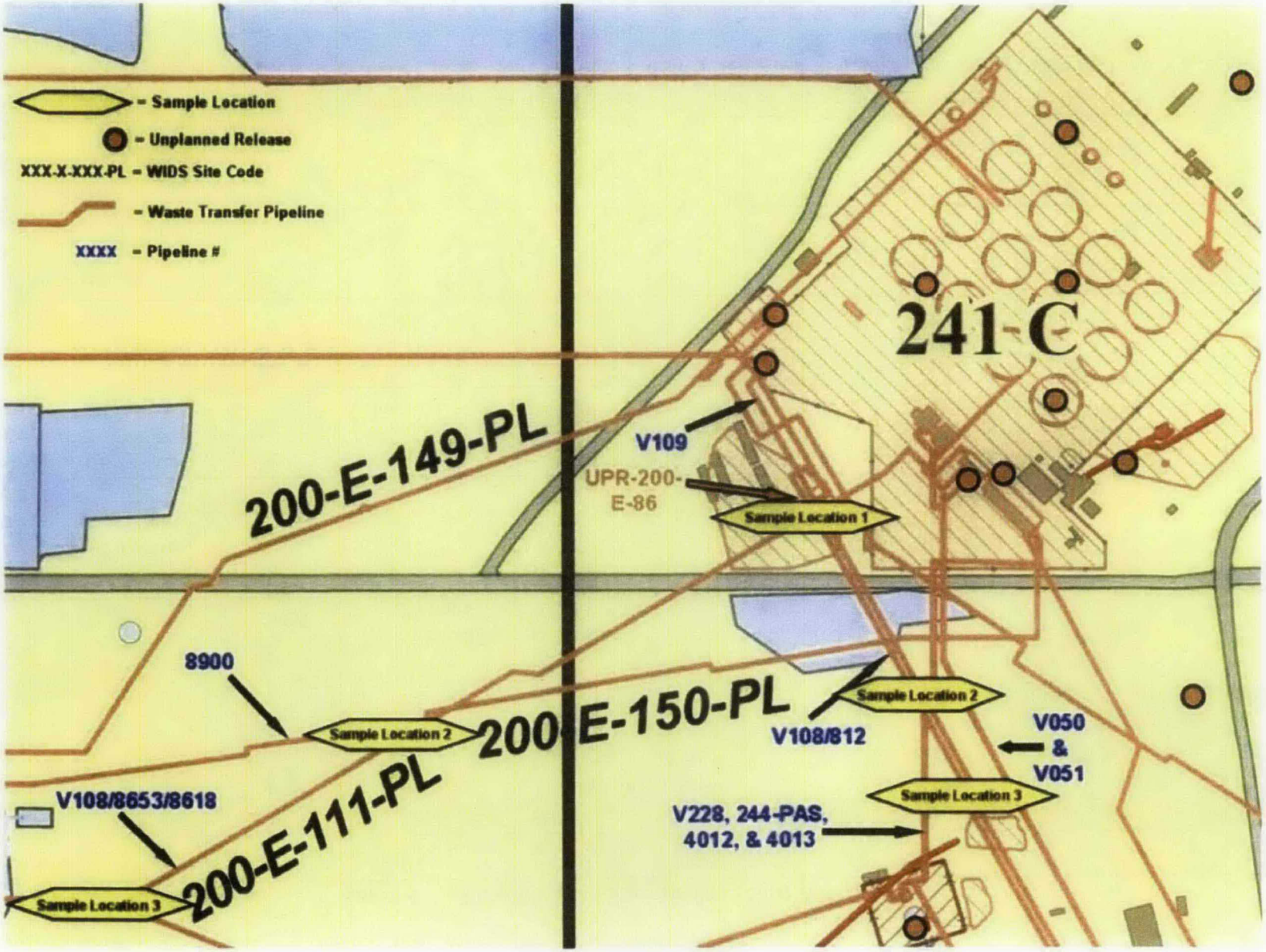

Figure 4-1. Phase 1 Tank Farm Pipeline Sample Locations

Table 4-1. Pipeline and Sample Location Attributes

Pipeline - Sample Location	Attributes									
	Known Leak	Low Point in Line	End of Long Run with Low Slope	One of a Number of Pipelines Used to Transfer the Same Waste[1]	At a Transition Point in Pipeline (e.g., Bend, Elbow)	Direct Buried Line	Encased Line	Construction Material Mismatch	Access to Multiple Lines at One Sample Location	Carried Waste Known to Have High Level of Contamination
V108/812 and V108/8653/8618 Sample Location 1	X	X	X	X	X	X	X	X	X	X
V108/812 Sample Location 2		X		X		X			X	X
V108/812 Sample Location 3		X		X		X			X	X
V108/8653/8618 Sample Location 2		X		X			X		X	X
V108/8653/8618 Sample Location 3		X		X			X		X	X

[1]V108/812 was used to transfer PUREX supernatant. Other pipelines that carried the same waste include V109, V130, 8902, and 4012. V108/8653/8618 was used to transfer PUREX acid sludge. Other pipelines that carried the same waste include V228 and 8901/8649/244.

Sampling at each location will be based on a conceptualization of residual waste in the pipelines. The conceptualizations of residual waste for intact and failed, direct-buried pipelines, encased pipelines, and encasements are shown in Figures 4-2. In general, contamination in the residual waste is likely a result of solids settled out on the bottom of the pipelines and insoluble constituents deposited on the pipe wall during operation. Contaminants in the residual waste are most likely insoluble metal cations (such as silver, bismuth, aluminum, iron, manganese, chromium, mercury, lead, silicon, and zirconium), insoluble radionuclides (such as strontium-90, uranium isotopes, actinides, and cobalt-60), soluble salts (such as sodium and potassium), and soluble radionuclides (such as cesium-137, iodine-129, and technetium-99). In cases where pipelines failed due to plugging, contaminants include both soluble and insoluble constituents of the waste that was transferred when plugging occurred.

Soil at each sample location will be characterized. Soil sampling is expected to be simpler than pipeline sampling. Therefore, soil will be collected by grab sampling at multiple depths and sent to a laboratory for analyses (see Section 5.0 for analytical requirements). One or more of the soil sampling methods described in Section 4.2.2 may be used. The number of grab samples and the location and depth of each grab will be based on field screening (e.g., surface radiation survey, ground penetration radar, etc.) and depth of the pipeline. Location and depth of soil grab samples will be specified in the appropriate PSAP.

Pipeline sampling poses significant difficulties and exposure to the workers. Therefore, the approach for pipeline sampling and analysis is somewhat different from soil sampling. At the first sample location for each pipeline, a section of pipe will be removed and sent to the laboratory for analysis of residue. Total length of the section of pipe removed is limited to 10 ft or less, based on a desire to limit excavation and for As Low As Reasonably Achievable (ALARA) concerns. Actual length of piping removed will be based on field survey results. The pipe section may be cut into smaller sub-sections for ease of shipping and handling.

Residual waste on the interior of the pipe (and between the primary and secondary pipe, if the pipe is encased and the primary pipe failed) will be removed and analyzed as required in Section 5.0. Liquids, if present in the pipeline, will be collected in sample jar(s) and shipped to a laboratory for analysis. If the amount of the sample material is insufficient for analysis of all constituents listed in Table 5-1, then only the constituents most likely to be present, as discussed above, will be analyzed. If the amount is insufficient even for these analytes, then DOE and Ecology will evaluate additional changes to the list of analyses. Changes to the analyses will be documented in the appropriate PSAP.

At the other sample locations for a pipeline, either field-deployed measurements or laboratory non-destructive assay (NDA) of a short section of pipe will be used to obtain limited data. These data may be used directly to confirm whether or not contamination in the pipeline exceeds cleanup levels. For example, if gamma energy data obtained with a field instrument or NDA indicates cesium-137 exceeds its cleanup level, then no further evaluation is necessary. This is a possible scenario for V108/812 because this pipeline was used to transfer PUREX supernatant, which is known to have high level of this radionuclide.

Field measurement or NDA data may be used indirectly also. If cesium-137 concentration is below its cleanup level, then concentration of other COPCs at these locations may be estimated by the use of scaling factors (concentration ratios of other constituents to cesium-137). First, a scaling factor is developed for each constituent using sample results from the first sample location. Second, obtain cesium-137 concentration of the residual waste in a pipe by using field gamma measurements or NDA. Third, estimate concentration of the other COPCs by scaling the measured cesium-137 concentration at each location. This is a possible scenario for V108/8653/8618 because this pipeline carried PUREX acid sludge, which has a relatively low level of cesium-137 but high levels of actinides and strontium-90.

After completion of sampling, the pipeline and the surrounding soil will be placed in a state that is protective of the worker and environment. Activities to achieve the end state will depend on sample location and sampling methods used. Guidance for achieving the end state after sampling will be provided in the PSAP.

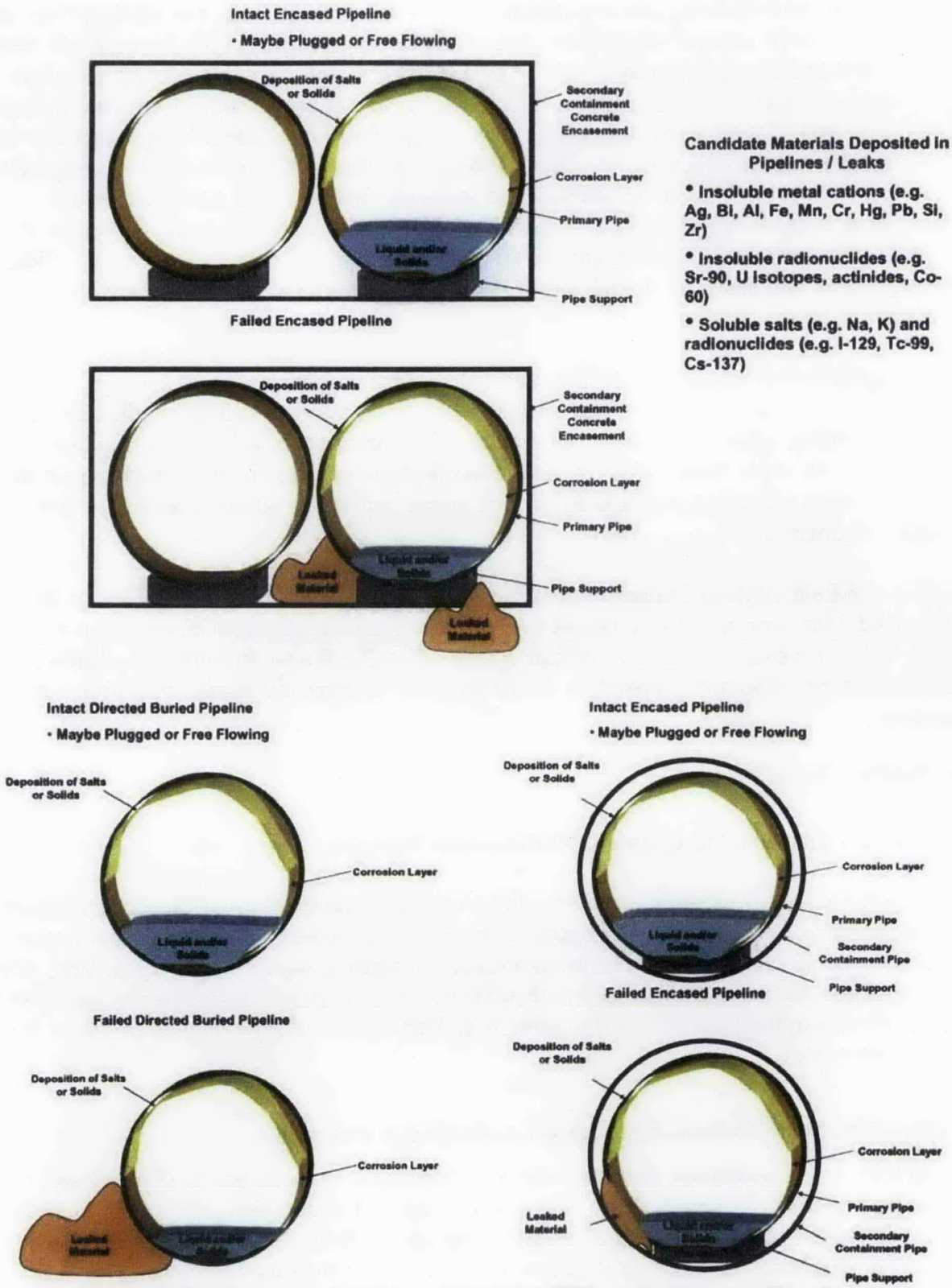

Figure 4-2. Conceptualization of Residual Waste in Process Pipelines

4.2 SAMPLING METHODS

Characterization activities include evaluation of the interior of pipelines and adjacent vadose zone soil. Within the interior of pipelines, samples of residual solids in the form of sediment, sludge or scale and liquid, if present, will be collected. For soil, sampling and geophysical logging using spectral and gross gamma, passive neutron, and active neutron (moisture) detectors will be performed. Direct-push technology (e.g., Geoprobe or equivalent equipment) will be used for vadoze soil sampling and geophysical logging. The sampling strategy is designed to provide focused evaluations on potentially contaminated locations and media inside the pipelines, and in adjacent subsurface soils where leakage may have occurred. Selection of samples in soils used for laboratory analysis will be guided by field screening results. Field screening results will assist in identifying the sample depths where the most extensive contamination occurs.

Prior to implementing intrusive activities, surface geophysical and radiation surveys will be conducted at all sample locations. The surface geophysical surveys will be conducted using ground-penetrating radar and/or electromagnetic induction and will aid in verifying buried pipeline locations, other buried utilizes, and subsurface anomalies. Surface radiation surveys will identify areas of surface contamination that might impact the intrusive activities and health and safety requirements.

Sampling and field-deployed measurement methods that may be used are described in Sections 4.2.1 and 4.2.2 for piping and soil, respectively. The specific methods to be used at a sample location will be identified in the appropriate PSAP. The PSAP also will provide additional guidance for excavation and preparation of the samples for shipping to and receiving at the laboratory.

4.2.1 Pipeline Sampling

Handheld and Deployed Instrument Radiological Surveys:

Radiological surveys of pipeline interiors will be used to provide information concerning the presence or absence of residual 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 will be presented in the PSAP(s). Alternatively, a short section of pipe may be removed for NDA at a laboratory.

Sampling Pipe Scale/Sediment Sludge for Laboratory Analyses:

Residual build-up of sediment, slug, or scale may be present in the interiors of pipelines. Liquid may also be present in some pipelines. These materials will be sampled at one location per pipeline. A section of pipe, up to maximum of 10ft long, will be removed and sent to a laboratory for analysis. As discussed earlier, the pipe section may be cut into smaller sub-

sections for ease of handling. Liquid, if present, will be collected in sample jar(s) and shipped to a laboratory for analysis.

A hydraulic-type cutting tool, similar to the "jaws of life" has been used to cut piping jumpers at tank farm underground valve pits, as well as at the Hanford 100K Area, to remove piping. This hydraulic shear is capable of cutting a pipe with a diameter up to 6 inches. Additionally, there are commercially available tools that mount on the outside of piping. These tools not only can cut the pipe pneumatically but also prepare the ends for handling. This could significantly reduce worker exposure.

4.2.2 Soil Sampling and Survey Methods

Investigations for the presence of contaminants in the soils surrounding pipelines will be conducted using both indirect and direct evaluation techniques. Subsurface investigations will include geophysical logging and soil sampling. One or more of the following sampling and survey methods may be used to characterize soil contamination:

Direct-Push Investigative Techniques:

Subsurface investigations using direct-push technology will be employed as part of the assessment for soil surrounding selected pipeline locations. 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 and soil moisture. Discrete sample intervals will have soil collected for field screening and laboratory analyses. This technology will work well in the unconsolidated sediments and fill material adjacent to buried pipelines.

Geophysical Logging Through Direct-Push Casing

Radioactivity levels will be measured in soils using geophysical logging instrumentation. Radioactive contamination is generally expected to be primary represented by gamma emitters (e.g., cesium-137). Driven small-diameter casing will be installed and used for down-hole logging with gamma-logging tools. The depth of a driven casing will be limited by the subsurface conditions (i.e., cobbles or gravel). Gross gamma and passive neutron logging probes will be used to determine areas of potentially high americium-241 and plutonium-239/240 concentrations. The small-diameter gross gamma and passive neutron probe system uses bismuth-germanium detector instrumentation for gross counting of the gamma-emitting radionuclides in the soil as a function of depth. The passive neutron logging instrument with a nHe-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.

4.2.3 Surface Geophysical Techniques for Pipeline Evaluations

Several geophysical techniques are available and will be used as needed to gather information on buried pipelines. 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.*

Magnetometry

Magnetometers permit rapid, non-contact surveys to locate buried metallic objects or features. This technique is applicable for use with buried metal pipelines. 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; 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.

Ground-Penetrating Radar and Electromagnetic Induction

Surface geophysical surveys using ground-penetrating radar (GPR) and electromagnetic induction (EMI) techniques will be used to verify the locations of pipelines as needed. GPR uses a transducer to transmit frequency module 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 non-invasive 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.

Surface Geophysical Exploration

Surface geophysical exploration can be used to extend the current level of understanding associated with subsurface contamination by providing spatial distributions that can be correlated with other characterization data. Resistivity data are sensitive to salts such as sodium nitrate, one of the major constituents in tank waste.

Electrical geophysical methods apply an electrical current to the ground and measure the voltage potential at another location. By using multiple electrodes at different locations, regions of lower resistivity can be mapped and subsequently interpreted as possible waste plumes. Because of concerns over possible interference from tanks, piping, and other infrastructure, different combinations of resistivity data may need to be collected such as surface lines, wells (including drywells), and a combination of well-to-surface lines. In addition several geophysical methods should be used to identify the presence and location of buried infrastructure as a prerequisite to

collecting the resistivity data. Infrastructure mapping should use a variety of methods including magnetic gradiometry, electromagnetic induction, and ground-penetrating radar. The infrastructure map will be used during the analysis and interpretation of the resistivity data to differentiate between the effects of buried infrastructure from the effects of subsurface contamination. See RPP-RPT-28955, *Surface Geophysical Exploration of T Tank Farm at the Hanford Site* for additional information.

4.3 SAMPLE CUSTODY

A chain-of-custody form shall be used for each sample and will accompany each sample from sampling through analysis. At a minimum, the following sampling information shall be included on the chain-of-custody form:

- Project name
- Signature of the collector
- Date and time of collection
- Sample type (e.g., pipe, soil, etc.)
- Requested analysis or provide a reference for sample analysis
- Signatures of persons involved in the chain of possession
- Date and time of possession
- Unique sample identification number assigned to the sample
- Location from which the sample was obtained
- A notation of pertinent sampling information including unusual characteristics or sampling problems
- A brief description of the sample matrix such as color or consistency if possible.

Each sample will be shipped to the laboratories in an approved shipping container per approved procedure. A custody seal will be affixed to the lid of each sample container.

The information documented on the chain-of-custody forms should match the instructions within the PSAP. Sampling activities are documented in the work package(s), and any deviations from the PSAP instructions, and the justification for the deviations, will be captured in the work package. Sample integrity and traceability are maintained via the chain-of-custody forms, which are included in the Format V laboratory report. The Format V laboratory report includes a narrative section that documents known deviations from the PSAP requirements. A description

of the Format V report is provided in Section 7.0.

5.0 LABORATORY ANALYSIS REQUIREMENTS

This section specifies requirements for laboratory analysis of pipe and soil samples. Because many of the samples are expected to be radioactive, analysis of the samples will be performed at DOE laboratories. The laboratories shall maintain a quality program that meets the requirements in Section 6.0. Sample handling requirements are provided in Section 5.1. Analytical requirements are specified in Section 5.2.

5.1 SAMPLE HANDLING REQUIREMENTS

The laboratory shall remove sample material from each section of pipe or soil jar as necessary and place it in an individual empty jar (i.e., material from individual samples shall be stored separately). Solids removal methods that may alter chemical characteristics of the sample material (e.g., rinsing) shall not be used. Liquid samples may be kept in the same jars as received. Each sample shall be weighed and the approximate net weight recorded. Close-up photographs of materials in each jar shall be taken. The photographs should show, as clearly as possible, the physical characteristics of the sample.

The laboratory will observe and record the following sample characteristics:

- Color and consistency of solid samples
- Color and clarity of liquid samples (if present)
- Suspended or settled solids in liquid samples, if present (volume of solids will be estimated as a percentage of the sample total volume).

5.2 METHODS AND REQUIREMENTS FOR ANALYSIS

Analytical requirements for pipeline and soil samples are summarized in Table 5-1. Pipe residue (liquid and solids) and soil samples will be analyzed for major constituent categories (VOCs, SVOCs, inorganics, and radionuclides) using specified analytical methods. Waste analyses will be performed utilizing the methods outlined in SW-846, where applicable. However, SW-846 methods may require some deviation to address radiological concerns and unique matrix conditions. All attempts will be made to meet the DQO requirements.

Constituents measured by the specified analytical methods are divided into primary and secondary analytes. Primary analytes are identified in Table 5-1 (and Table 5-2 for organic analytes) and categorized as such if they are included in any of the following:

- The SST Part A Permit (Part A) tank waste inventory

- Underlying hazardous constituents listed in WAC 173-303-610, "Closure and post-closure"; or Title 40, *Code of Federal Regulations*, Part 268, "Land Disposal Restrictions" (40 CFR 258) (40 CFR 268.48, "Universal treatment standards")

- Radionuclides from 10 CFR 61, "Licensing Requirements for Land Disposal of Radioactive Waste" (10 CFR 61.55, "Waste classification")

Primary constituents will be analyzed to the quality control (QC) requirements specified in the DQO. Secondary constituents are measured by the same analytical methods but are not required to meet the specified QC requirements.

Some constituents may be measured by more than one method. In these cases, the selection of the method may depend on the action levels required for a decision, the expectation that the constituent is present, or the detection limit that can be achieved for each method.

Hexavalent chromium concentration will be estimated by total chromium measurements. If total chromium concentration measurements exceed applicable threshold for hexavalent chromium, then analysis of hexavalent chromium will be performed.

For organic analyses, tentatively identified compounds (TICs) will be identified using the Reconstructed Ion Chromatogram. The Reconstructed Ion Chromatogram is evaluated for TICs by identifying peaks that have not already been identified as target compounds according to the following criteria. The criteria discussed below are from the proposed language for revision three of Volume 4 of DOE/RL-96-68, *Hanford Analytical Services Quality Assurance Requirements Documents*.

The library match for a TIC should be higher than 75% before this detailed evaluation is initiated. The method-specified tune criteria should be met. Special attention to the tune at low masses should be taken when evaluating volatile compounds. The concentration of a TIC should be greater than 10% of the nearest internal standard or estimated 5 nanogram on column injection, whichever is smaller. Early (injection peak) and late eluting peaks (column bleed and coeluting compounds) should have adequate background subtraction to permit use of these TIC criteria. If isotopic patterns are present, the mass ratios should agree with the reference spectrum within 10%. The base mass peak for the sample should be the same as the reference spectrum. If a molecular ion is present in the reference spectrum, the sample should also have a molecular ion mass. Reference spectrum ions greater than 20% should be in the sample spectrum. Sample ions greater than 20% that are not in the reference spectrum need to be evaluated. Major sample ions (greater than 20%) should match relative intensities to the base peak to those same ratios for the reference spectrum within 10-30%.

The TIC evaluation is limited to the 30 largest TICs for the volatile organic analysis and the 30 largest for the semivolatile organic analysis meeting the criteria discussed above.

Table 5-1. Chemical, Radiological, and Physical Analytical Requirements for Samples. (3 sheets)

Instrument	Analyte	EPA Analytical Method	Prep method for solids (a/d/f/m/w/e/dist)	Quality control					
				Duplicate per Pipeline	Matrix spike	Matrix spike DUP	Blank	LCS	Units (for liquids or solids as appro-priate)
Gravimetric	Bulk density or SpG[1]	Not available	d	One pipe and one soil samples	NA	NA	NA	ea AB	g/mL or unitless
Thermogravimetric	Wt% H_20	Not available	d	One pipe and one soil samples	NA	NA	NA	ea AB	wt%
ICP/AES	Primary inorganics (Ag, Al, As, Ba, Be, Cd, Co, Cr, Cu, Fe, Pb, Mn, Mo, Ni, Sb, Se, Sr, Tl, U, V, Zn)[6]	EPA Method 6010B	f, m, or a	One pipe and one soil samples	ea PB or AB[2]	NR	ea PB or AB	ea PB or AB	µg/g or µg/mL
ICP/MS[3]	^{237}Np, ^{233}U, ^{234}U, ^{235}U, ^{236}U, ^{238}U, ^{230}Th, ^{232}Th	EPA Method 6020	f, m, or a	One pipe and one soil samples	ea PB or AB	NR	ea PB or AB	ea PB or AB	µg/g or µg/mL
Distillation/ISE	S^{2-}	EPA Method 9030B/9215	d	One pipe and one soil samples	ea AB	NR	ea AB	ea AB	µg/g or µg/mL
Liquid scintillation	^{63}Ni	Not available	f, m, or a	One pipe and one soil samples	NA	NR	ea PB or AB	ea PB or AB	µCi/g or µCi/mL
IC	Primary inorganics (F^-, Cl^-, SO_4^{2-}, NO_2^-, NO_3^-, $C_2H_3O_2^-$, CHO_2^-, $C_2H_3O_3^-$, $C_2O_4^{2-}$)[6]	EPA Method 9056	w	One pipe and one soil samples	ea AB	NR	ea PB	ea AB	µg/g or µg/mL
IC	NH_4^+	EPA Method 300.7	dist	One pipe and one soil samples	ea PB	NR	ea PB	ea PB	µg/g or µg/mL
CVAA	Hg	EPA Method 7471A/7470A	d	One pipe and one soil samples	ea AB	NR	ea AB	ea AB	µg/g or µg/mL
Spectrophotometric	CN^-	EPA Method 9010C	dist	One pipe and one soil samples	ea AB	NR	ea AB	ea AB	µg/g or µg/mL
Sep & beta count	^{90}Sr	Not available	f or m	One pipe and one soil samples	NA	NR	ea AB	ea AB	µCi/g or µCi/mL

Table 5-1. Chemical, Radiological, and Physical Analytical Requirements for Samples. (3 sheets)

Instrument	Analyte	EPA Analytical Method	Prep method for solids (a/d/f/m/w/e/dist)	Quality control					
				Duplicate per Pipeline	Matrix spike	Matrix spike DUP	Blank	LCS	Units (for liquids or solids as appro-priate)
Separation, AEA[4]	$^{238,239/240}Pu$, ^{241}Am, $^{243/244}Cm$, ^{242}Cm	Not available	f or m	One pipe and one soil samples	NA	NR	ea AB	ea AB	µCi/g or µCi/mL
Sep/liquid scintillation	^{3}H	Not available	w	One pipe and one soil samples	ea AB[5]	NR	ea PB	ea AB	µCi/g or µCi/mL
Sep/liquid scintillation	^{14}C	Not available	w	One pipe and one soil samples	ea AB[5]	NR	ea PB	ea AB	µCi/g or µCi/mL
Anion-cation exchange/distilla-tion/liquid scintillation	^{79}Se	Not available	a or m	One pipe and one soil samples	NA	NA	ea PB or AB	Standard not available	µCi/g or µCi/mL
ICP/MS	^{99}Tc	EPA Method 6020	f, m, or a	One pipe and one soil samples	ea AB	NR	ea PB or AB	ea PB or AB	µg/g or µg/mL
Sep/GEA	^{129}I	Not available	f/w	One pipe and one soil samples	NA	NA	ea AB	ea AB	µCi/g or µCi/mL
GEA[5]	Primary gamma emitters: $^{152,154,155}Eu$, ^{137}Cs, ^{60}Co, ^{125}Sb, ^{226}Ra	Not available	f or m	One pipe and one soil samples	NA	NA	ea AB	ea AB	µCi/g or µCi/mL

Table 5-1. Chemical, Radiological, and Physical Analytical Requirements for Samples. (3 sheets)

Instrument	Analyte	EPA Analytical Method	Prep method for solids (a/d/f/m/w/e/dist)	Quality control					
				Duplicate per Pipeline	Matrix spike	Matrix spike DUP	Blank	LCS	Units (for liquids or solids as appro-priate)
GC/MS	Primary VOC (see Table 5-2)	EPA Method 8260B	d	One pipe and one soil samples	ea AB	ea AB	ea AB	ea AB	µg/L or µg/kg wet wt.
GC/MS	Primary SVOC (see Table 5-2)	EPA Method 8270C	e	One pipe and one soil samples	ea PB	ea PB	ea PB	ea PB	µg/L or µg/kg wet wt.
PH Meter	pH	EPA Method 9045D	d	One pipe and one soil samples	NA	NA	NA	ea AB	pH
GC/ECD	PCBs (Aroclors 1016, 1221, 1232, 1242, 1248, 1254, and 1260)	EPA Method 8082	e	One pipe and one soil samples	ea PB	ea PB	ea PB	ea PB	µg/L wet wt. or µg /kg dry wt.

Notes:

[1]Use SpG procedure when solids are too dry or are observed to contain significant air "pockets" that may affect accuracy or repeatability of the measurements. The LCS is applicable to the SpG analysis only.
[2]Serial dilutions or matrix spikes may be used as necessary.
[3]LCS and spike for ^{232}Th and ^{235}U only. Initial calibration verification and post-digest spike for ^{232}Th, ^{237}Np, ^{235}U, and ^{238}U.
[4]LCS for $^{239/240}$Pu and ^{241}Am only.
[5]LCS for ^{137}Cs and ^{60}Co only.
[6]Mo, Cl, and SO_4 are not identified as TankFarm Process Waste Pipeline System constituents in D&D-30262 but were added during review of this SAP.

Prep Method Abbreviations:
e = extraction, d = direct, f = fusion, a = acid, w = water, dist = distillation, m = microwave, sep = separation

Miscellaneous Abbreviations:
ea = each, NA = not applicable, NR = not required, AB = analytical batch, PB = preparation batch, DUP = duplicate analyses

Analytical Method Abbreviations:
AEA = alpha energy analysis.
CVAA = cold vapor atomic absorption.
GC/ECD = gas chromatography/electron capture detector.
GC/MS = gas chromatography/mass spectrometry.
GEA = gamma energy analysis.
IC = ion chromatography.
ICP/AES = inductively coupled plasma/atomic emission spectrometry.
ICP/MS = inductively coupled plasma/mass spectrometry.
ISE = ion selective electrode.
LCS = laboratory control sample.
PCB = polychlorinated biphenyl.
SpG = specific gravity.
SVOC = semivolatile organic compound.
VOC = volatile organic compound.

Table 5-2. Primary Organic Analytes

Primary VOA analytes	CAS No.	Primary SVOA analytes	CAS No.
1,1,1-Trichloroethane	71-55-6	2-Methylphenol (o-cresol)	95-48-7
1,1,2,2-Tetrachloroethene	127-18-4	Butylbenzylphthalate	85-68-7
1,1,2,2-Tetrachloroethane	79-34-5	2,4,5 Trichlorophenol	95-95-4
1,1,2-Trichloro-1,2,2-trifluoroethane	76-13-1	2,4,6-Trichlorophenol	88-06-2
1,1,2-Trichloroethane	79-00-5	2,6-Bis(tert-butyl)-4-methylphenol	128-37-0
1,1,2-Trichloroethylene	79-01-6	2-Chlorophenol	95-57-8
1,1,Dichloroethene	75-35-4	2-Ethoxyethanol	110-80-5
1,2-Dichloroethane	107-06-2	4-Methylphenol (p-cresol)	106-44-5
Chloroethene (vinyl chloride)	75-01-4	Acenaphthene	83-32-9
2-Butanone (MEK)	78-93-3	Cresylic acid (cresol, mixed isomers)	1319-77-3
2-Nitropropane	79-46-9	Cyclohexanone	108-94-1
2-Propanone (Acetone)	67-64-1	Di-n-butylphthalate	84-74-2
4-methyl-2-pentanone (MIBK)	108-10-1	Di-n-octylphthalate	117-84-0
Benzene	71-43-2	N-nitroso-di-n-propylamine	621-64-7
Carbon disulfide	75-15-0	Fluoranthene	206-44-0
Carbon tetrachloride	56-23-5	o-Nitrophenol	88-75-5
Chlorobenzene	108-90-7	p-Chloro-m-cresol (4-Chloro-3-methylphenol)	59-50-7
Chloroform	67-66-3	m-Cresol (3-Methylphenol)	108-39-4
Dichloromethane (methylene chloride)	75-09-2	Pyrene	129-00-0
Ethyl acetate	141-78-6	N-Nitrosomorpholine	59-89-2
Ethylbenzene	100-41-4	1,2,4-Trichlorobenzene	120-82-1
Diethyl ether	60-29-7	2,4-Dinitrotoluene	121-14-2
Toluene	108-88-3	Hexachloroethane	67-72-1
trans-1,3,-Dichloropropene	542-75-6	Hexachlorobutadiene	87-68-3
Trichlorofluoromethane	75-69-4	Nitrobenzene	98-95-3
Xylenes	1330-20-7	Naphthalene	91-20-3
o-Xylene	95-47-6	o-Dichlorobenzene	95-50-1
m-Xylene	108-38-3	Pyridine	110-86-1
p-Xylene	106-42-3	Isobutanol	78-83-1
--	--	n-Butyl alcohol (1-butanol)	71-36-3
--	--	Tributyl phosphate	126-73-8
--	--	Dibutyl phosphate*	107-66-4
--	--	Monobutyl phosphate*	--
--	--	Benzo (a) anthracene*	56-55-3
--	--	Benzo (b) fluorathene*	205-99-2
--	--	Benzo (k) fluorathene*	207-08-9
--	--	Benzo (a) pyrene*	50-32-8

Table 5-2. Primary Organic Analytes

Primary VOA analytes	CAS No.	Primary SVOA analytes	CAS No.
--	--	Chrysene*	218-01-9
--	--	Dibenzo (ab) anthracene*	53-70-3
--	--	Indeno (123-cd) pyrene*	193-39-5

Note: *This analyte is not identified as a Tank Farm Process Waste Pipeline System constituent in D&D-30262 but was added during the review of this SAP.

Abbreviations:

CAS = Chemical Abstracts Service.
SVOA = semivolatile organic analysis.
VOA = volatile organic analysis.

6.0 QUALITY ASSURANCE AND QUALITY CONTROL

Quality requirements for conducting River Protection Project (RPP) sampling and analysis are described in DOE/RL-96-68, *Hanford Analytical Services Quality Assurance Requirements Documents*. ATL-MP-1011, *ATL Quality Assurance Project Plan for 222-S Laboratory* specifies the requirements for ensuring the quality of sample analysis conducted at the 222-S Laboratory. This quality assurance (QA) plan meets DOE/RL-96-68 minimum requirements as the baseline for laboratory quality systems.

All activities (sampling and analysis) will be performed using approved methods, procedures, and work packages that are written in accordance with approved operational and laboratory QA plans, which are consistent with the requirements of this SAP. Sampling and analysis activities shall be performed by qualified personnel using properly maintained and calibrated equipment.

6.1 FIELD QUALITY CONTROL

Field QC samples shall be collected to evaluate the potential for cross-contamination and laboratory performance. Field QC for sampling in the 200-IS-1 tank farm pipelines will require the collection of field duplicates, equipment rinsate blank, and trip blank samples, where appropriate. If possible, field duplicates should be collected from contaminated areas so valid comparisons between the samples can be made. However, the samples should not be collected from zones that are expected to contain high levels of transuranic-contaminated soils because of the high cost and added handling requirements associated with transuranic materials. Limited sample material is anticipated as being available within the interior of pipelines. Because of this situation, sufficient sample quantity may not be available for the collection of field QC samples and the percentage frequency goals specified for each type of field QC sample may not be achievable. Available sample material will always be prioritized for use in the analysis of the primary analytical samples. The field QC sample types and the frequency goals for collection are described in the following subsections.

Field Duplicates

Each field duplicate shall be retrieved from the sample interval or location using the same equipment (e.g., collected from same split-spoon or sample mixing bowl) and sampling technique as the original sample. Field duplicates for soil are collected and homogenized before being divided into two samples in the field. If volatile organic analysis (VOA) samples are required, they should be collected before homogenization. The duplicate samples shall be sent to the primary laboratory in the same manner as the routine site samples. Field duplicates provide information regarding the homogeneity of the sample matrix and can be used to evaluate the precision of the analysis process.

At least 5 percent of the total collected soil samples will be duplicated (one field duplicate will be collected for every 20 samples). At least one field duplicate shall be collected from the samples taken for each of the pipeline bins investigated. The duplicate samples shall be suitable

for analysis by an offsite laboratory and shall be analyzed for all of the COPCs listed in Table 5-1.

Field Splits

Field split samples will be collected at the same frequency as field duplicate samples. Each split sample shall be retrieved from the same sample interval or location using the same equipment (e.g., collected from same one split-spoon or sample mixing bowl) and sampling technique as the original sample. Samples shall be homogenized, split into two separate aliquots in the field, and sent to two independent laboratories. If VOA samples are required, they should be collected before homogenization. The splits will be used to verify the performance of the primary laboratory.

The split samples will be obtained from a sample medium that is expected to have some contamination and that is suitable for analysis in an offsite laboratory and shall be analyzed for all of the COPCs listed in Table 5-1.

Equipment Rinsate Blanks

Equipment rinsate blanks are used to verify the adequacy of sampling equipment decontamination procedures and shall be collected for each sampling method or type of equipment used. The field geologist can request that additional equipment blanks be taken. Equipment blanks shall consist of deionized water washed through decontaminated sampling equipment and placed in containers identified in the Sampling Authorization Forms. Note that the bottle and preservation requirements for water may differ from the requirements for soil. Equipment rinsate blanks shall be analyzed for the following:

- Gross alpha
- Gross beta
- Metals (excluding hexavalent chromium and mercury)
- Anions (except cyanide)
- VOAs of interest
- SVOAs of interest.

These analytes are considered the best indicators of decontamination effectiveness.

Trip Blanks

The volatile organic trip blanks will constitute at least 5 percent of all volatile organic compound (VOC) samples. If applicable, at least one trip blank shall be collected for each of the pipeline bins. Trip blanks shall consist of laboratory-grade deionized water added to a clean sample container. The trip blanks shall travel to the field with the associated bottle sets and will be returned to the laboratory with the samples. They will remain unopened during their transport and handling. Trip blanks are prepared as a check for possible contamination originating from container preparation methods, shipment, handling, storage, or site conditions. The trip blank shall be analyzed for VOCs only.

Prevention of Cross-Contamination

Special care should be taken to prevent cross-contamination of soil samples. Particular care will be exercised 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 them on or near potential contamination sources, such as uncovered ground
- Handling bottles or equipment with dirty hands
- Improperly decontaminating equipment before sampling or between sampling events.

6.2 QUALITY ASSURANCE/QUALITY CONTROL REQUIREMENTS FOR LABORATORY ANALYSIS

Laboratories performing analyses in support of this SAP shall have approved and implemented QA plans. These QA plans shall meet the minimum requirements of DOE/RL-96-68 as the baseline for laboratory quality systems. Because Phase 1 sampling will focus on pipelines and soils exhibiting a high level of contamination, samples collected according to this SAP will be analyzed at the 222-S Laboratory in the 200 West Area. The 222-S Laboratory conducts sample analyses according to ATL-MP-1011, which meets the minimum requirements of DOE/RL-96-68.

6.2.1 Quality Control Requirements

Required QC analyses (duplicates, matrix spikes, blanks, laboratory control samples) are identified in Table 5.1. The laboratory shall also use calibration and calibration check standards appropriate for the analytical instrumentation as defined in DOE/RL-96-68. The QC acceptance criteria for laboratory control samples, spikes, and duplicate are specified in the DQO (D&D-30262) and are summarized in Table 6.1. Laboratory blanks shall be evaluated against the method detection limits. The QC criteria are goals for demonstrating reliable method performance. The laboratory will use its internal QA system for addressing any QC failures. If the QC failures are systematic and cannot be resolved by the internal protocols, the project manager/assigned task lead shall be consulted to determine the proper action. The laboratory should suggest a course of action at that time. All data not meeting the QC requirements shall be properly noted and the associated QC failures discussed in the narrative section of the Format V data report.

Table 6-1. Quality Control Parameters for Primary Analytes (2 Sheets)

Analytes	Method	QC Acceptance Criteria		
		LCS % Recovery[5]	Spike % Recovery[5]	Duplicate/ MSD RPD[1]
Al, Sb, As, Ba, Be, Cd, Cr, Co, Cu, Fe, Pb, Mn, Mo, Ni, Se, Ag, Sr, Tl, U, V, Zn	ICP/AES	70-130%	70-130%	≤30%
Hg	CVAA	70-130%	70-130%	≤30%
F^-, NO_2^-, NO_3^-, Cl^-, SO_4^{2-}, NH_4^+, $C_2H_3O_2^-$, CHO_2^-, $C_2H_3O_3^-$, $C_2O_4^{2-}$	IC	70-130%	70-130%	≤30%
CN^-	Spectrophotometric	70-130%	70-130%	≤30%
S^{2-}	Distillation/ISE	70-130%	70-130%	≤30%
Bulk Density or SpG	Gravimetric	70-130%[2]	NA	≤30%
pH	pH meter	± 0.1 pH units	NA	NA
VOC	GC/MS	70-130%	70-130%	≤30%
SVOC	GC/MS	70-130%	70-130%	≤30%
PCBs	GC/ECD	70-130%	70-130%	≤30%
Weight percent water	Thermogravimetric	70-130%	NA	≤30%
^{233}U ^{234}U, ^{235}U, ^{236}U, ^{238}U, ^{237}Np, ^{230}Th, ^{232}Th	ICP/MS	70-130%[3]	70-130%[3]	≤30%
^{60}Co, ^{137}Cs, ^{226}Ra	GEA	70-130%	NA	≤30%
^{152}Eu, ^{154}Eu, ^{155}Eu, ^{125}Sb	GEA	NA	NA	≤30%
^{129}I	GEA	70-130%	NA	≤30%
^{14}C, ^{3}H	Liquid scintillation counting	70-130%	70-130%	≤30%
^{63}Ni	Liquid scintillation counting	70-130%	NA	≤30%
^{90}Sr	Beta counting	70-130%	NA	≤30%
^{99}Tc	ICP/MS	70-130%	70-130%	≤30%
^{79}Se	Liquid scintillation counting	NA	NA	≤30%
$^{239/240}Pu$, ^{241}Am	Alpha counting	70-130%	NA	≤30%
^{241}Pu	Calculation from ^{238}Pu and $^{239/240}Pu$ [4]	NA	NA	NA
^{228}Th	Calculation from ^{232}U and ^{232}Th. ^{232}U to be calculated from U or U isotopes [4]	NA	NA	NA
^{238}Pu, ^{242}Cm, $^{243/244}Cm$	Alpha counting	NA	NA	≤30%

Abbreviations:

CVAA	Cold Vapor Atomic Absorption
GC/ECD	Gas chromatography/electron capture detection
GC/MS	Gas chromatography/mass spectrometry
GEA	Gamma Energy Analysis
IC	Ion Chromatography
ICP/AES	Inductively Coupled Plasma / Atomic Emission Spectroscopy
ICP/MS	Inductively Coupled Plasma / Mass Spectroscopy
ISE	Ion selective electrode
LCS	Laboratory control sample
MSD	matrix spike duplicate
NA	Not applicable

Table 6-1. Quality Control Parameters for Primary Analytes (2 Sheets)

Analytes	Method	QC Acceptance Criteria		
		LCS % Recovery[5]	Spike % Recovery[5]	Duplicate/ MSD RPD[1]

PCB	Polychlorinated biphenyl
QC	quality control
RPD	Relative percent difference
SpG	Specific gravity
SVOC	semi-volatile organic compound
VOC	volatile organic compound

Notes:

[1]If primary and duplicate results are available above detection limits, RPD will be based on these results.

[2]LCS is applicable to SpG analysis only.

[3]LCS and matrix spike for ^{235}U, ^{237}Np, ^{238}U, and ^{232}Th only.

[4]Calculations will be performed by Process Engineering.

[5]Laboratories must meet statistically based controls if more stringent.

6.2.2 Target Detection Limits

D&D-30262 provides target detection limits for tank farms pipeline sample analysis. Limits for primary radionuclides and chemicals are shown in Table 6.2 and 6.3.

Table 6-2. Target Detection Limits for Primary Radionuclides (2 Sheets)

Chemical Abstracts Service No. or Constituent Identifier No.	Analyte	Survey or Analytical Method	Lowest Overall CUL (pCi/g)	Target Detection Limits (pCi/g)
14234-35-6	Antimony-125	Gamma GS	--	0.3
14596-10-2	Americium-241	Am-241 AEA	31.1	1
14762-75-5	Carbon-14	C-14 LSC (low level)	4.65	1
10045-97-3	Cesium-137	Gamma GS	6.2	0.1
10198-40-0	Cobalt-60	Gamma GS	1.4	0.05
15510-73-3	Curium-242	Am-241/Cu-244 AEA	--	1.0
15757-87-6	Curium-243	Am-241/Cu-244 AEA	110	1.0
13981-15-2	Curium-244	Am-241/Cu-244 AEA	744	1.0
14683-23-9	Europium-152	Gamma GS	3.3	0.1
15585-10-1	Europium-154	Gamma GS	3.0	0.1
14391-16-3	Europium-155	Gamma GS	125	0.1
15046-84-1	Iodine 129	Iodine-129-LSC	0.12	2
13994-20-2	Neptunium-237	ICP/MS	2.5	1

Table 6-2. Target Detection Limits for Primary Radionuclides (2 Sheets)

Chemical Abstracts Service No. or Constituent Identifier No.	Analyte	Survey or Analytical Method	Lowest Overall CUL (pCi/g)	Target Detection Limits (pCi/g)
13981-37-8	Nickel-63	Ni-63 LSC	4,026	30
13981-16-3	Plutonium-238	AEA	37.4	1
Pu-239/240	Plutonium-239/240	AEA	33.9	1
13982-63-3	Radium-226	Gamma GS	7.03	0.2
15758-85-9	Selenium-79	Selenium-79-LSC	197,000	10
Rad-Sr	Strontium-90	Strontium-89,90 - Total Sr - Gas Proportional Counting	4.5	1
14133-76-7	Technetium-99	ICP/MS	1.93	1
4-82-9	Thorium-228	TBD	7.73	1
14269-63-7	Thorium-230	ICP/MS	20.1	1
TH-232	Thorium-232		4.8	1
10028-17-8	Tritium	Tritium – H-3 LSC(mid level)	48.2	30
13966-29-5	Uranium-233/234	ICP/MS	1.1	1
15117-96-1	Uranium-235		101	1
U-238	Uranium-238		1.06	1
N/A	Gross cesium-137 counts	Portable NaI detector		3.1
N/A	Gross alpha	Portable contamination detector		100 d/min/ 100 cm^2
N/A	Gross beta/gamma	Portable contamination detector		5,000 d/min/ 100 cm^2

CUL= cleanup level

TBD = to be determined

GS = gamma spectroscopy.
LSC = liquid scintillation counter.
AEA = alpha energy analysis.
ICP/MS = inductively coupled plasma/masss spectrometry

Table 6-3. Target Detection Limits for Primary Chemicals (5 Sheets)

Chemical Abstracts Service No. or Constituent Identifier No.	Analyte	Survey or Analytical Method	Lowest Overall CUL (mg/kg)	Target Detection Limits (mg/kg)
7429-90-5	Aluminum	EPA Method 6010B	45.2	5
7440-36-0	Antimony	EPA Methods 6010B, 6020, or 200.8 (trace)	5	0.6
7440-38-2	Arsenic	EPA Methods 6010B, 6020, or 200.8	6.5	1
7440-39-3	Barium	EPA Methods 6010B, 6020, or 200.8	132	20
7440-41-7	Beryllium	EPA Methods 6010B, 6020, or 200.8	10	0.5
7440-43-9	Cadmium	EPA Methods 6010B, 6020, or 200.8	0.81	0.5
7440-47-3	Chromium (III)/ Chromium (total)	EPA Methods 6010B, 6020, or 200.8	42	1
7440-48-4	Cobalt	EPA Methods 6010B, 6020, or 200.8	20	2
7440-50-8	Copper	EPA Methods 6010B, 6020, or 200.8	50	1
7439-89-6	Iron	EPA Methods 6010B, 6020, or 200.8	152	5
7439-92-1	Lead	EPA Methods 6010B, 6020, or 200.8	50	5
7439-96-5	Manganese	EPA Methods 6010B, 6020, or 200.8	512	1.9*
7439-97-6	Mercury	EPA Methods 7470A, 7471A, 6020, or 200.8	0.33	0.2
7439-98-7	Molybdenum	EPA Methods 7470A, 7471A, 6020, or 200.8	2	19*
7440-02-0	Nickel	EPA Methods 6010B, 6020, or 200.8	30	4
7782-49-2	Selenium	EPA Methods 6010B, 6020, or 200.8	0.3	1
7440-22-4	Silver	EPA Methods 6010B, 6020, or 200.8	2	2
7440-24-6	Strontium	EPA Methods 6010B, 6020, or 200.8	2,920	1
7440-28-0	Thallium	EPA Methods 6010B, 6020, or 200.8	1	0.5

Table 6-3. Target Detection Limits for Primary Chemicals (5 Sheets)

Chemical Abstracts Service No. or Constituent Identifier No.	Analyte	Survey or Analytical Method	Lowest Overall CUL (mg/kg)	Target Detection Limits (mg/kg)
7440-61-1	Uranium	EPA Methods 200.8, 6020, or kinetic phosphorescence absorption	3.21	1
7440-62-2	Vanadium	EPA Methods 6010B, 6020, or 200.8	560	2.5
7440-66-6	Zinc	EPA Methods 6010B, 6020, or 200.8	86	1
57-12-5	Cyanide (includes ferrocyanide)	EPA Methods 9010C total cyanide or 335	0.8	0.5
16984-48-8	Fluoride	IC, EPA Method 9056 or 300.0	5.78	5
14797-55-8	Nitrate	IC, EPA Method 9056 or 300.0	40	2.5
14797-65-0	Nitrite	IC, EPA Method 9056 or 300.0	4	2.5
16887-00-6	Chloride	IC, EPA Method 9056 or 300.0	1000	0.3*
14808-79-8	Sulfate	IC, EPA Method 9056 or 300.0	1000	2.7*
71-50-1	Acetate	IC, EPA Method 9056 or 300.0	--	4.5*
64-18-6	Formate	IC, EPA Method 9056 or 300.0	--	10.0
79-14-1	Glycolate	IC, EPA Method 9056 or 300.0	---	3.8*
144-62-7	Oxalate	IC, EPA Method 9056 or 300.0	--	2*
18496-25-8	Sulfide	EPA Method 9030	--	5
NA	Ammonium (NH_4)	EPA Method 300.7	9.23	0.5
67-64-1	Acetone	EPA Method 8260	28.9	0.02
71-43-2	Benzene	EPA Method 8260	0.00448	0.0015
75-15-0	Carbon disulfide	EPA Method 8260	5.65	0.005
56-23-5	Carbon tetrachloride	EPA Method 8260	0.00310	0.0015
108-90-7	Chlorobenzene	EPA Method 8260	0.874	0.005
67-66-3	Chloroform (trichloromethane)	EPA Method 8260	0.0381	0.005
108-94-1	Cyclohexanone	EPA Method 8270C	344	0.5
107-06-2	1,2-Dichloroethane	EPA Method 8260	0.00232	0.0015
75-35-4	1,1-Dichloroethylene	EPA Method 8260	0.000522	0.01
75-09-2	Dichloromethane (methylene chloride)	EPA Method 8260	0.0218	0.002
10061-02-6	Dichloropropene; 1,3,- (trans-)	EPA Method 8260	0.00141	0.005
141-78-6	Ethyl acetate	EPA Method 8015	59.5	5
60-29-7	Diethyl ether	EPA Method 8015, 8260	6.68	5

Table 6-3. Target Detection Limits for Primary Chemicals (5 Sheets)

Chemical Abstracts Service No. or Constituent Identifier No.	Analyte	Survey or Analytical Method	Lowest Overall CUL (mg/kg)	Target Detection Limits (mg/kg)
100-41-4	Ethyl benzene	EPA Method 8260	6.05	0.005
67-72-1	Hexachloroethane	EPA Method 8270C	0.125	0.33
108-10-1	Methyl isobutyl ketone (MIBK hexone)	EPA Method 8260	2.71	0.01
78-93-3	Methyl ethyl ketone (MEK)	EPA Method 8260	19.6	0.01
79-46-9	Nitropropane; 2-	EPA Method 8260	0.0000208	0.002*
79-34-5	Tetrachloroethane; 1,1,2,2-	EPA Method 8260	0.00123	0.005
127-18-4	Tetrachloroethene (PCE)	EPA Method 8260	0.000859	0.005
108-88-3	Toluene	EPA Method 8260	4.65	0.005
76-13-1	trichloro-1,2,2-trifluoroethane; 1,1,2-	EPA Method 8260	22,000	0.010
71-55-6	1,1,1-Trichloroethane (TCA)	EPA Method 8260	1.58	0.005
79-00-5	1,1,2-Trichloroethane	EPA Method 8260	0.00427	0.002
83-32-9	Acenaphthene	EPA Method 8270C	20	0.33
71-36-3	Butanol; n- (n-butyl alcohol)	EPA Method 8260, 8015	6.62	5
85-68-7	Butylbenzylphthalate	EPA Method 8270C	893	0.33
95-57-8	Chlorophenol; 2-	EPA Method 8270C	0.943	0.33
M + P CRESOL	Cresol; m + p (3/4-Methylphenol)	EPA Method 8270C	10.1	0.33
95-48-7	Cresol; o- (2-Methylphenol)	EPA Method 8270C	10.3	0.33
1319-77-3	Cresylic acid (cresol, mixed isomers)	EPA Method 8270C	--	0.5*
84-74-2	Dibutylphthalate (Di-n-butylphthalate)	EPA Method 8270C	2.2	0.33
117-84-0	Di-n-octylphthalate	EPA Method 8270C	0.524	0.33
95-50-1	Dichlorobenzene; 1,2- (ortho-)	EPA Method 8270C	7.03	0.33
121-14-2	Dinitrotoluene; 2,4-	EPA Method 8270C	0.189	0.33
110-80-5	Ethoxyethanol; 2-	TBD	25.7	TBD
206-44-0	Fluoranthene	EPA Method 8270C	631	0.33
87-68-3	Hexachlorobutadiene	EPA Method 8270C	0.605	0.33
78-83-1	Isobutyl alcohol (Isobutanol)	EPA Methods 8260 or 8015	19.4	5
128-37-0	methylphenol; 2,6-Bis(tert-butyl)-4-	EPA Method 8270C	--	1.2*

Table 6-3. Target Detection Limits for Primary Chemicals (5 Sheets)

Chemical Abstracts Service No. or Constituent Identifier No.	Analyte	Survey or Analytical Method	Lowest Overall CUL (mg/kg)	Target Detection Limits (mg/kg)
59-50-7	methylphenol; 4-Chloro-3- (p-Chloro-m-cresol)	EPA Method 8270C	4,000	0.33
91-20-3	Naphthalene	EPA Method 8270C	4.46	0.33
98-95-3	Nitrobenzene	EPA Method 8270C	0.026	0.33
88-75-5	Nitrophenol; o-	EPA Method 8270C	---	0.66
621-64-7	Nitroso-di-n-propylamine	EPA Method 8270C	0.000056	0.33
79-01-6	Trichloroethylene (TCE)	EPA Method 8260	7.21E-4	3.7E-4*
75-69-4	Trichlorofluoromethane	EPA Method 8260	28.4	0.01
75-04-1	Vinyl chloride	EPA Method 8260	0.000184	0.01
1330-20-7	Xylenes	EPA Method 8260	14.6	0.01
108-38-3	Xylene; m-	EPA Method 8260	84.4	5.1E-4*
95-47-6	Xylene; o-	EPA Method 8260	91.9	2.4E-4*
106-42-3	Xylene; p-	EPA Method 8260	172	5.1E-4*
120-82-1	1,2,4 - Trichlorobenzene	EPA Method 8270C	2.98	0.33
59-89-2	Nitrosomorpholine; N-	EPA Method 8270C	--	0.33
129-00-0	Pyrene	EPA Method 8270C	655	0.33
110-86-1	Pyridine	EPA Method 8270C	0.0746	0.66
95-95-4	Trichlorophenol; 2,4,5-	EPA Method 8270C	4	0.33
88-06-2	Trichlorophenol; 2,4,6-	EPA Method 8270C	0.0924	0.33
		EPA Method 8041		0.165
126-73-8	Tributyl phosphate	EPA Method 8270C	6.18	3.3
107-66-4	Dibutyl phosphate*	EPA Method 8270C	--	TBD
--	Monobutyl phosphate*	EPA Method 8270C	--	TBD
56-55-3	Benzo (a) anthracene*	EPA Method 8270C	0.856	0.33
205-99-2	Benzo (b) fluorathene*	EPA Method 8270C	1.37	0.33
207-08-9	Benzo (k) fluorathene*	EPA Method 8270C	13.7	0.33
50-32-8	Benzo (a) pyrene*	EPA Method 8270C	0.137	0.33
218-01-9	Chrysene*	EPA Method 8270C	95.6	0.33
53-70-3	Dibenzo (ab) anthracene*	EPA Method 8270C	0.137	0.33
193-39-5	Indeno (123-cd) pyrene*	EPA Method 8270C	1.37	0.33
2674-11-2	Aroclor 1016	PCBs, EPA Method 8082	0.092	0.02
11104-26-2	Aroclor 1221	PCBs, EPA Method 8082	0.092	0.02
11141-16-5	Aroclor 1232	PCBs, EPA Method 8082	0.092	0.02

Table 6-3. Target Detection Limits for Primary Chemicals (5 Sheets)

Chemical Abstracts Service No. or Constituent Identifier No.	Analyte	Survey or Analytical Method	Lowest Overall CUL (mg/kg)	Target Detection Limits (mg/kg)
53969-21-9	Aroclor 1242	PCBs, EPA Method 8082	0.0394	0.02
126572-29-6	Aroclor 1248	PCBs, EPA Method 8082	0.0386	0.02
11097-6999-1	Aroclor 1254	PCBs, EPA Method 8082	0.066	0.02
11096-82-5	Aroclor 1260	PCBs, EPA Method 8082	0.072	0.02

Note: *Target detection limit for this analyte is not specified in D&D-30262. It is based on detection limits achieved in the recent analyses of soil samples taken near tank 241-S-102 (RPP-RPT-36439, *Final Report for the Contaminated Soil Samples at Tank 241-S-102 in Support of the Type A Investigation of the Tank Waste Spill*).

Abbreviations:

CUL = cleanup level.
EPA = U.S. Environmental Protection Agency.
IC = ion chromatography.
TBD = to be determined
N/A= not applicable.
PCB= polychlorinated biphenyl.

7.0 DATA REPORTING

The data package(s) from the 222-S Laboratory will be in Format V. A Format V data package, as defined in ATL-MP-1011 is necessary because the data are expected to receive extensive review from external individuals and organizations. The Format V data package is subject to internal laboratory QA verification and review including peer review prior to release. Upon release, the data package will receive a third party validation.

The Format V data package requires a comprehensive report of analytical data. All analytical data, including waste sample analyses, blank analyses, holding time checks, matrix spike duplicate analyses, and surrogate recoveries shall be verified by the laboratory prior to reporting. The data package shall also include TICs found in volatile organic analysis (VOA) and semivolatile organic analysis (SVOA). A discussion of the TIC evaluation process shall be provided in the narrative.

In addition to the data package(s), an electronic version of the analytical results shall be provided to the Hanford Environmental Information System (HEIS) database.

8.0 CHANGE CONTROL

Field activity and laboratory work scope changes may be required because of unexpected field conditions, new information, health and safety concerns, or other circumstances. Changes to work scope may result in modifications to this SAP. Work scope changes that do not result in deviation from the SAP requirements, can be made in the field or laboratory with the approval of the project manager or assigned task lead. These work scope changes will be documented in the sampling work package and/or Format V laboratory report and the retrieval data report. Justification for the changes to work scope shall be provided in sufficient detail to understand the basis for the change. Alternately, if field or laboratory conditions result in substantial work scope changes, the SAP may be revised with DOE and Ecology approval.

Waste sampling and field measurement methods and analytical strategies (e.g., constituent listings and data analysis) may be updated as new technologies or information become available. The impact of these updates to the SAP will be judged as they are identified to determine if revisions to the SAP will be necessary. Ecology, DOE and its contractors will participate in the SAP update evaluation process and any subsequent revisions to the SAP.

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APPENDIX A

QUALITY ASSURANCE PROJECT PLAN FOR PHASE 1 SAMPLING AND ANALYSIS OF THE 200-IS-1 OPERABLE UNIT TANK FARM PIPELINES

QUALITY ASSURANCE PROJECT PLAN FOR PHASE 1 SAMPLING AND ANALYSIS OF THE 200-IS-1 OPERABLE UNIT TANK FARM PIPELINES

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

- U.S. Department of Energy (DOE) Order 414.1C, *Quality Assurance*
- 10 CFR 830.120, "Quality Assurance Requirements"
- EPA/240/B-01/003, *EPA Requirements for Quality Assurance Project Plans*, EPA QA/R-5.

A-1.0 PROJECT MANAGEMENT

This section addresses the basic areas of project management, and it ensures 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. The QAPjP is organized according to the elements described in EPA QA/R-5.

A-1.1 PROJECT/TASK ORGANIZATION

The project organization is described in the subsections that follow and is shown in Figure A-1.

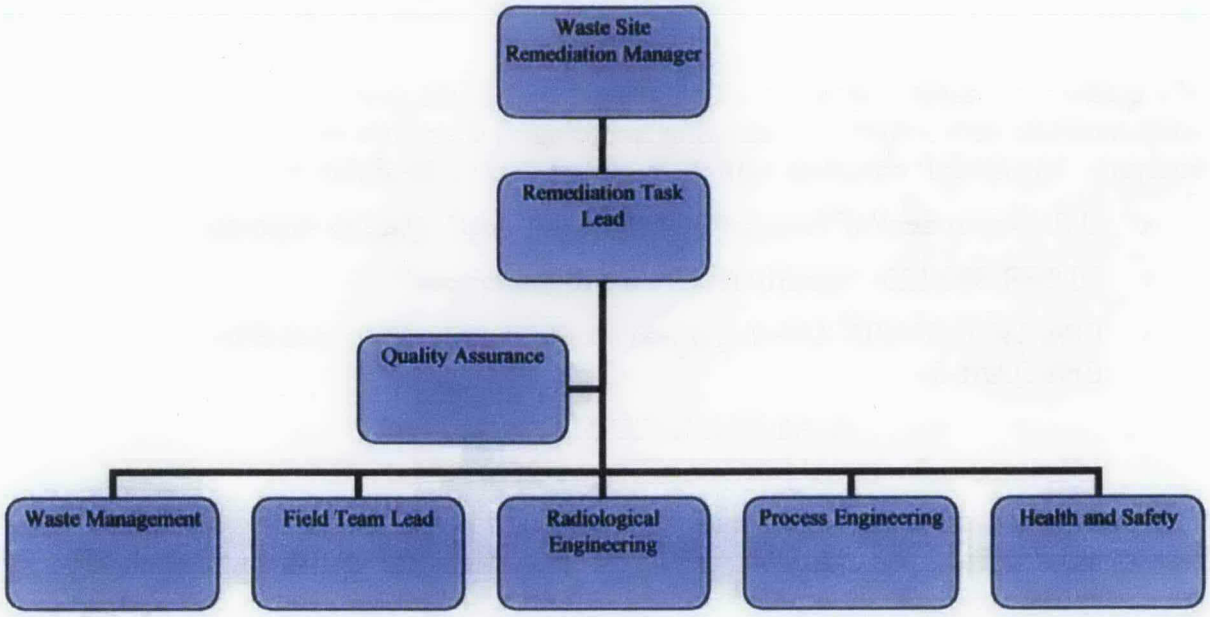
Waste Site Remediation Manager

The Waste Site Remediation manager provides oversight for all activities and coordinates with DOE and Ecology in support of sampling activities. In addition, support is provided to the task lead to ensure that the work is performed safely and cost-effectively.

Remediation Task Lead

The Remediation task lead is responsible for direct management of sampling documents and requirements, field activities, and subcontracted tasks. The task lead ensures that the field team lead, samplers, and others responsible for implementation of this SAP and the QAPjP are provided with current copies of this document and any revisions thereto. The task lead works closely with quality assurance, health and safety, and the field team leader to integrate these and the other lead disciplines in planning and implementing the work scope. The task lead also coordinates with and reports to DOE, Ecology, and the Tank Farm contractor on all sampling activities.

Figure A-1. Project Organization



Quality Assurance

Quality Assurance is responsible for quality assurance issues on the project. Responsibilities include oversight of implementation of the project quality assurance requirements; review of project documents, including SAPs (and the QAPjP); and participation in quality assurance assessments and surveillances on sample collection and analysis activities, as appropriate.

Waste Management

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 (e.g., with WAC 173-303) of the characterization data to generate waste designations, profiles, and other documents that confirm compliance with waste disposal requirements.

Field Team Leader

The field team leader has the overall responsibility for the planning, coordination, and execution of the field sampling 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 leader communicates with the Remediation task lead to identify field constraints that could affect the sampling design. In addition, the field team leader directs the procurement and installation of materials and equipment needed to support the field work.

The field team leader oversees field-sampling activities that include sample collection, packaging, provision of certified clean sampling bottles/containers, documentation of sampling activities in controlled logbooks, chain-of-custody documentation, and packaging and transportation of samples to the laboratory or shipping center.

Radiological Engineering

The Radiological Engineering lead is responsible for the radiological engineering and health physics support within the project. Specific responsibilities include conducting 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. Radiological Engineering interfaces with the project safety and health representative and plans and directs radiological control technician support for all activities.

Process Engineering

Process Engineering prepares this SAP and individual pipeline sampling and analysis plans (PSAPs). Process Engineering selects the laboratories that perform the analyses and requests assessments/surveillances of the laboratories. This organization receives the analytical data from the laboratories, arranges for data entry into the Hanford Environmental Information System (HEIS) database, and arranges for data validation. It performs reviews of sample data against existing knowledge and data quality assessments according to guidelines in EPA QA/G-9, *Guidance for Data Quality Assessment*.

Health and Safety

Responsibilities include coordination of industrial safety and health support within the project as carried out through safety and health plans, job hazard analyses, and other pertinent safety documents required by Federal regulation or by internal Tank Farm Contractor work requirements. In addition, assistance is provided to project personnel in complying with applicable health and safety standards and requirements. Personnel protective clothing requirements are coordinated with Radiological Engineering.

A-1.2 PROBLEM DEFINITION/BACKGROUND

See Sections 1.0 and 2.0 of the SAP.

A-1.3 PROJECT/TASK DESCRIPTION

See Section 3.0 of the SAP.

A-1.4 QUALITY OBJECTIVES AND CRITERIA

See Sections 5.0 and 6.0 of the SAP.

A-1.5 SPECIAL TRAINING/CERTIFICATION

Sampling and laboratory personnel shall complete the necessary training and receives appropriate certification to perform assigned tasks in support of the 200-IS-1 characterization project. 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 radiation training
- Radiological worker training.

A graded approach is used to ensure that workers receive a level of training commensurate with their responsibilities that complies with applicable U.S. Department of Energy orders and government regulations. Specialized employee training includes prejob briefings, on-the-job training, emergency preparedness, plan-of-the-day activities, and facility/worksite orientations.

A-1.6 DOCUMENTS AND RECORDS

All information pertinent to field sampling and surveying will be recorded in field checklists and bound logbooks in accordance with existing sample collection protocols. The sampling team will be responsible for recording all relevant sampling information. Entries made in the logbook will be dated and signed by the individual who made the entry. Program requirements for managing the generation, identification, transfer, protection, storage, retention, retrieval, and disposition of records within the Tank Farms Contractor will be followed.

Requirements for laboratory data reporting are discussed in Sections 7.0 and 8.0 of the SAP.

A-2.0 DATA GENERATION AND ACQUISITION

A-2.1 SAMPLING PROCESS DESIGN

See Section 4.1 of the SAP.

A-2.2 SAMPLING METHODS

See Section 4.2 of the SAP.

A-2.3 SAMPLE HANDLING AND CUSTODY

See Section 4.3 of the SAP.

A-2.4 ANALYTICAL METHODS

See Table 5.1 of the SAP.

A-2.5 QUALITY CONTROL

Quality control sample requirements and acceptance criteria for these samples are specified in Section 6.0 of the SAP. Overall quality assurance and quality control requirements for characterization are discussed in this section.

A-2.5.1 Quality Assurance Objective

The quality assurance objective of this plan is to develop implementation guidance that will provide data of known and appropriate quality. Data quality is assessed by representativeness, comparability, accuracy, and precision. The applicable QC guidelines, quantitative target limits, and levels of effort for assessing data quality are dictated by the intended use of the data and the nature of the analytical method. Each of these is addressed in the following subsections:

Representativeness

Representativeness is a measure of how closely the results reflect the actual concentration and distribution of the chemical and radiological constituents in the matrix sampled. Sampling design has been developed and sampling techniques will be selected with the goal of optimizing representativeness of the samples.

Comparability

Comparability expresses the confidence with which one data set can be compared to another. Data comparability will be maintained using standard procedures and consistent

methods and units. Also, split samples will be used to compare performance of laboratories.

Accuracy

Accuracy is an assessment of the closeness of the measured value to the true value. Accuracy of chemical test results is assessed by spiking samples with known standards and establishing the average recovery. A matrix spike is the addition to a sample of a known amount of a standard compound similar to the compounds being measured. Sample accuracy is expressed as the percent recovery of a spiked sample. Table 6-1 provides the accuracy criteria for laboratory analyses.

Precision

Precision is a measure of the data reproducibility when more than one measurement has been taken on the same sample. Precision can be expressed as the relative percent difference for duplicate measurements or relative standard deviation for triplicates. Table 6.1 lists the analytical precision criteria for fixed laboratory analyses.

Detection Limits

Detection limits are functions of the analytical method used to provide the data and the quantity of the sample available for analyses. Method detection limits for the COPCs are presented on Tables 6-2 and 6-3.

Laboratory Quality Control

The laboratory method blanks, duplicates, laboratory control sample/blank spike, and matrix spikes are defined in Chapter 1 of SW-846 and will be run at the frequency specified in Chapter 1 of SW-846. Because of anticipated limited sample quantity being available within the pipelines, sufficient material may be available to perform both method analysis and associated laboratory QC. Available sample quantity will always be prioritized and allocated to completion of the method analysis. If insufficient sample is available for completion of laboratory QC analyses, the laboratory will be make note of the condition in the data package narrative and the associated data results will have laboratory qualifies added as appropriate.

A-2.5.3 Sample Preservation, Containers, and Holding Times

Sample preservation, containers, and holding times for radiological and nonradiological analytes are shown in Table A-1.

Table A-1. Sample Preservation, Container, and Holding Time Guidelines

Analytes	Matrices	Bottle		Preservation	Packing Requirements	Holding Time
		Number	Type			
Radionuclides	Soil/Sludge/ Sediment/Scale	1	G/P	None	None	6 months
IC anions	Soil/Sludge/ Sediment/Scale	1	G/P	None	Cool 4 °C	48 hours
ICP metals	Soil/Sludge/ Sediment/Scale	1	G/P	None	None	6 months
Mercury	Soil/Sludge/ Sediment/Scale	1	G	None	None	28 days
Total cyanide	Soil/Sludge/ Sediment/Scale	1	G	None	Cool 4 °C	14 days
pH (soil)	Soil/Sludge/ Sediment/Scale	1	G/P	None	None	Within 24 hrs of lab receipt
SVOA	Soil/Sludge/ Sediment/Scale	1	AG	None	Cool 4 °C	14/40 days
VOA	Soil/Sludge/ Sediment/Scale	2 - 8	aGs	Methanol (high level) Freeze (low level)	Methanol Cool 4 °C; Freeze < - 7°C and > -20°C	14 days
PCBs	Soil/Sludge/ Sediment/Scale	1	G	None	Cool 4 °C	14 days

AG = amber glass
CVAA = cold vapor atomic absorption
EPA = U.S. Environmental Protection Agency
G = glass
GC = gas chromatography
IC = ion chromatography
ICP = inductively coupled plasma
P = plastic
PCB = polychlorinated biphenyl
SVOA = semivolatile organic analysis
VOA = volatile organic analysis

A-2.5.4 Sample Collection Requirements

Sample Location

Pipeline and soil sample locations are selected as described in Section 4.0 of the SAP. Minor adjustments to the specified locations may be made to mitigate unsafe conditions, avoid structural interferences, or bypass utilities. Changes in sample locations that do not affect the DQOs will require approval of Process Engineering and the task lead. Changes to sample locations that result in impacts to the DQOs will require concurrence by DOE and Ecology.

Surface geophysical and radiation surveys will be conducted at all sample locations. The surface geophysical surveys will be conducted using ground-penetrating radar and/or electromagnetic imaging and will aid in verifying the locations of buried pipelines and in selecting soil probe locations to avoid subsurface obstructions. The surface radiation surveys will identify areas of surface contamination that might affect health and safety of the workers.

Sample Identification

The sample and data-tracking database will be used to track the samples from the point of collection through the collection and 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 this project in accordance with onsite organizational procedures. 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.

Each sample container will be labeled with the following information using a waterproof marker on firmly affixed water-resistant labels:

- Sample identification number
- Sample collection date and time
- Name or initials of person collecting the sample
- Preservation method (if applicable).

A list of sample analyses is not required for sample labels because the list could be quite long. The laboratory will consult the PSAPs for appropriate analyses and additional guidance for preparing the sample for analysis.

Sample Custody

See Section 4.3 of the SAP.

Sample Containers and Preservatives

Level I EPA pre-cleaned sample containers will be used for soil samples collected for chemical and radiological analysis. Container sizes may vary depending on laboratory-specific volumes/requirements for meeting analytical detection limits. If, however, the dose rate on the outside of a sample jar or the curie content within the sample exceeds levels acceptable by an offsite laboratory, the sampling lead can send smaller volumes to the laboratory.

Sample Shipping

The radiological control technician will measure the contamination levels on the outside of each sample jar and the dose rates on each sample jar. The radiological control technician also will measure the radiological activity on the outside of the sample container (through the container) and will document the highest contact radiological reading in millirem per hour. This information, along with other data, will be used to select proper packaging, marking, labeling, and shipping paperwork in accordance with U.S. Department of Transportation regulations (49 CFR, "Transportation") and to verify that the sample can be received by the analytical laboratory in accordance with the laboratory's acceptance criteria.

A-2.6 INSTRUMENT/EQUIPMENT TESTING, INSPECTION, AND MAINTENANCE

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 per manufacturer or other applicable guidelines. Maintenance requirements (such as parts lists and documentation of routine maintenance) will be included in the individual laboratory and the onsite organization quality assurance plan or operating procedures (as appropriate). Calibration of laboratory instruments will be performed in a manner consistent with SW-846, *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods*, or with auditable U.S. Department of Energy Hanford Site-wide and contractual requirements.

Consumables, supplies, and reagents will be reviewed in accordance with SW-846 requirements and will be appropriate for their use. Note that contamination is monitored by the QC samples discussed in Section 6.1 of the SAP.

A-2.7 INSTRUMENT/EQUIPMENT CALIBRATION AND FREQUENCY

See Sections 7.2 and A-2.6.

A-2.8 INSPECTION/ACCEPTANCE OF SUPPLIES AND CONSUMABLES

See Section A-2.6.

A-2.9 NON-DIRECT MEASUREMENTS

See Section 4.1 for a discussion on use of NDA.

A-2.10 DATA MANAGEMENT

Data generated as a result of sampling and data analysis activities will follow requirements outlined in this QAPjP and shall be managed and stored in accordance with applicable programmatic requirements governing data management procedures. At the direction of the task lead, all analytical data packages shall be subject to final technical review by qualified personnel before the results are submitted to the regulatory agencies or before inclusion in reports. Electronic data access, when appropriate, shall be via a database (e.g., HEIS or a project-specific database). Where electronic data are not available, hard copies shall be provided in accordance with Section 9.6 of the *Hanford Federal Facility Agreement and Consent Order* (Ecology, EPA, and DOE. 1989).

Planning for sample collection and analysis shall be in accordance with the programmatic requirements governing laboratory sample collection activities. In the event that specific procedures do not exist for a particular work evolution, or if 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 teams' requirements include the activities associated with the following:

- Chain of custody/sample analysis requests
- Project and sample identification for sampling services
- Control of certificates of analysis
- Logbooks, checklists
- Sample packaging and shipping.

Approved work control packages and procedures will be used to document radiological measurements when implementing this SAP. Examples of the types of documentation for field radiological data include the following:

- Instructions regarding the minimum requirements for documenting radiological controls information as discussed in 10 CFR 835, "Occupational Radiation Protection"
- Instructions for managing the identification, creation, review, approval, storage, transfer, and retrieval of Hanford Site 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 survey/sample plans

- The requirements associated with preparing and transporting regulated material.

A-3.0 ASSESSMENT AND OVERSIGHT

A-3.1 ASSESSMENT AND RESPONSE ACTIONS

Project management and Quality Assurance may conduct random surveillance and assessments to verify compliance with the requirements outlined in this SAP, project work packages, the project quality management plan, procedures, and regulatory requirements. Deficiencies identified by these assessments shall be reported in accordance with existing programmatic requirements. Corrective actions will be implemented as required by the Tank Farms Contractor policy and procedures.

A-3.2 REPORTS TO MANAGEMENT

Management will be made aware of deficiencies identified by assessments and surveillances and subsequent corrective actions.

A-4.0 DATA VALIDATION AND USABILITY

A-4.1 DATA REVIEW, VERIFICATION, AND VALIDATION

Sample data will be reviewed against existing knowledge of the characteristics and/or composition of the type(s) of waste that was transferred through the pipes. See Section 4.1 for additional discussion of process knowledge. Verification activities include checking completeness of laboratory analytical data packages (e.g., complete laboratory QC documentation, all data results present, data narrative summary is complete, and all report pages are present). Validation shall be performed on completed data packages by a qualified independent contractor. Validation shall consist of verifying required deliverables, requested versus reported analyses, and transcription errors. Validation also shall include the evaluation and qualification of results based on holding time, method blanks, matrix spikes, laboratory control samples, laboratory duplicates, and chemical and tracer recoveries, as appropriate to the methods used. At least 5 percent of all data shall be validated. No validation will be performed for physical data, field measurements, or NDA results.

A-4.2 VERIFICATION AND VALIDATION METHOD

See above section (Section A-4.1).

A-4.3 RECONCILIATION WITH USER REQUIREMENTS

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. Data quality assessment will be performed according to guidelines in EPA/600/R-96/084, *Guidance for Data Quality Assessment, Practical Methods for Data Analysis*, EPA QA/G-9.

A-5.0 QUALITY ASSURANCE PROJECT PLAN REFERENCES

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10 CFR 835, "Occupational Radiation Protection, " Title 10, *Code of Federal Regulations*, Part 835, as amended.

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APPENDIX C

SAMPLING AND ANALYSIS PLAN FOR THE 241-CX-72 STORAGE TANK

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2

CONTENTS

C1.0 INTRODUCTION C1-1
C1.1 200-IS-1 OPERABLE UNIT AND WASTE-SITE LOCATION C1-1
C1.2 SITE DESCRIPTION AND HISTORY C1-1
C1.2.1 241-CX Tank System C1-1
C1.2.2 241-CX-72 Storage Tank C1-1

C2.0 QUALITY ASSURANCE PROJECT PLAN C2-1
C2.1 PROJECT MANAGEMENT C2-1
C2.1.1 Project/Task Organization C2-1
C2.1.2 Background and Problem Definition C2-4
C2.1.3 Project and Task Description C2-4
C2.1.4 Quality Objectives and Criteria for Measurement Data C2-4
C2.1.5 Quality Assurance Objective C2-7
C2.1.6 Special Training Requirements/Certification C2-16
C2.1.7 Documents and Records C2-16
C2.2 DATA GENERATION AND ACQUISITION C2-17
C2.2.1 Sample Process Design C2-17
C2.2.2 Sampling Methods C2-18
C2.2.3 Field Sample Handling and Custody C2-20
C2.2.4 Analytical Methods C2-24
C2.2.5 Quality Control C2-24
C2.2.6 Instrument and Equipment Testing, Inspection, and Maintenance C2-26
C2.2.7 Instrument and Equipment Calibration and Frequency C2-26
C2.2.8 Inspection and Acceptance of Supplies and Consumables C2-26
C2.2.9 Non-Direct Measurements C2-27
C2.2.10 Data Management C2-27
C2.3 ASSESSMENT AND OVERSIGHT C2-27
C2.3.1 Assessments and Response Action C2-27
C2.3.2 Reports to Management C2-28
C2.3.3 Changes in Workscope C2-28
C2.4 DATA VALIDATION AND USABILITY C2-28
C2.4.1 Data Review, Verification, and Validation C2-28
C2.4.2 Verification and Validation Methods C2-28
C2.4.3 Reconciliation With User Requirements C2-29

C3.0 FIELD-SAMPLING PLAN C3-1
C3.1 SAMPLING OBJECTIVES C3-1
C3.2 FIELD MEASUREMENTS C3-3
C3.2.1 Surface Radiation Surveys C3-3
C3.2.2 Screening C3-3
C3.2.3 Borehole Sampling and Analysis C3-4
C3.2.4 Pre-Shipment Sample Screening C3-4
C3.3 SURVEYING C3-4
C3.4 WASTE MANAGEMENT SAMPLING C3-4

C4.0 HEALTH AND SAFETY C4-1

C5.0 MANAGEMENT OF INVESTIGATION-DERIVED WASTE C5-1

C6.0 REFERENCES C6-1

FIGURES

Figure C-1. 241-CX Tank System Area Plan View C1-2

Figure C-2. Plot of Relative Axial Profile Neutron Flux and Dose Rate Measured in the 241-CX-72 Storage Tank. C1-3

Figure C-3. Photograph of Containment Building (Greenhouse) Placed Over the 241-CX-72 Storage Tank in 1990 (Photo Taken December 1999). C1-7

Figure C-4. Photograph of Plate Covering Access Caisson to Top of Tank. C1-8

Figure C-5. Schematic Diagram of 241-CX-72 Storage Tank Layout. C1-9

Figure C-6. Project Organization. C2-2

Figure C-7. Approximate Sampling Depths Within the 241-CX-72 Storage Tank. C3-2

TABLES

Table C-1. Summary Information for the 241-CX-72 Storage Tank C1-5

Table C-2. CX-241-72 Storage Tank (200-IS-1 Operable Unit) Contaminants of Potential Concern List. C2-5

Table C-3a. Analytical Performance Requirements for Radionuclides. C2-8

Table C-3b. Analytical Performance Requirements for Nonradionuclides. C2-9

Table C-4. Field-Screening Methods. C2-18

Table C-5. Summary of Projected Sample Collection Requirements C2-20

Table C-6. Sample Preservation, Container, and Holding Time Guidelines and Analytical Priorities. C2-22

Table C-7. 241-CX-72 Storage Tank Sampling Design. C3-1

TERMS

AEA	alpha energy analysis
AG	amber glass
ALARA	as low as reasonably achievable
ASTM	American Society for Testing and Materials
bgs	below ground surface
CAS	Chemical Abstracts Service
CERCLA	*Comprehensive Environmental Response, Compensation, and Liability Act of 1980*
CLARC	*Cleanup Levels and Risk Calculations under the Model Toxics Control Act Regulation* (CLARC Version 3.1) (Ecology 94-145)
CFR	*Code of Federal Regulations*
COPC	contaminant of potential concern
CVAA	cold vapor atomic absorption
DOE	U.S. Department of Energy
d/min	disintegrations per minute
DQO	data quality objective
EPA	U.S. Environmental Protection Agency
FS	feasibility study
GEA	gamma energy analysis
GPC	gas proportional counting
GW	groundwater
HEIS	*Hanford Environmental Information System* database
IC	ion chromatograph
ICP	inductively coupled plasma
ICP/MS	inductively coupled plasma/mass spectrometry
IDW	investigation-derived waste
N/A	not applicable
NaI	sodium iodide
NCEA	National Center for Environmental Assessment
ORP	DOE, Office of River Protection
OU	operable unit
ppm_v	parts per million volume
PUREX	Plutonium-Uranium Extraction (Plant or process)
QA	quality assurance
QAPjP	quality assurance project plan
QC	quality control
RCRA	*Resource Conservation and Recovery Act of 1976*
RESRAD	RESidual RADioactivity (dose model)
RfD	reference dose
RL	DOE, Richland Operations Office
SAP	sampling and analysis plan
STOMP	Subsurface Transport Over Multiple Phases (code)
TBD	to be determined
TSD	treatment, storage, and/or disposal (unit)

VOA	volatile organic analyte
WAC	*Washington Administrative Code*
WTPH-D	Washington State total petroleum hydrocarbons – diesel range
WTPH-G	Washington State total petroleum hydrocarbons – gasoline range

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

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APPENDIX C

SAMPLING AND ANALYSIS PLAN FOR THE 241-CX-72 STORAGE TANK

C1.0 INTRODUCTION

This Sampling and Analysis Plan (SAP) directs the activities to be performed to characterize the waste contents within the *Resource Conservation and Recovery Act of 1976* (RCRA) treatment, storage, and/or disposal (TSD) unit CX-241-72 Storage Tank in the 200-IS-1 Operable Unit (OU). Characterization of the CX-241-72 tank contents is not a Phase 1 sampling activity associated with the pipeline systems. This sampling is being performed to gather data needed for evaluation of RCRA tank closure options.

The sampling and analyses described in this document will provide data to characterize the waste contents within the 241-CX -72 Storage Tank. Characterization activities described in the SAP are based on implementing the data quality objective (DQO) process. Elements of this SAP were derived from the DQO processes undertaken for the CX-241 Tank System, and include content previously presented in DOE/RL-2002-14, Rev. 0, Appendix B, and DOE/RL-2002-14, Rev. 1, Draft A, Appendix B.

C1.1 200-IS-1 OPERABLE UNIT AND WASTE-SITE LOCATION

The 241-CX-72 Storage Tank is located within the Hanford Site in south-central Washington State, at the former Hot Semiworks Facility, east of B Plant in the 200 East Area. This waste site is located within the exclusive land-use boundary identified in DOE/EIS-0222-F, *Final Hanford Comprehensive Land-Use Plan Environmental Impact Statement.*

C1.2 SITE DESCRIPTION AND HISTORY

The following subsections briefly describe the 241-CX-72 Storage Tank included in this SAP.

C1.2.1 241-CX Tank System

The 241-CX Tank System consists of the following three tanks: 241-CX-70 Storage Tank, 241-CX-71 Neutralization Tank, and 241-CX-72 Storage Tank (Figure C-1). The tanks no longer receive waste. Prior process uses and the status of the 241-CX-72 Storage Tank are summarized in the following discussion.

C1.2.2 241-CX-72 Storage Tank

This tank was used for approximately 1 year in 1956 when 8,725 L (2,305 gal) of waste were transferred into the tank for storage. The 241-CX-72 Storage Tank also was used to study the

concentration of waste generated from the Hot Semiworks Facility pilot studies. Decontamination flushes from the Hot Semiworks Facility also might have been sent to the 241-CX-72 Storage Tank. Between December 1956 and May 1957, the waste in the tank was heated until enough liquid evaporated that it was nearly dry. From 1960 through 1967, the 241-CX-72 Storage Tank remained idle until it was taken out of service in 1967. In 1986, the 241-CX-72 Storage Tank was decommissioned and filled with approximately 7.3 m (24 ft) of grout over a 3.4 m (11-ft) heel consisting of non-liquid waste. Gamma spectroscopic, relative axial neutron flux profile, axial temperature profile, and axial dose rate profile measurements were taken from a periphery drywell to estimate remaining radionuclide content (Figure C-2). The 11-ft-thick sludge/waste heel at the bottom of the tank contains fission products and transuranium isotopes. The design capacity of the 241-CX-72 Storage Tank is 8,860 L (2,340 gal).

Figure C-1. 241-CX Tank System Area Plan View.

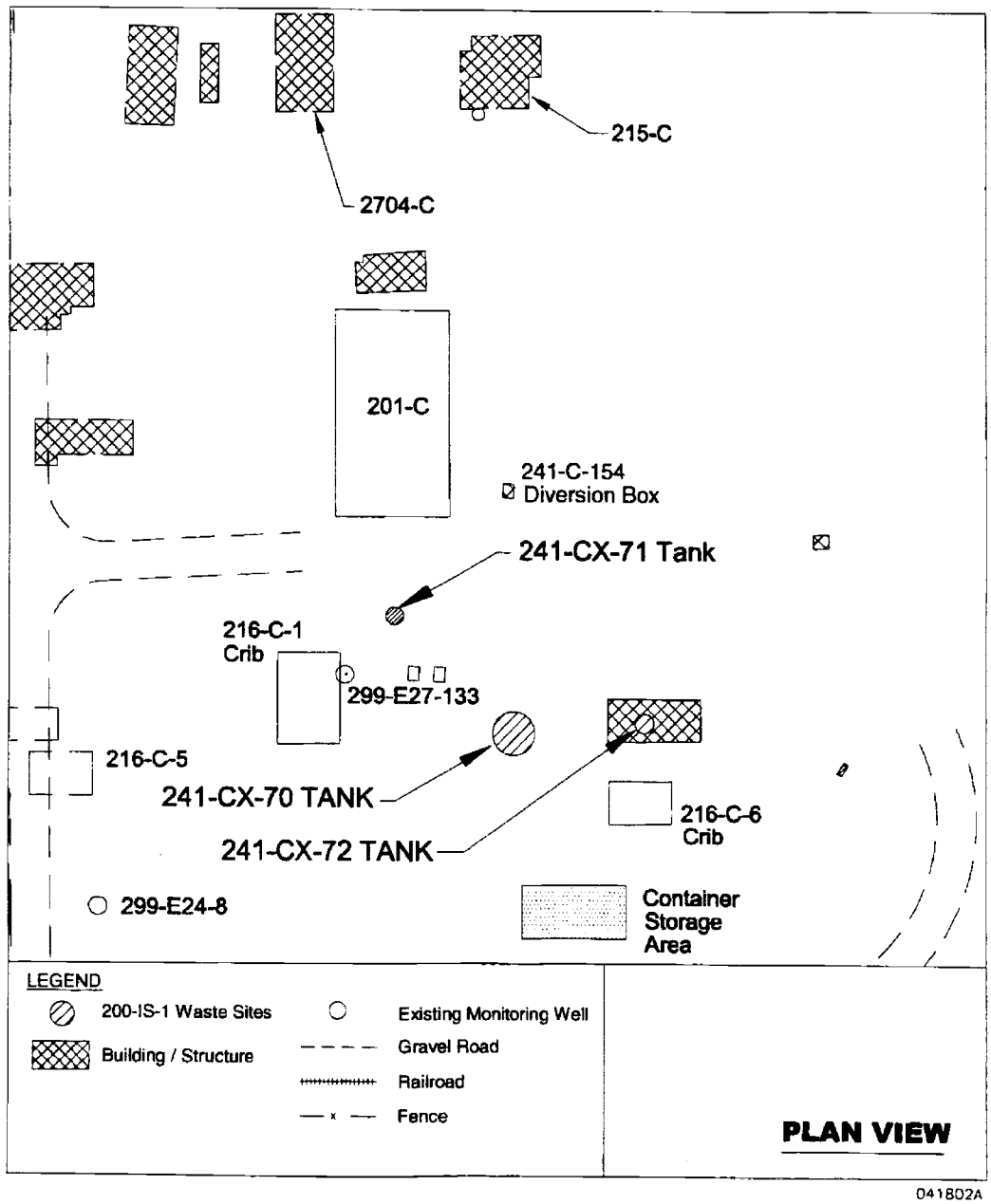
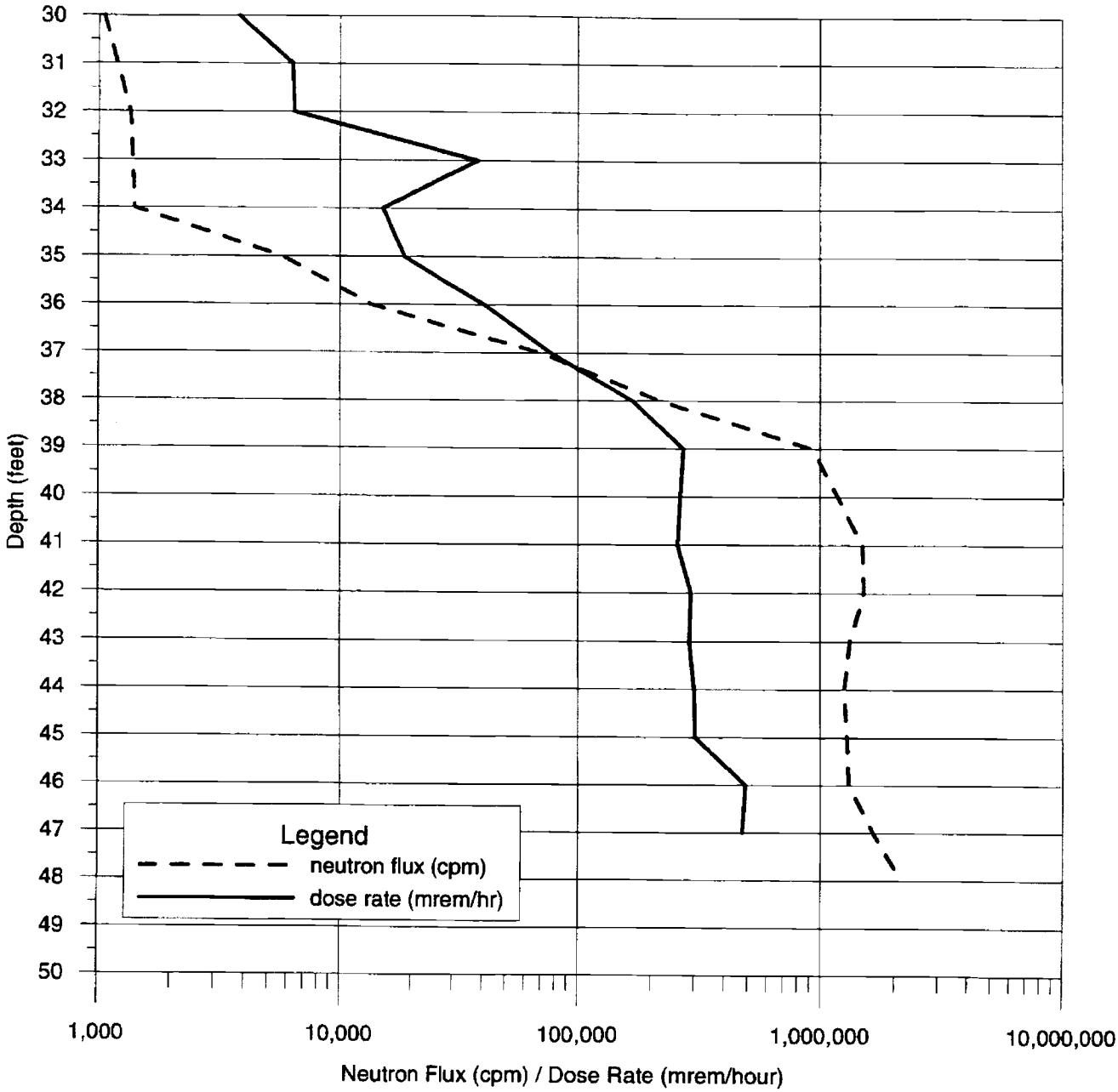


Figure C-2. Plot of Relative Axial Profile Neutron Flux and Dose Rate Measured in the 241-CX-72 Storage Tank.



NOTE: The flange at the top of the drywell was used as the reference point for the depths indicated in this plot. Bottom of the drywell was measured at 48 ft. Neutron flux measurements were taken in January and May 1989. Beta/gamma dose rate readings were taken subsequent to neutron measurements. Information source: WHC-SD-CP-TI-148, *Radiological Evaluation of Hot Semiworks Tank 241-CX-72*.

The tank is being managed under RCRA interim status and is identified in a Hanford RCRA Dangerous Waste Permit Application, Part A, Form 3. Based on a conservative designation, mixed waste could be present containing toxic constituents (D002, and D004 through D011), and state-only (WC02, WT01, and WT02). Information that has been compiled regarding the tank's prior and current inventory is presented in Table C-1.

A greenhouse (Figure C-3) and caisson were constructed over the tank in 1990 in support of a plan to remove the grout. The soil covering the upper portion of the tank and risers also was excavated in 1990, and a steel caisson was extended from grade level to the top of the tank. Because the tank contained an agitator assembly, mockup testing of grout removal activities was conducted from January to September 1992. The mockup testing was ultimately terminated due to problems encountered when drilling through the mockup of grout and embedded steel (WHC 1993, *Facility Decommissioning Report for Tank 241-CX-70*).

The top of the vessel is currently sealed with a plate that extends over and seals the caisson (Figure C-4). Five pipes extend from the tank to the above-grade level and two pipelines enter the tank underground. Pipe openings at the top of the tank include a 2-in. fill pipe, a 3-in. vapor pipe, a 4-in. dip tube nozzle, a 3-in. sealed test (dry) well, and two 8-in. access nozzles (HW-55963 RD, *The Self Concentration of High Level PUREX Wastes in The Hot Semiworks Waste Concentrator*). A manually operated agitator, extending above the tank, was used to manipulate five individual paddles. The bottom of the caisson is sealed with a 12-in.-thick reinforced grout plug that provides a base pad for the tank. The annulus between the tank and caisson remains empty. The caisson to access the risers and the top of the tank is covered with a protective lid located at floor-level in the greenhouse (BHI-01173, *Auditable Safety Analysis for Surveillance and Maintenance of the 241-CX Tank System*). An underground vault is located 9 ft to the north of the centerline of the tank (Figure C-5). The vault was used to support former waste concentration experiments and consisted of a mechanical pit, an instrument pit, and a sampler pit. Drawings H-2-71672, *Piping Plans 241CX Tanks 70 71 72*, and SK-2-56955, *Piping Plans 241-CX Tanks 70 71 72*, indicated that the waste streams entering the tank bypassed the vault. The vault was filled with grout in 1986 as part of the decommissioning activities (BHI-01173).

Table C-1. Summary Information for the 241-CX-72 Storage Tank. (2 Pages)

Tank Identification	Facility Served	Tank Volume and Type	Tank Construction	Function	Tank Inventory (Based on Process Knowledge)			Tank Inventory (Based on Samples or Radiological Logging)		Status
					Nonradiological Constituents	Radiological Constituents	Volume Handled	Nonradiological Constituents	Radiological Constituents	
241-CX-72	201-C Bldg, A and C cells	2,000- to 2,300-gal experimental underground concentration tank[1,2]	Tank is vertically oriented; 40-in. diameter by 35.8 ft high; 0.38-in.-thick stainless steel plating with five stiffening rings around perimeter, connected by three rows of vertical guides; resting on concrete pad inside 6-ft diameter carbon-steel caisson; cylindrical heater located just above each stiffening ring; top of tank sealed with plate that extends over and seals the caisson; bottom of caisson sealed with 12-in. thick reinforced-grout plug that provides base for tank. Top of tank is 14 ft bgs; bottom is ~50 ft bgs.[1,2]	Designed, constructed, and used for terminal storage of waste associated with pilot PUREX waste concentration studies performed in A and C cells; tank also may have been used for fluids from decontamination of Hot Semiworks Facility after separations projects; investigations of bumping phenomenon were conducted in the tank.[1,7,8,11,12,13]	Chemical residues in sludge/ aggregate; minor compared to radiological source term[3]	Upperbound estimate: 200 g Pu, 10,000 Ci Cs-137[5,8,9]	8,700 L (2,300 gal)[10]	Nondestructive assay (1989): fluorine compounds (see information in radiological constituents column)[8]	In-tank samples (1974): Pu (total) 1.13 E-8 g/gal, U (total) 2.43 E-3 g/gal, Sr-89/90 4.33 mCi/g, Cs-137 undetected;[4] (1988) 2,000 to 8,000 disintegrations per minute alpha, 2640 to 5810 pCi gamma, beta/gamma ratio of 25:1, estimated 9,000 to 10,000 Ci Cs-137.[4] 1989 nondestructive assay (gamma spectroscopic, relative axial neutron flux, neutron flux, axial temperature profile, and axial dose rate profile measurements) taken from periphery drywell (not direct samples): ~11-ft sediment layer consisting of fission products and transuranic isotopes at bottom of tank; suggested uniform distribution of activity in sludge layer, with likely higher concentration in bottom 2 to 3 ft of tank; activity layer is dry and does not contain hydrogenous materials to thermalize the neutrons generated within contents of the tank; axial temperature profile measurements of 60 °F to 72 °F indicated presence of heat-generating wastes; dose rates vary from 4 rem/h at 10 ft above sludge layer to 265 R/h at top of sludge layer, increasing to ~491 R/h at bottom of sludge layer; transuranic content likely is present in fluorides; plutonium content of sludge is between 150 and 200 g.[8]	Capped with grout; 650 gal of dried sludge in bottom[2,6]

Table C-1. Summary Information for the 241-CX-72 Storage Tank. (2 Pages)

Tank Identification	Facility Served	Tank Volume and Type	Tank Construction	Function	Tank Inventory (Based on Process Knowledge)			Tank Inventory (Based on Samples or Radiological Logging)		Status
					Nonradiological Constituents	Radiological Constituents	Volume Handled	Nonradiological Constituents	Radiological Constituents	

bgs = below ground surface.
PUREX = Plutonium-Uranium Extraction (Plant or process).

[1]BHI-01173, *Auditable Safety Analysis for Surveillance and Maintenance of the 241-CX Tank System.*
[2]BHI-01018, *Environmental Restoration Contractor Management Plan for Inactive Miscellaneous Underground Storage Tanks (IMUSTS).*
[3]DOE-RL-92-18, *Semiworks Plant Source Aggregate Area Management Study Report.*
[4]AR00227, "Disposition and Isolation of Tanks 270-E-1, 270-W, 241-CX-70, 241-CX-71, and 241-CX-72."
[5]WHC-SD-DD-SAD-001, *Safety Evaluation for Interim Waste Management Activities in Tank 241-CX-70, Tank 241-CX-71, and Tank 241-CX-72.*
[6]WHC-MR-0144, *Plan and Approach for Completion of Decommissioning of Strontium Semiworks Plant.*
[7]WHC-SD-DD-TI-040, *Tank 241-CX-72 Preliminary Waste Characterization.*
[8]WHC-SD-CP-TI-148, *Radiological Evaluation of Hot Semiworks Tank 241-CX-72.*
[9]WHC-SD-DD-TI-051, *An Estimation of the Radionuclide Content of Tank 241-CX-72.*
[10]HW-52860, *Standby Status Report for Hot Semi-Works Facility.*
[11]H-2-4093, *Hot Semi-Works Process Piping Plan A Cell.*
[12]H-2-4420, *Plot Plan Hot Semi-Works Waste Self-Concentrator.*
[13]H-2-4535, *Site Plan + Underground Piping Strontium Facilities.*

Figure C-3. Photograph of Containment Building (Greenhouse) Placed Over the 241-CX-72 Storage Tank in 1990 (Photo Taken December 1999).

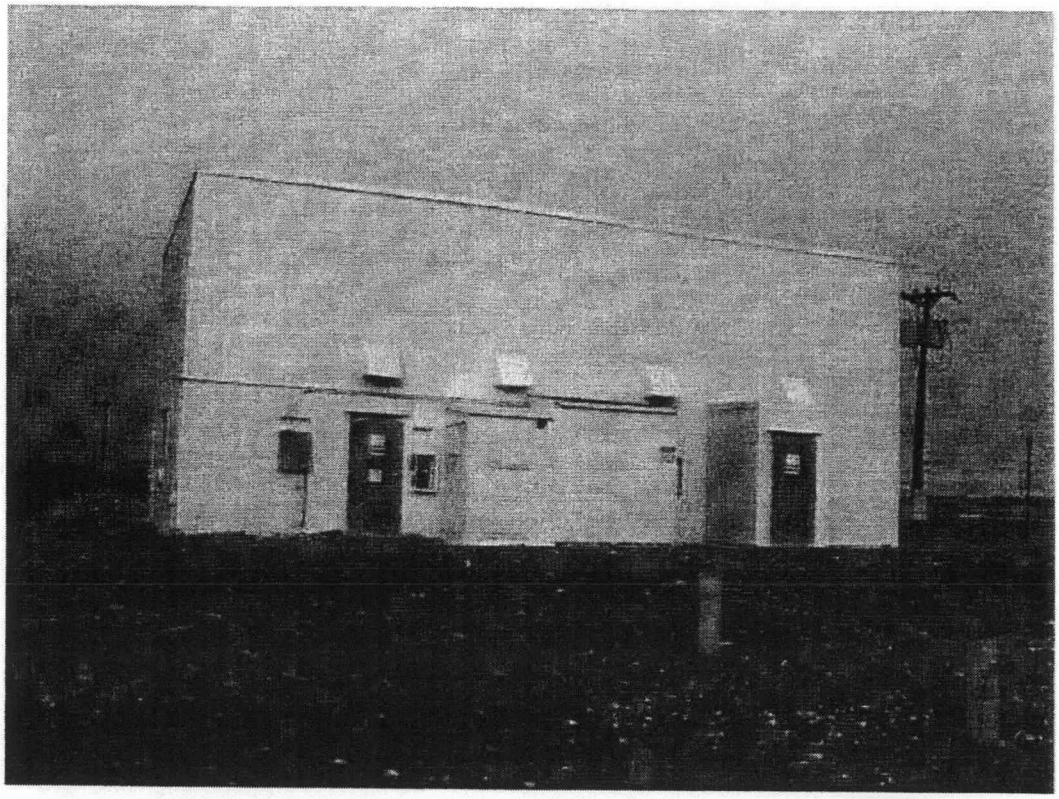
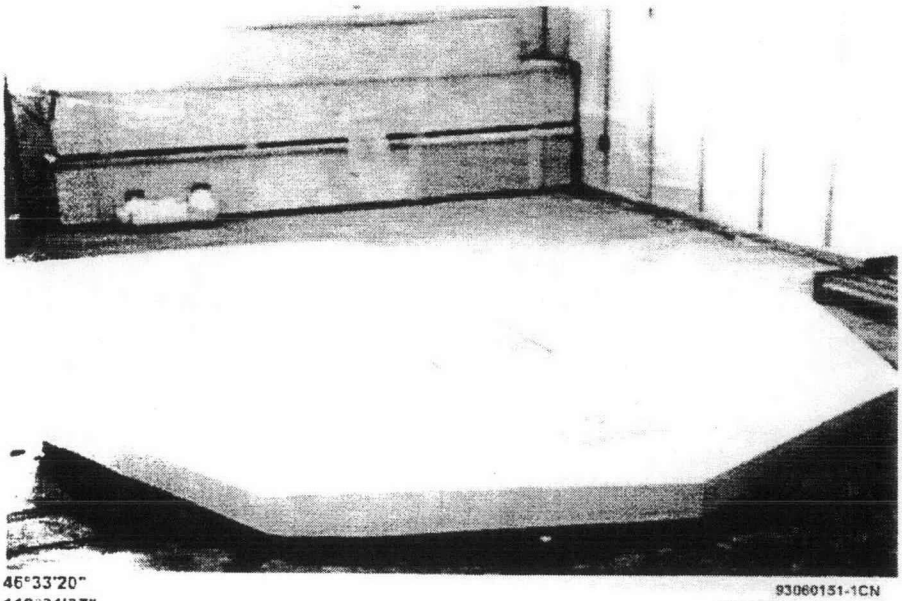


Figure C-4. Photograph of Plate Covering Access Caisson to Top of Tank.

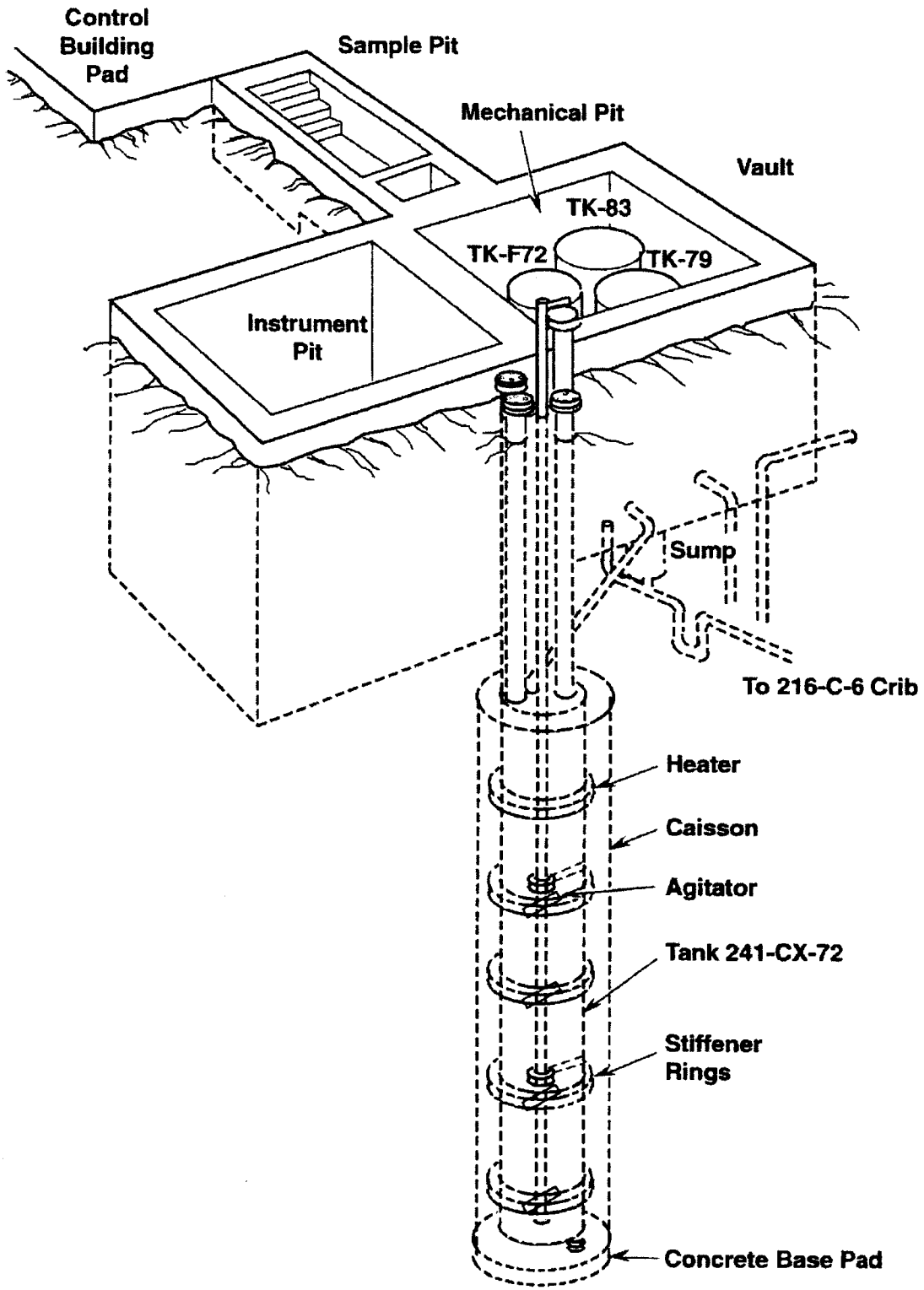
241-CX TANK SYSTEM
TANK 241-CX-72



46°33'20"
119°31'37"

93060151-1CN
(PHOTO TAKEN 1993)

Figure C-5. Schematic Diagram of 241-CX-72 Storage Tank Layout.



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C2.0 QUALITY ASSURANCE PROJECT PLAN

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

- U.S. Department of Energy (DOE) Directive CRD O 414.1C, *Quality Assurance*
- 10 CFR 830 Subpart A, "Quality Assurance Requirements"
- EPA/240/B-01/003, *EPA Requirements for Quality Assurance Project Plans*, EPA QA/R-5.

C2.1 PROJECT MANAGEMENT

This section addresses the basic areas of project management and ensures 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.

C2.1.1 Project/Task Organization

The project organization is described in the subsections that follow and is shown in Figure C-6.

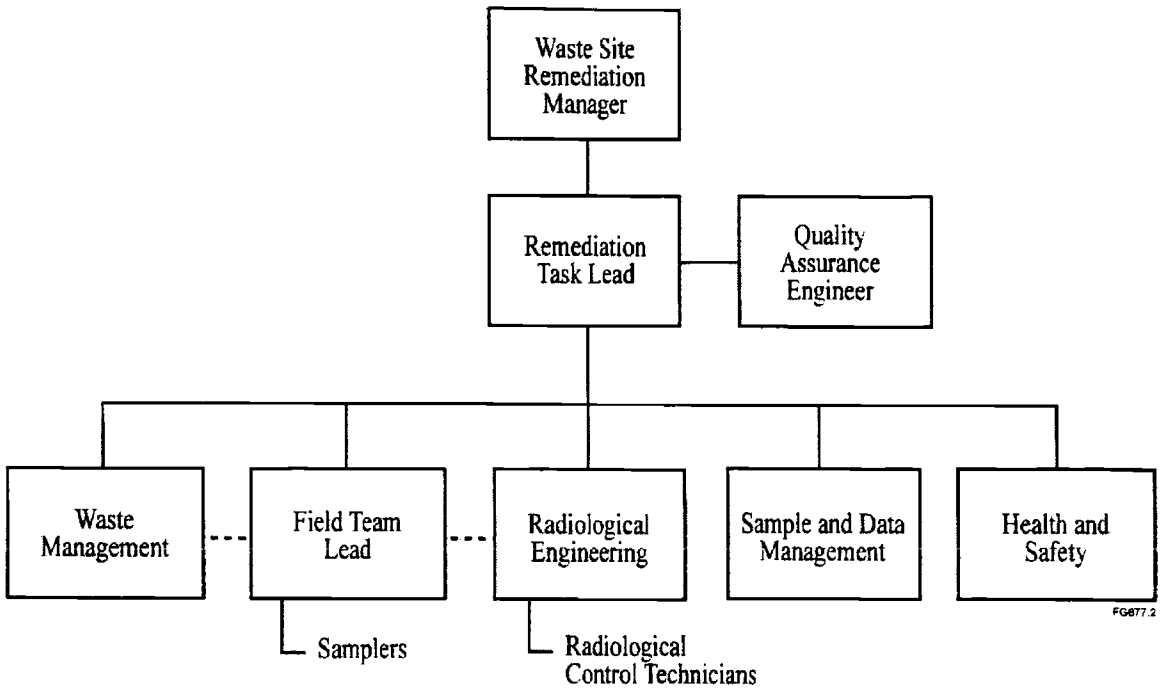
C2.1.1.1 Waste Site Remediation Manager

The Waste Site Remediation manager provides oversight for all activities and coordinates with DOE, Richland Operations Office (RL) and regulators in support of sampling activities. In addition, support is provided to the task lead to ensure that the work is performed safely and cost-effectively.

C2.1.1.2 Remediation Task Lead

The Remediation task lead is responsible for direct management of sampling documents and requirements, field activities, and subcontracted tasks. The task lead ensures that the field team lead, samplers, and others responsible for implementation of this SAP and the QAPjP are provided with current copies of this document and any revisions thereto. The task lead works closely with quality assurance, health and safety, and the field team lead to integrate these and the other lead disciplines in planning and implementing the workscope. The task lead also coordinates with, and reports to, RL, regulators, and the Project Hanford Management Contractor on all sampling activities.

Figure C-6. Project Organization.



C2.1.1.3 Quality Assurance Engineer

The Quality Assurance engineer is matrixed to the Remediation task lead and is responsible for quality assurance issues on the project. Responsibilities include oversight of implementation of the project quality assurance requirements; review of project documents, including SAPs (and the QAPjP); and participation in quality assurance assessments on sample collection and analysis activities, as appropriate.

C2.1.1.4 Waste Management

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 (e.g., with WAC 173-303, "Dangerous Waste Regulations") of the characterization data to generate waste designations, profiles, and other documents that confirm compliance with Environmental Restoration Disposal Facility waste acceptance criteria specified in BHI-00139, *Environmental Restoration Disposal Facility Waste Acceptance Criteria.*

C2.1.1.5 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 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 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, documentation of sampling activities in controlled logbooks, chain-of-custody documentation, and packaging and transportation of samples to the laboratory or shipping center.

The field team leads, samplers, and others responsible for implementation of this SAP and the QAPjP will be provided with current copies of this document and any revisions thereto.

C2.1.1.6 Radiological Engineering

The Radiological Engineering lead is responsible for the radiological engineering and health physics support within 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. Radiological Engineering interfaces with the project safety and health representative and plans and directs radiological control technician support for all activities.

C2.1.1.7 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 quality assurance requirements, or their equivalent, as approved by RL, the U.S. Environmental Protection Agency (EPA), and the Washington State Department of Ecology. The Sample and Data Management organization initiates audits of the laboratories periodically to ensure compliance. Sample and Data Management receives the analytical data from the laboratories, makes the data entry into the *Hanford Environmental Information System* (HEIS) database, and arranges for data validation. Validation will be performed on completed data packages (including quality control [QC] samples) by Fluor Hanford's Environmental Information Services group or by a qualified independent contractor.

C2.1.1.8 Health and Safety

Responsibilities include coordination of industrial safety and health support within the project as carried out through safety and health plans, job hazard analyses, and other pertinent safety documents required by Federal regulation or by internal Fluor Hanford work requirements. In addition, assistance is provided to project personnel in complying with applicable health and safety standards and requirements. Personnel protective clothing requirements are coordinated with Radiological Engineering.

C2.1.2 Background and Problem Definition

The 200-IS-1 OU consists of waste sites that stored or transferred liquid waste containing low to high concentrations of radionuclides and nonradiological constituents. The sites include RCRA TSD units and RCRA past-practice waste sites. Included in the 200-IS-1 Tanks/Lines/Pits/Boxes Waste Group OU is the 241-CX Tank System. Interim closure activities have been completed for these RCRA units.

For the 241-CX-72 Storage Tank, environmental measurements are necessary to support the remedial investigation/feasibility study process and remedial decisions. To meet RCRA closure requirements, the composition of the waste remaining in the tank needs to be determined.

C2.1.3 Project and Task Description

The field activities described in the SAP include use of borehole drilling and sampling and analysis for evaluation of the waste contents within the 241-CX-72 Storage Tank. A borehole will be drilled through about 25 ft of grout into an approximately 11-ft-thick sludge/waste heel occupying the bottom of the tank. Coring will be conducted to retrieve material from the designated sample intervals. Samples will be analyzed for radiological and nonradiological contaminants of potential concern (COPC). Sampling for analysis of investigative-derived waste (IDW) generated during drilling will be addressed through a waste designation DQO process before the field characterization activities begin.

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 survey data for the borehole location, the number and types of samples collected and associated HEIS numbers, inventory of IDW containers, geological logs, and field-screening results.

C2.1.4 Quality Objectives and Criteria for Measurement Data

EPA 600/R-96/055, *Guidance for the Data Quality Objectives Process*, EPA QA/G-4, was used to support the development of this SAP. The DQO process is a strategic planning approach that provides a systematic process for defining the criteria that a data collection design should satisfy. Using the DQO process ensures that the type, quantity, and quality of environmental data used in decision making will be appropriate for the intended application. This section summarizes the key outputs resulting from the implementation of the DQO process.

C2.1.4.1 Contaminants of Concern

The DQO process identifies the need to develop a list of COPCs for the 200-IS-1 OU waste sites. Development of the COPCs is an essential step toward refining the preliminary conceptual contaminant distribution models. From an investigation of historical sources including process documents, logbooks, original plant technical manuals, and interviews of plant operators, a preliminary list of potential contaminants was identified. Screening of this list was conducted during the DQO process to arrive at a final list of COPCs for the 200-IS-1 OU. As part of the

assessment and integration of DOE, Office of River Protection (ORP)-owned waste sites into the 200-IS-1 OU work plan, a follow-on DQO effort was conducted in the fall of 2004 and a more comprehensive list of COPCs was developed. Development of this list is summarized in Section 3.6 of DOE/RL-2002-14, Rev. 1, Draft A. The revised list of COPCs is identified in Table C-2. Because of limited documentation and uncertainties associated with some waste stream compositions, routing processes, and disposal actions, this comprehensive COPC list was developed for use at any 200-IS-1 OU waste site. Based on the supplemental DQO process conducted in the fall of 2004, use of this list for the 241-CX Tank System was determined to be appropriate.

Table C-2. CX-241-72 Storage Tank (200-IS-1 Operable Unit) Contaminants of Potential Concern List. (2 Pages)

CAS Number	Analyte Name	CAS Number	Analyte Name
Radionuclides			
14596-10-2	Americium-241	13981-16-3	Plutonium-238
14234-35-6	Antimony-125	15117-48-3	Plutonium-239
14762-75-5	Carbon-14	14119-33-6	Plutonium-240
13967-70-9	Cesium-134	13982-63-3	Radium-226
10045-97-3	Cesium-137	15262-20-1	Radium-228
10198-40-0	Cobalt-60	10098-97-2	Strontium-90
14683-23-9	Europium-152	14133-76-7	Technetium-99
15585-10-1	Europium-154	7440-29-1	Thorium-232
14391-16-3	Europium-155	13968-55-3	Uranium-233
10028-17-8	Hydrogen-3 (tritium)	13966-29-5	Uranium-234
15046-84-1	Iodine-129	15117-96-1	Uranium-235
13994-20-2	Neptunium-237	13982-70-2	Uranium-236
13981-37-8	Nickel-63	7440-61-1	Uranium-238
Inorganics			
7429-90-5	Aluminum	7439-96-5	Manganese
7664-41-7	Ammonia/ammonium	7439-97-6	Mercury (inorganic)
7440-36-0	Antimony	7439-98-7	Molybdenum
7440-38-2	Arsenic	7440-02-0	Nickel
22569-72-8	Arsenic (III)	14797-55-8	Nitrate
17428-41-0	Arsenic (V)	14797-65-0	Nitrite
7440-39-3	Barium	14265-44-2	Phosphate
7440-43-9	Cadmium	7782-49-2	Selenium
16887-00-6	Chloride	7440-22-4	Silver
7440-47-3	Chromium III	7440-24-6	Strontium
18540-29-9	Chromium (VI)	14808-79-8	Sulfate
7440-48-4	Cobalt	14265-45-3	Sulfite

Table C-2. CX-241-72 Storage Tank (200-IS-1 Operable Unit) Contaminants of Potential Concern List. (2 Pages)

CAS Number	Analyte Name	CAS Number	Analyte Name
7440-50-8	Copper	7440-28-0	Thallium
57-12-5	Cyanide	7440-31-5	Tin
16984-48-8	Fluoride	7440-61-1	Uranium
7553-56-2	Iodine	7440-62-2	Vanadium
7439-92-1	Lead	7440-66-6	Zinc
7439-93-2	Lithium		
Organics			
75-34-3	1,1-dichloroethane (DCA)	156-59-2	Cis-1,2-dichlorothylene
75-35-4	1,1-dichloroethene	53-70-3	Dibenz[a,h]anthracene
71-55-6	1,1,1-trichloroethane (TCA)	75-09-2	Dichloromethane (methylene chloride)
79-00-5	1,1,2-trichloroethane	100-41-4	Ethyl benzene
79-34-5	1,1,2,2-tetrachloroethane	193-39-5	Indeno[1,2,3-cd]pyrene
95-50-1	1,2-dichlorobenzene	108-10-1	Methyl isobutyl ketone (MIBK, hexone)
107-06-2	1,2-dichloroethane (DCA)	91-20-3	Naphthalene
541-73-1	1,3-dichlorobenzene	104-51-8	n-butyl benzene
121-14-2	2,4-dinitrotoluene	127-18-4	Tetrachloroethylene (PCE)
78-93-3	2-butanone (methyl ethyl ketone/MEK)	108-88-3	Toluene
591-78-6	2-hexanone	156-60-5	Trans-1,2-dichloroethene
71-43-2	Benzene	79-01-6	Trichloroethylene (TCE)
56-55-3	Benzo[a]anthracene	1330-20-7	Xylene
50-32-8	Benzo[a]pyrene	68334-30-5	Total petroleum hydrocarbons (TPH)
205-99-2	Benzo[b]fluoranthene	95-48-7	2-methylphenol (o-cresol)
207-08-9	Benzo[k]fluoranthene	106-44-5	4-methylphenol (p-cresol)
71-36-3	Butanol (n-butyl alcohol)	112-40-3	Normal paraffin hydrocarbons
56-23-5	Carbon tetrachloride	108-95-2	Phenol
108-90-7	Chlorobenzene	1336-36-3	Polychlorinated biphenyls (PCBs)
67-66-3	Chloroform	N/A	Gasoline range organics
218-01-9	Chrysene	68334-30-5	Diesel range organics

CAS = Chemical Abstracts Service. N/A = not applicable.

If additional analytes not identified as COPCs are detected by the analytical methods used for laboratory analysis, the additional detected analytes and their concentrations will be evaluated against regulatory standards, or risk-based screening levels if exposure data are available, and existing process knowledge. All detected analytes will be reported and included in support of remedial action decision making.

C2.1.4.2 Error Tolerance and Decision Consequences

A nonstatistical sampling design was identified as appropriate for this waste site. Using a nonstatistical sampling design, there is no need to define the tolerable limits on decision error because these only apply to statistical designs. Chapters 5.0 and 6.0 of the Work Plan summarize the activities that are planned after the characterization efforts described in this SAP are evaluated.

C2.1.4.3 Analytical Quality Objectives

Analytical quality objectives and criteria for laboratory measurement data are presented in Table C-3 for radiological and nonradiological analytes. Analyses of physical properties will be performed according to American Society for Testing and Materials procedures, if applicable.

In the event of a laboratory analytical failure, the laboratory is required to initiate corrective actions with the Sample Data Management team of the Environmental Information Systems group. As part of the data package transmittal procedure, a sample disposition record is generated to define the problem and to indicate the agreed-upon solution reached with discussions by the project manager or task lead. As part of the sample disposition process, quarterly trend reports containing quality statistics are compiled based on the sample disposition records. This provides an insight into emerging problems and the effectiveness of past responses to problems.

C2.1.4.4 Laboratory Sample Custody

Sample custody during laboratory analysis will be addressed in the applicable laboratory standard operating procedures. Laboratory custody procedures will ensure the maintenance of sample integrity and identification throughout the analytical process.

C2.1.5 Quality Assurance Objective

The quality assurance objective of this plan is to develop implementation guidance that will provide data of known and appropriate quality and adhere to the approved Fluor Hanford QAPjP. Data quality is assessed by representativeness, comparability, accuracy, precision, and completeness. The applicable QC guidelines, quantitative target limits, and levels of effort for assessing data quality are dictated by the intended use of the data and the nature of the analytical method. Each of these is addressed in the following subsections.

Table C-3a. Analytical Performance Requirements for Radionuclides.

COPCs	CAS #	Preliminary Action Levels Used to Determine Analytical Requirements[a]			Name/Analytical Technology[c]	Target Quantitation Limits[d]		Precision Water	Accuracy Water	Precision Soil/Solids	Accuracy Soil/Solids
		15 mrem/yr[b] (pCi/g)	100 mrem/yr[b] (pCi/g)	GW Protection[b] (pCi/g)		Water Activity (pCi/L)	Soil/ Solids Activity (pCi/g)				
Radionuclides											
Americium-241	14596-10-2	335	2,240	N/A	Americium isotopic – AEA	1	1	±20%(e)	80-120%(e)	±35%(e)	65-135%(e)
Antimony-125	14234-35-6	32.4	216	N/A	GEA	50	0.1	±20%(e)	80-120%(e)	±35%(e)	65-135%(e)
Carbon-14	14762-75-5	33,100	221,000	N/A	Chem. separation – liquid scintillation	15	15	±20%(e)	80-120%(e)	±35%(e)	65-135%(e)
Cesium-134	13967-70-9	8.43	56.2	N/A	GEA	15	0.1	±20%(e)	80-120%(e)	±35%(e)	65-135%(e)
Cesium-137	10045-97-3	23.4	156	N/A	GEA	15	0.1	±20%(e)	80-120%(e)	±35%(e)	65-135%(e)
Cobalt-60	10198-40-0	4.90	32.7	N/A	GEA	25	0.05	±20%(e)	80-120%(e)	±35%(e)	65-135%(e)
Europium-152	14683-23-9	11.4	75.7	N/A	GEA	50	0.1	±20%(e)	80-120%(e)	±35%(e)	65-135%(e)
Europium-154	15585-10-1	10.3	68.9	N/A	GEA	50	0.1	±20%(e)	80-120%(e)	±35%(e)	65-135%(e)
Europium-155	14391-16-3	426	2,840	N/A	GEA	50	0.1	±20%(e)	80-120%(e)	±35%(e)	65-135%(e)
Iodine-129	15046-84-1	3,081	20,500	0.024	Chem. separation – low-energy photon spectroscopy	5	2	±20%(e)	80-120%(e)	±35%(e)	65-135%(e)
Neptunium-237	13994-20-2	59.2	395	N/A	Neptunium-237 isotopic – AEA	1	1	±20%(e)	80-120%(e)	±35%(e)	65-135%(e)
Nickel-63	13981-37-8	4,026	20,500,000	N/A	Chem. separation – liquid scintillation	15	15	±20%(e)	80-120%(e)	±35%(e)	65-135%(e)
Plutonium-238	13981-16-3	470	3,130	N/A	Plutonium isotopic – AEA	1	1	±20%(e)	80-120%(e)	±35%(e)	65-135%(e)
Plutonium-239/240	Pu-239/240	425	2,840	N/A	Plutonium isotopic – AEA	1	1	±20%(e)	80-120%(e)	±35%(e)	65-135%(e)
Radium-226	13982-63-3	7.03	46.9	N/A	Chem. separation – liquid GEA – solid	1	0.1	±20%(e)	80-120%(e)	±35%(e)	65-135%(e)
Radium-228	15262-20-1	8.15	54.3	N/A	Chem. separation – liquid GEA – solid	3	0.2	±20%(e)	80-120%(e)	±35%(e)	65-135%(e)
Strontium-90	Rad-Sr	2,410	16,100	N/A	Chem. separation – GPC	2	1	±20%(e)	80-120%(e)	±35%(e)	65-135%(e)
Technetium-99	14133-76-7	412,000	2,740,000	171	Chem. separation – liquid scintillation	15	15	±20%(e)	80-120%(e)	±35%(e)	65-135%(e)
Thorium-232	7440-29-1	4.8	32	N/A	Thorium isotopic – AEA/ICP/MS	1	1	±20%(e)	80-120%(e)	±35%(e)	65-135%(e)
Tritium (H-3)	10028-17-8	66,900	446,000	4,100	Chem. separation – liquid scintillation	400	400	±20%(e)	80-120%(e)	±35%(e)	65-135%(e)
Uranium-233/234	13966-29-5	2,660	3,280	39.5	Uranium isotopic – AEA/ICP/MS	1	1	±20%(e)	80-120%(e)	±35%(e)	65-135%(e)
Uranium-235/236	15117-96-1	101	67.4	3.92	Uranium isotopic – AEA/ICP/MS	1	1	±20%(e)	80-120%(e)	±35%(e)	65-135%(e)
Uranium-238	U-238	504	3,360	38.1	Uranium isotopic – AEA/ICP/MS	1	1	±20%(e)	80-120%(e)	±35%(e)	65-135%(e)

Footnotes, acronyms, and references are cited at the end of Table C-3b.

Table C-3b. Analytical Performance Requirements for Nonradionuclides. (6 Pages)

COPCs	CAS #	Preliminary Action Level[a]			Name/Analytical Technology[c]	Required Target Quantitation Limits[d]		Precision Water	Accuracy Water	Precision Soil	Accuracy Soil
		WAC 173-340-745 Method C[d] (mg/kg)	GW Protection[e] (mg/kg)	Terrestrial Biota Protection[h] (mg/kg)		Water Conc. (mg/L)	Soil Conc. (mg/kg)				
Metals											
Aluminum	7429-90-5	11,800 (i)	45	N/A	EPA Method 6010	0.05	5	±20%(j)	80-120%(j)	±35%(j)	65-135%(j)
Antimony	7440-36-0	1,400	5.4	(k)	EPA Method 6010/200.8	0.06	0.6	±20%(j)	80-120%(j)	±35%(j)	65-135%(j)
Arsenic	7440-38-2	87.5	6.5 (l)	6.5 (l)	EPA Method 6010/200.8	0.1	10	±20%(j)	80-120%(j)	±35%(j)	65-135%(j)
Barium	7440-39-3	245,000	923	1,320	EPA Method 6010/200.8	0.05	2	±20%(j)	80-120%(j)	±35%(j)	65-135%(j)
Cadmium	7440-43-9	139 (m)	0.81 (n)	36	EPA Method 6010/200.8 (trace)	0.002	0.2	±20%(j)	80-120%(j)	±35%(j)	65-135%(j)
Chromium (total)	7440-47-3	N/A	2,000	135	EPA Method 6010/200.8 (trace)	0.002	0.2	±20%(j)	80-120%(j)	±35%(j)	65-135%(j)
Chromium VI	18540-29-9	2.1 (m)	0.2 (o)	N/A	EPA Method 7196 – colorimetric	0.01	0.5	±20%(j)	80-120%(j)	±35%(j)	65-135%(j)
Cobalt	7440-48-4	70,000 (p)	290 (p)	(k)	EPA Method 6010/200.8	0.02	2	±20%(j)	80-120%(j)	±35%(j)	65-135%(j)
Copper	7440-50-8	130,000	22 (n)	550	EPA Method 6010/200.8	0.025	2.5	±20%(j)	80-120%(j)	±35%(j)	65-135%(j)
Lead	7439-92-1	1,000 (q)	270 (o)	220	EPA Method 6010/200.8	0.1	10	±20%(j)	80-120%(j)	±35%(j)	65-135%(j)
					EPA Method 6010/200.8 (trace)	0.01	1	±20%(j)	80-120%(j)	±35%(j)	65-135%(j)
Lithium	7439-93-2	70,000 (r)	1,930 (r)	N/A	EPA Method 6010	0.025	2.5	±20%(j)	80-120%(j)	±35%(j)	65-135%(j)
Manganese	7439-96-5	490,000	65.3	23,500	EPA Method 6010/200.8	0.005	0.5	±20%(j)	80-120%(j)	±35%(j)	65-135%(j)
Mercury	7439-97-6	1,050	0.33 (n)	9	EPA Method 7470/200.8	0.0005	N/A	±20%(j)	80-120%(j)	±35%(j)	65-135%(j)
					EPA Method 7471/200.8	N/A	0.2	±20%(j)	80-120%(j)	±35%(j)	65-135%(j)
Molybdenum	7439-98-7	17,500	32.3	71	EPA Method 6010/200.8	0.02	2	±20%(j)	80-120%(j)	±35%(j)	65-135%(j)
Nickel	7440-02-0	70,000 (s)	130	1,850	EPA Method 6010/200.8	0.04	4	±20%(j)	80-120%(j)	±35%(j)	65-135%(j)
Selenium	7782-49-2	17,500	5.2	0.8	EPA Method 6010/200.8	0.1	1	±20%(j)	80-120%(j)	±35%(j)	65-135%(j)
Silver	7440-22-4	17,500	0.88 (t)	(k)	EPA Method 6010/200.8 (trace)	0.005	0.5	±20%(j)	80-120%(j)	±35%(j)	65-135%(j)
Strontium	7440-24-6	2,100,000	2,920	N/A	EPA Method 6010/200.8	0.01	1	±20%(j)	80-120%(j)	±35%(j)	65-135%(j)
Thallium	7440-28-0	245	1.59	N/A	EPA Method 6010/200.8	0.05	0.5	±20%(j)	80-120%(j)	±35%(j)	65-135%(j)
Tin	7440-31-5	2,100,000	25,000	(k)	EPA Method 6010/200.8	0.1	10	±20%(j)	80-120%(j)	±35%(j)	65-135%(j)
Uranium (total)	7440-61-1	1,050	1.32	N/A	Uranium total – kinetic phosphorescence analysis/EPA Method 200.8	0.0001	0.001	±20%(j)	80-120%(j)	±35%(j)	65-135%(j)
Vanadium	7440-62-2	24,500	2,240	(k)	EPA Method 6010/200.8	0.025	2.5	±20%(j)	80-120%(j)	±35%(j)	65-135%(j)
Zinc	7440-66-6	1,050,000	5,970	570	EPA Method 6010/200.8	1.01	1	±20%(j)	80-120%(j)	±35%(j)	65-135%(j)

Table C-3b. Analytical Performance Requirements for Nonradionuclides. (6 Pages)

COPCs	CAS #	Preliminary Action Level[a]			Name/Analytical Technology[c]	Required Target Quantitation Limits[d]		Precision Water	Accuracy Water	Precision Soil	Accuracy Soil
		WAC 173-340-745 Method C[f] (mg/kg)	GW Protection[g] (mg/kg)	Terrestrial Biota Protection[h] (mg/kg)		Water Conc. (mg/L)	Soil Conc. (mg/kg)				
Inorganics											
Ammonia/ ammonium	7664-41-7	N/A	N/A	N/A	EPA Method 350/300.7	0.05	0.5	±20%(j)	80-120%(j)	±35%(j)	65-135%(j)
Chloride	16887-00-6	N/A	1,000	N/A	EPA Method 300.0	0.5	5	±20%(j)	80-120%(j)	±35%(j)	65-135%(j)
Cyanide	57-12-5	70,000	0.80	N/A	Total cyanide – EPA Method 9010 – colorimetric	0.005	0.5	±20%(j)	80-120%(j)	±35%(j)	65-135%(j)
Fluoride	16984-48-8	210,000	24.1	N/A	EPA Method 300.0	0.5	5	±20%(j)	80-120%(j)	±35%(j)	65-135%(j)
Iodine	7553-56-2	N/A	N/A	N/A	EPA Method 345.1	2	20	±20%(j)	80-120%(j)	±35%(j)	65-135%(j)
Nitrate	14797-55-8	5,600,000	40	N/A	EPA Method 300.0	0.25	2.5	±20%(j)	80-120%(j)	±35%(j)	65-135%(j)
Nitrite	14797-65-0	350,000	4	N/A	EPA Method 300.0	0.25	2.5	±20%(j)	80-120%(j)	±35%(j)	65-135%(j)
Phosphate	14265-44-2	N/A	N/A	N/A	EPA Method 300.0	0.5	5	±20%(j)	80-120%(j)	±35%(j)	65-135%(j)
Sulfate	14808-79-8	N/A	1,030	N/A	EPA Method 300.0	0.5	5	±20%(j)	80-120%(j)	±35%(j)	65-135%(j)
Sulfite	14265-45-3	N/A	N/A	N/A	EPA Method 377.1	2	20	±20%(j)	80-120%(j)	±35%(j)	65-135%(j)
Organics											
1,1-dichloroethylene	75-35-4	219	0.0005	N/A	EPA Method 8260/5035A	0.005	0.005	±20%(u)	50-150%(u)	±35%(u)	50-150%(u)
1,1,2-trichloroethane	79-00-5	2,300	0.00427	N/A	EPA Method 8260/5035A	0.005	0.005	±20%(u)	50-150%(u)	±35%(u)	50-150%(u)
1,1,2,2-tetrachloroethane	79-34-5	656	0.00123	N/A	EPA Method 8260/5035A	0.005	0.005	±20%(u)	50-150%(u)	±35%(u)	50-150%(u)
1,2-dichlorobenzene	95-50-1	315,000	7.03	N/A	EPA Method 8270	0.01	0.330	±20%(u)	50-150%(u)	±35%(u)	50-150%(u)
1,3-dichlorobenzene	541-73-1	105,000) (v)	3.09 (v)	N/A	EPA Method 8270	0.01	0.330	±20%(u)	50-150%(u)	±35%(u)	50-150%(u)
2,4-dinitrotoluene	121-14-2	7,000	0.189	N/A	EPA Method 8270	0.01	0.330	±20%(u)	50-150%(u)	±35%(u)	50-150%(u)
2-hexanone	591-78-6	140,000 (w)	2.73 (w)	N/A	EPA Method 8260/5035A	0.01	0.01	±20%(u)	50-150%(u)	±35%(u)	50-150%(u)
Benzene	71-43-2	2,390	0.00448	N/A	EPA Method 8260/5035A	0.005	0.0015	±20%(u)	50-150%(u)	±35%(u)	50-150%(u)
Benzo[a]anthracene	56-55-3	180 (p)	0.856 (p)	N/A	EPA Method 8270	0.01	0.330	±20%(u)	50-150%(u)	±35%(u)	50-150%(u)
Benzo[a]pyrene	50-32-8	18 (x)	0.232 (x)	300	EPA Method 8270	0.01	0.330	±20%(u)	50-150%(u)	±35%(u)	50-150%(u)
Benzo[b]fluoranthene	205-99-0	180 (p)	2.95 (p)	N/A	EPA Method 8270	0.01	0.330	±20%(u)	50-150%(u)	±35%(u)	50-150%(u)
Benzo[k]fluoranthene	207-08-9	1,800 (p)	29.5 (p)	N/A	EPA Method 8270	0.01	0.330	±20%(u)	50-150%(u)	±35%(u)	50-150%(u)
n-butyl alcohol	71-36-3	350,000	6.62	N/A	EPA Method 8015	5	5	±20%(u)	50-150%(u)	±35%(u)	50-150%(u)
Carbon tetrachloride	56-23-5	1,010	0.0031	N/A	EPA Method 8260/5035A	0.005	0.0015	±20%(u)	50-150%(u)	±35%(u)	50-150%(u)
Chlorobenzene	108-90-7	70,000	0.874	N/A	EPA Method 8260/5035A	0.005	0.005	±20%(u)	50-150%(u)	±35%(u)	50-150%(u)

Table C-3b. Analytical Performance Requirements for Nonradionuclides. (6 Pages)

COPCs	CAS #	Preliminary Action Level[a]			Name/Analytical Technology[c]	Required Target Quantitation Limits[d]		Precision Water	Accuracy Water	Precision Soil	Accuracy Soil
		WAC 173-340-745 Method C[e] (mg/kg)	GW Protection[g] (mg/kg)	Terrestrial Biota Protection[h] (mg/kg)		Water Conc. (mg/L)	Soil Conc. (mg/kg)				
Chloroform	67-66-3	21,500	0.0381	N/A	EPA Method 8260/5035A	0.005	0.005	±20%(u)	50-150%(u)	±35%(u)	50-150%(u)
Chrysene	218-01-9	18,000 (p)	95.6 (p)	N/A	EPA Method 8270	0.01	0.330	±20%(u)	50-150%(u)	±35%(u)	50-150%(u)
Butyl benzene; n	104-51-8	240 (y)	110 (y)	N/A	EPA Method 8260/5035A	0.005	0.005	±20%(u)	50-150%(u)	±35%(u)	50-150%(u)
Dibenz[a,h]anthracene	53-70-3	18	0.429	N/A	EPA Method 8270	0.01	0.330	±20%(u)	50-150%(u)	±35%(u)	50-150%(u)
Dichloroethane; 1,1	75-34-3	350,000	4.37	N/A	EPA Method 8260/5035A	0.01	0.01	±20%(u)	50-150%(u)	±35%(u)	50-150%(u)
Dichloroethane; 1,2	107-06-2	1,440	0.00232	N/A	EPA Method 8260/5035A	0.005	0.0015	±20%(u)	50-150%(u)	±35%(u)	50-150%(u)
Dichloroethylene; 1,2- (trans)	156-60-5	31,500 (z)	0.36 (t)	N/A	EPA Method 8260/5035A	0.001	0.001	±20%(u)	50-150%(u)	±35%(u)	50-150%(u)
Dichloroethylene; 1,2-cis-	156-59-2	31,500 (z)	0.36 (t)	N/A	EPA Method 8260/5035A	0.001	0.001	±20%(u)	50-150%(u)	±35%(u)	50-150%(u)
Ethylbenzene	100-41-4	350,000	6.05	N/A	EPA Method 8260/5035A	0.005	0.005	±20%(u)	50-150%(u)	±35%(u)	50-150%(u)
Indeno[1,2,3-cd]pyrene	193-39-5	180 (p)	8.33 (p)	N/A	EPA Method 8270	0.01	0.330	±20%(u)	50-150%(u)	±35%(u)	50-150%(u)
Methyl ethyl ketone (MEK; 2-butanone)	78-93-3	2,100,000	19.6	N/A	EPA Method 8260/5035A	0.01	0.01	±20%(u)	50-150%(u)	±35%(u)	50-150%(u)
Naphthalene	91-20-3	14,000 (aa)	2.03 (aa)	N/A	EPA Method 8270	0.01	0.330	±20%(u)	50-150%(u)	±35%(u)	50-150%(u)
Methyl isobutyl ketone (MIBK hexone)	108-10-1	280,000	2.71	N/A	EPA Method 8260/5035A	0.01	0.01	±20%(u)	50-150%(u)	±35%(u)	50-150%(u)
Methylene chloride (dichloromethane)	75-09-2	17,500	0.0218	N/A	EPA Method 8260/5035A	0.005	0.005	±20%(u)	50-150%(u)	±35%(u)	50-150%(u)
Polychlorinated biphenyls	1336-36-3	10 (q)	0.0021 (bb)	2	EPA Method 8082	0.0005	0.0165	±20%(u)	50-150%(u)	±35%(u)	50-150%(u)
Tetrachloroethylene	127-18-4	243	0.00086	N/A	EPA Method 8260/5035A	0.005	0.005	±20%(u)	50-150%(u)	±35%(u)	50-150%(u)
Toluene	108-88-3	28,000	4.65	N/A	EPA Method 8260/5035A	0.005	0.005	±20%(u)	50-150%(u)	±35%(u)	50-150%(u)
Trichlorethane; 1,1,1	71-55-6	3,150,000	1.58	N/A	EPA Method 8260/5035A	0.005	0.005	±20%(u)	50-150%(u)	±35%(u)	50-150%(u)
Trichloroethylene	79-01-6	328	0.00072	N/A	EPA Method 8260/5035A	0.005	0.005	±20%(u)	50-150%(u)	±35%(u)	50-150%(u)
Xylene (total)	1330-20-7	700,000	14.6	N/A	EPA Method 8260/5035A	0.005	0.005	±20%(u)	50-150%(u)	±35%(u)	50-150%(u)
Total petroleum hydrocarbons – diesel to oil range (kerosene)	68334-30-5	2,000 (q)	2,000 (q)	15,000	WTPH-D/Analytical Methods for Petroleum Hydrocarbons (Ecology 97-602)	0.5	5	±20%(u)	50-150%(u)	±35%(u)	50-150%(u)
Oil and Grease	8008-20-6	2,000	2,000	N/A	EPA 413.N	2	200	±20%(u)	50-150%(u)	±35%(u)	50-150%(u)
2-methylphenol (o-cresol)	95-48-7	175,000	10.3	N/A	EPA Method 8270	0.01	0.330	±20%(u)	50-150%(u)	±35%(u)	50-150%(u)

Table C-3b. Analytical Performance Requirements for Nonradionuclides. (6 Pages)

COPCs	CAS #	Preliminary Action Level[a]			Name/Analytical Technology[c]	Required Target Quantitation Limits[d]		Precision Water	Accuracy Water	Precision Soil	Accuracy Soil
		WAC 173-340-745 Method C[f] (mg/kg)	GW Protection[g] (mg/kg)	Terrestrial Biota Protection[h] (mg/kg)		Water Conc. (mg/L)	Soil Conc. (mg/kg)				
4-methylphenol (p-cresol)	106-44-5	17,500	1.01	N/A	EPA Method 8270	0.01	0.330	±20%(u)	50-150%(u)	±35%(u)	50-150%(u)
Total petroleum hydrocarbons – (gasoline range)	8006-61-9	30 (q)	30 (q)	12,000	WTPH-G/Analytical Methods for Petroleum Hydrocarbons (Ecology 97-602)	0.5	5	±20%(u)	50-150%(u)	±35%(u)	50-150%(u)
Normal paraffin hydrocarbons (n-dodecane)	112-40-3	2,000 (q)	2,000 (q)	15,000	Nonhalogenated VOA - EPA Method 8015M – gas chromatography modified for hydrocarbons	0.5	5	±20%(u)	50-150%(u)	±35%(u)	50-150%(u)
Phenol	108-95-2	1,050,000	22	N/A	EPA Method 8270	0.01	0.330	±20%(u)	50-150%(u)	±35%(u)	50-150%(u)
Physical Properties											
Alkalinity	N/A	N/A	N/A	N/A	EPA Method 310	N/A	TBD	N/A	N/A	±35%(j)	65-135%(j)
Gross alpha	14127-62-9	N/A	N/A	N/A	GPC	N/A	TBD	N/A	N/A	N/A	N/A
Gross beta	12587-47-2	N/A	N/A	N/A	GPC	N/A	TBD	N/A	N/A	N/A	N/A
Gross gamma	N/A	N/A	N/A	N/A	NaI or germanium detectors in scan mode	N/A	TBD	N/A	N/A	N/A	N/A
Moisture content	N/A	N/A	N/A	N/A	ASTM D2216	N/A	wt%	N/A	N/A	N/A	N/A
pH	N/A	N/A	N/A	N/A	EPA Method 150/9045	0.1 unit	0.1 unit	N/A	N/A	N/A	N/A
Bulk Density	N/A	N/A	N/A	N/A	ASTM D2937	N/A	wt%	N/A	N/A	N/A	N/A
Particle size distribution	N/A	N/A	N/A	N/A	ASTM D422	N/A	wt%	N/A	N/A	N/A	N/A

[a]The preliminary action level is the regulatory- or risk-based value used to determine appropriate analytical requirements (e.g., detection limits). Remedial action levels will be proposed in the feasibility study, will be finalized in the record of decision, and will drive remediation of the sites.

[b]15 mrem/yr = nonrad worker industrial exposure scenario; 2,000 h/yr onsite, 60% indoors, 40% outdoors. 100 mrem/yr = rad-worker industrial scenario; 2,000 h/yr onsite, 60% indoors, 40% outdoors. GW = groundwater protection radionuclide values based on RESRAD modeling of drinking water exposure with the entire vadose zone presumed to be contaminated. Groundwater protection may be evaluated using the STOMP code or another model to predict movement of contaminants through the vadose zone.

[c]All four-digit numbers refer to SW-846, *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, Third Edition: Final Update III-B*.

[d] Target quantization limit requirements for analytical laboratories (dependent on method and laboratory capabilities). Water values for sampling quality control (e.g., equipment blanks/rinses) or drainable liquid (if recovered). For water and soil media, matrix affects may have an impact on a specific sample basis.

[e]Accuracy criteria for associated batch laboratory control sample percent recoveries. Except for GEA, additional analysis-specific evaluations also preformed for matrix spikes, tracers, and carriers as appropriate to the method. Precision criteria for batch laboratory replicate sample analyses.

[f]WAC 173-340-745, "Soil Cleanup Standards for Industrial Properties," Method C industrial soil values for direct exposure from the CLARC Version 3.1 tables, updated November 2001.

[g]WAC 173-340-747, "Deriving Soil Concentrations for Ground Water Protection," soil concentrations protective of groundwater based on Method B values for groundwater from the CLARC Version 3.1 tables, updated January 2008, except as noted.

[h]Value is from Table 749-2 of WAC 173-340-900, "Tables," amended February 12, 2001.

[i]Hanford Site background concentration for soil.

[j]Accuracy criteria for associated batch matrix spike percent recoveries. Evaluation based on statistical control of laboratory control samples also performed. Precision criteria for batch laboratory replicate matrix spike analyses or replicate sample analysis.

Table C-3b. Analytical Performance Requirements for Nonradionuclides. (6 Pages)

COPCs	CAS #	Preliminary Action Level[k]			Name/Analytical Technology[e]	Required Target Quantitation Limits[d]		Precision Water	Accuracy Water	Precision Soil	Accuracy Soil
		WAC 173-340-745 Method C[f] (mg/kg)	GW Protection[g] (mg/kg)	Terrestrial Biota Protection[h] (mg/kg)		Water Conc. (mg/L)	Soil Conc. (mg/kg)				

[k]According to Footnote d of Table 749-2, Priority Contaminants of Ecological Concern for Sites that Qualify for the Simplified Terrestrial Ecological Evaluation Procedure, referenced in WAC 173-340-7492, "Simplified Terrestrial Ecological Evaluation Procedures," safe concentration has not yet been established for these constituents. See WAC 173-340-7492 (2)(c).
[l]Statewide background value for arsenic.
[m]Calculated using air cleanup standards from WAC 173-340-750(3)(a)(ii)(B), page 210, equation 750-2, with Washington State Department of Health mass loading of particulates in air of 10^{-4} g/m^3.
[n]Value is less than Hanford Site soil background. Therefore, the soil background concentration is used as the preliminary action level.
[o]Calculated using a Kds values of 0 mL/g for hexavalent chromium, 900 mL/g for lead, and WAC 173-340-747(5).
[p]Calculated using RfD from Oak Ridge National Laboratory, July 14, 2004.
[q]Based on WAC 173-340-900, Tables 740-1 and 745-1, amended February 12, 2001.
[r]Based on reference dose from Region 3; NCEA.
[s]Based on soluble salts value.
[t]Calculated using WAC 173-340-720 drinking water standards as inputs to the three-phase model for protection of drinking water [WAC 173-340-747(4), amended February 12, 2001], except as noted.
[u]Accuracy criteria is the minimum for associated batch laboratory control sample percent recoveries. Laboratories must meet statistically based control if more stringent. Additional analyte-specific evaluations also preformed for matrix spikes, and surrogates as appropriate to the method. Precision criteria for batch laboratory replicate matrix spike analyses.
[v]Calculated using RfD from Region 3.
[w]Calculated from EPA Region 3 toxicity values; NCEA.
[x]Values are from the *Integrated Risk Information System* database.
[y]WAC 173-340-747(4) fixed-parameter three-phase partitioning model equation value for soil protection of groundwater calculated using drinking water standards from EPA Region 9.
[z]Values reported for mixed isomers rather than cis/trans-1,2-dichloroethylene because both are present and the mixed isomers value is more protective.
[aa]Calculated from Rfd in the *Integrated Risk Information System* database, which first appeared December 22, 2003.
[bb]Based on soil concentration that is protective of the river.

40 CFR 131, "Water Quality Standards."
ASTM, *1993 Annual Book of ASTM Standards*, Volume 04.08.
Ecology 94-145, *Cleanup Levels and Risk Calculations under the Model Toxics Control Act Cleanup Regulation; CLARC, Version 3.1.*
Ecology 97-602, 1997, *Analytical Methods for Petroleum Hydrocarbons.*
Integrated Risk Information System database (EPA 2003).
PNNL-11216, *STOMP -- Subsurface Transport Over Multiple Phases: Application Guide.*
SW-846, *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, Third Edition; Final Update III-B.*
WAC 173-201A-040, "Water Quality Standards for Surface Waters of the State of Washington," "Toxic Substances."
WAC 173-340, "Model Toxics Control Act -- Cleanup."
WAC 173-340-720, "Ground Water Cleanup Standards."
WAC 173 340 750(3)(b)(ii)(B), "Cleanup Standards to Protect Air Quality," "Method B Air Cleanup Levels," "Applicability," "Human Health Protection," "Carcinogens."

For EPA Method 200.8, see EPA/600/R-94/111, *Methods for the Determination of Metals in Environmental Samples, Supplement 1.*
For EPA Method 300.7, see EPA/600/4-86/024, *Development of Standard Methods for the Collection and Analysis of Precipitation.*
For EPA Methods 150.1, 300.0, 310, 345.1, 377.1, and 413.N, see EPA/600/4-79/020, *Methods of Chemical Analysis of Water and Wastes.*

Table C-3b. Analytical Performance Requirements for Nonradionuclides. (6 Pages)

COPCs	CAS #	Preliminary Action Level[a]			Name/Analytical Technology[c]	Required Target Quantitation Limits[d]		Precision Water	Accuracy Water	Precision Soil	Accuracy Soil
		WAC 173-340-745 Method C[f] (mg/kg)	GW Protection[g] (mg/kg)	Terrestrial Biota Protection[h] (mg/kg)		Water Conc. (mg/L)	Soil Conc. (mg/kg)				

AEA = alpha energy analysis.
ASTM = American Society for Testing and Materials.
CAS = Chemical Abstracts Service.
CLARC = *Cleanup Levels and Risk Calculations under the Model Toxics Control Act Regulation* (CLARC Version 3.1) (Ecology 94-145).
COPC = contaminant of potential concern.
CVAA = cold vapor atomic absorption.
EPA = U.S. Environmental Protection Agency.
GEA = gamma energy analysis.
GPC = gas proportional counting.
GW = groundwater.
ICP/MS = inductively coupled plasma/mass spectrometry.
N/A = not applicable.
NaI = sodium iodide.
NCEA = National Center for Environmental Assessment.
RESRAD = RESidual RADioactivity (dose model).
RfD = reference dose.
STOMP = Subsurface Transport Over Multiple Phases (code) (PNNL-11216).
TBD = to be determined.
VOA = volatile organic analyte.
WAC = *Washington Administrative Code*.
WTPH-D = Washington state total petroleum hydrocarbons – diesel range.
WTPH-G = Washington state total petroleum hydrocarbons – gasoline range.

C2.1.5.1 Representativeness

Representativeness is a measure of how closely the results reflect the actual concentration and distribution of the chemical and radiological constituents in the matrix sampled. 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. The documentation will establish that protocols have been followed and that sample identification and integrity are ensured.

C2.1.5.2 Comparability

Comparability expresses the confidence with which one data set can be compared to another. Data comparability will be maintained using standard procedures and consistent methods and units. Table C-3 lists applicable fixed-laboratory methods for analytes and target detection limits. Actual detection limits will depend on the sample matrix and the sample quantity available. Data will be reported as defined for specific samples.

C2.1.5.3 Accuracy

Accuracy is an assessment of the closeness of the measured value to the true value. Accuracy of chemical test results is assessed by spiking samples with known standards and establishing the average recovery. A matrix spike is the addition to a sample of a known amount of a standard compound similar to the compounds being measured. Radionuclide measurements that require chemical separations use this technique to measure method performance. For radionuclide measurements that are analyzed by gamma spectroscopy, laboratories typically compare results of blind audit samples against known standards to establish accuracy. Validity of calibrations is evaluated by comparing results from the measurement of a standard to known values and/or by generation of in-house statistical limits based on three standard deviations (+/- 3 SD). Table C-3 lists the accuracy provided for fixed-laboratory analyses for the project.

C2.1.5.4 Precision

Precision is a measure of the data spread when more than one measurement has been taken on the same sample. Precision can be expressed as the relative percent difference for duplicate measurements or relative standard deviation for triplicates. Table C-3 lists the analytical precision for fixed-laboratory analyses.

C2.1.5.5 Completeness

A target value for data completeness was not defined in the DQO process; therefore, no requirement applies to this SAP.

C2.1.5.6 Detection Limits

Detection limits are functions of the analytical method used to provide the data and the quantity of the sample available for analyses. Method detection limits for the COPC are presented in Table C-3.

C2.1.6 Special Training Requirements/Certification

Typical training or certification requirements have been instituted by the Project Hanford Management Contractor 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 Daniel Hanford, Inc.*), regulations, DOE orders, contractor requirements documents, American National Standards Institute/American Society of Mechanical Engineers standards, *Washington Administrative Code*, etc. For example, training or certification requirements needed by sampling personnel will be in accordance with Site analytical quality requirements.

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 radiation training
- Radiological worker training.

A graded approach is used to ensure that workers receive a level of training commensurate with their responsibilities that complies with applicable DOE orders and government regulations. Specialized employee training includes prejob briefings, on-the-job training, emergency preparedness, plan-of-the-day activities, and facility/worksite orientations.

C2.1.7 Documents and Records

Planning for sample collection and analysis shall be in accordance with the programmatic requirements governing fixed-laboratory sample collection activities as discussed in the sample teams' procedures. In the event that specific procedures do not exist for a particular work evolution, or if 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 teams' requirements include the activities associated with the following:

- Chain-of-custody/sample analysis requests
- Project and sample identification for sampling services
- Control of certificates of analysis
- Logbooks, checklists
- Sample packaging and shipping.

Approved work control packages and procedures will be used to document radiological measurements when implementing this SAP. Examples of the types of documentation for field radiological data include the following:

- Instructions regarding the minimum requirements for documenting radiological controls information as discussed in 10 CFR 835, "Occupational Radiation Protection"
- Instructions for managing the identification, creation, review, approval, storage, transfer, and retrieval of Hanford Site 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 survey/sample plans
- The requirements associated with preparing and transporting regulated material.

C2.2 DATA GENERATION AND ACQUISITION

C2.2.1 Sample Process Design

A nonstatistical sampling design (professional judgment) was used to determine sample locations for this waste site. A biased (or focused) sampling approach was selected based on process knowledge and expected behavior of COPCs. The total number of samples selected for analysis was based on acquiring sufficient data to assess the vertical profile of the waste and to determine if any stratification and heterogeneity occurred within the waste present in the tank.

For this below-ground RCRA storage tank, the purpose of this investigation is to determine the composition and concentrations of the remaining hazardous and/or radioactive COPCs within the tank.

The field-sampling plan for the characterization effort is presented in Chapter C3.0 of this SAP. Chapter C3.0 presents information on sampling objectives and methodologies. Changes to the workscope detailed in the SAP may be required because of unexpected field conditions, new information, health and safety concerns, or other anomalies. Minor changes that have no adverse effect on the DQOs or project schedule can be made in the field with the approval of the project manager or assigned task lead and then documented in the daily field logbook and/or field summary reports. Changes that affect the DQOs will require concurrence by RL and the lead regulatory agency and can be documented through unit managers' meetings. Alternatively, if substantial changes are required, this SAP can be revised and reissued, requiring RL and regulator approval.

C2.2.2 Sampling Methods

C2.2.2.1 Investigative Techniques

Field-screening measurements, in addition to the collection of samples for laboratory analysis, will be used to determine occurrence of COPCs.

C2.2.2.2 Field-Screening Analyses

The applicable field-screening methods and performance requirements are presented in Table C-4. Special care should be taken to prevent cross-contamination of field-screening equipment by properly storing and handling the equipment and performing proper decontamination between sampling events.

Table C-4. Field-Screening Methods.

Measurement Type	Emission Type	Method/Instrument	Detection Limit
Exposure/dose rate	Beta/gamma	RO-20/RO-03 portable ionization chamber	0.5 mrem/h
Contamination level	Alpha	100 cm^2 portable alpha meter or equivalent instrument	90 d/min α/100 cm^2 (10 sec static count) 250 d/min α/100 cm^2 (1 in/sec scan speed)
Contamination level	Beta/gamma	100 cm^2 ruggedized scintillation detector or equivalent	500 d/min β–γ/100 cm^2 (20 sec static count @ 13% efficiency) 1,400 d/min β–γ/100 cm^2 (2 in/sec scan speed)
Contamination level	Gamma	2- by 2-in. NaI detector (e.g., Ludlum 44-3 or equivalent)	3 pCi/g Cs-137 in soils
Contamination level	Gamma	2 in. by 10 mm NaI low-energy gamma detector (e.g., Eberline PG-2 or equivalent)	20 pCi/g Am-241 in soils
Vapor screening	Volatile organic compounds	Handheld photo ionization detector	~1 ppm_v (common field photo ionization detector instruments can indicate down to 1 ppm_v or less)

Eberline E-600 and SHP380-A/B are trademarks of Eberline Instruments, a subsidiary of Thermo Electron Corporation, Waltham, Massachusetts.
Ludlum is a trademark of Ludlum Measurements, Inc., Sweetwater, Texas.
RO-20 and RO-03 are trademarks of Eberline Instruments, a subsidiary of Thermo Electron Corporation, Waltham Massachusetts.

d/min = disintegrations per minute.
ppm_v = parts per million volume.

C2.2.2.3 Radiological Field Data

Alpha and beta/gamma field data will be used to support the characterization described in this SAP, as appropriate. The following information will be disseminated to personnel performing work in support of this SAP, as appropriate:

- Instructions to the radiological control technicians on methods required to measure sample activity and media for gamma, alpha, and/or beta emissions, as appropriate. This will include direction to allow the radiological control technicians to calculate a number of quantities supporting sample analysis.

- Information regarding the Geiger-Mueller[1] portable instrument, to include a physical description of the Geiger-Mueller instrument, radiation and energy response characteristics, calibration/maintenance and performance testing descriptions, and the application/operation of the instrument. The Geiger-Mueller instrument is a commonly used beta/gamma instrument on the Hanford Site when removable surface contamination measurements and direct measurements of the total surface contamination are performed.

- Information regarding the portable alpha meter, to include a physical description of the portable alpha meter, radiation and energy response characteristics, calibration/ maintenance and performance testing descriptions, and the application/operation of the instrument. The portable alpha meter instrument is a commonly used alpha instrument on the Hanford Site when removable surface contamination measurements and direct measurements of the total surface contamination are performed.

- Information regarding the sodium iodide detector, to include a physical description of the sodium iodide detector, radiation and energy response characteristics, calibration/ maintenance and performance testing descriptions, and the application/operation of the instrument. The sodium iodide detector instrument is a commonly used gamma detector on the Hanford Site when direct measurements are performed.

- Information on the characteristics associated with the hand-held probes to be used in the performance of direct radiological measurements. The information includes a physical description of the probe, the radiation and energy response characteristics, calibration/maintenance and performance testing descriptions, and the application/operation of the instrument. Probes appropriate for the type and energy range of radioactivity present are commonly used on the Hanford Site when removable surface contamination measurements and direct measurements of the total surface contamination are performed.

C2.2.2.4 Sample Location

The borehole location will be identified in the field before starting the activity. The location will be marked by the technical lead or field team lead assigned by the project manager. After the

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[1] Geiger-Mueller is not a trademark.

location has been marked, minor adjustments to the location may be made to mitigate unsafe conditions and avoid structural interferences. Sample location identification numbers will be defined during or after sampling. Changes in sample locations that do not affect the DQOs will require approval of the task lead. Changes to sample locations that result in impacts to the DQOs will require concurrence by RL and the lead regulatory agency.

Surface radiation surveys will be conducted at the borehole location. The surface radiation surveys will identify areas of surface contamination that might affect the field activities and health and safety.

C2.2.2.5 Summary of Sampling Activities

Table C-5 summarizes the number and types of characterization and field quality control samples to be collected at the 241-CX-72 Storage tank.

Table C-5. Summary of Projected Sample Collection Requirements.

Sampling Method	241-CX-72 Storage Tank
Boreholes for Samples Collection	1
Samples for Radiological and Nonradiological Contaminants of Potential Concern	
Core samples	4
Quality Control Samples	
Duplicates	1
Splits	1
Equipment blanks	1
Field blank	1
Total number of quality control samples	4

C2.2.3 Field Sample Handling and Custody

C2.2.3.1 Sample Identification

The *Sample Data Tracking* database will be used to track the samples from the point of collection through the collection and 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 this project in accordance with onsite organizational procedures. 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.

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 and time
- Name or initials of person collecting the sample
- Analysis required
- Preservation method (if applicable).

C2.2.3.2 Field Sampling Logbook

All information pertinent to field sampling and analysis will be recorded in field checklists and bound logbooks in accordance with existing sample collection protocols. The sampling team will be responsible for recording all relevant sampling information. Entries made in the logbook will be dated and signed by the individual who made the entry. Program requirements for managing the generation, identification, transfer, protection, storage, retention, retrieval, and disposition of records within the Project Hanford Management Contractor will be followed.

C2.2.3.3 Sample Custody

Sample custody will be maintained in accordance with existing Hanford Site protocols. The custody of samples will be maintained from the time the samples are collected until the ultimate disposal of the samples, as appropriate. A chain-of-custody record will be initiated in the field at the time of sampling and will accompany each set of samples shipped to any laboratory. Samples will be sent to the laboratory in accordance with applicable shipping procedures. The analyses requested for each sample will be indicated on the accompanying Chain-of-Custody Form. Custody tape will be used to provide indication of tampering with the samples. The custody tape will be inscribed with the sampler's initials and the date. Chain-of-custody procedures will be followed throughout sample collection, transfer, analysis, and disposal to ensure that sample integrity is maintained. Each time the responsibility changes for the custody of the sample, the new and previous custodians will sign the record and note the date and time. The shipper will make a copy of the signed record before sample shipment and will transmit the copy to Sample and Data Management within 48 hours of shipping.

C2.2.3.4 Sample Containers and Preservatives

Level I EPA pre-cleaned sample containers will be used for samples collected for chemical and radiological analysis. Container sizes may vary depending on laboratory-specific volumes/requirements for meeting analytical detection limits. If, however, the dose rate on the outside of a sample jar or the curie content within the sample exceeds levels acceptable by a laboratory, smaller volumes may be sent to the laboratory after consultation with Sample and Data Management to determine acceptable volumes. Sample preservation, containers, and holding times for radiological and nonradiological analytes in are shown in Table C-6.

Table C-6. Sample Preservation, Container, and Holding Time Guidelines and Analytical Priorities. (2 Pages)

Analytes	Analytical Priority[a]	Matrix	Bottle		Amount[a,b,c]	Preservation	Packing Requirements	Holding Time
			Number	Type				
Radionuclides								
Americium-241	10	Soil/Solids	1	G/P	10 to 1,000 g	None	None	6 months
Cesium-137	1	Soil/Solids	1	G/P	100 to 1,500 g	None	None	6 months
Cobalt-60	1	Soil/Solids						
Europium-152	1	Soil/Solids						
Europium-154	1	Soil/Solids						
Europium-155	1	Soil/Solids						
Iodine-129	12	Soil/Solids	1	G/P	10 to 1,000 g	None	None	6 months
Plutonium-238	1	Soil/Solids	1	G/P	10 to 1,000 g	None	None	6 months
Plutonium-239/240	1	Soil/Solids						
Strontium-90	1	Soil/Solids	1	G/P	10 to 1,000 g	None	None	6 months
Technetium-99	8	Soil/Solids	1	G/P	10 to 1,000 g	None	None	6 months
Tritium (H-3)	12	Soil/Solids	1	G	100 to 500 g	None	None	6 months
Uranium-233/234	1	Soil/Solids	1	G/P	10 to 1,000 g	None	None	6 months
Uranium-235/236	1	Soil/Solids						
Uranium-238	1	Soil/Solids						
Chemicals								
Ammonia/ ammonium – 350.1	3	Soil/Solids	1	G/P	50 to 500 g	None	Cool 4 °C	28 days
IC anions – 300.0	3	Soil/Solids	1	G/P	50 to 500 g	None	Cool 4 °C	28 days/ 48 hours
IC anions – 353.1 for nitrate/nitrite	3	Soil/Solids	1	G/P	50 to 500 g	None	Cool 4 °C	28 days/ 48 hours
ICP metals – 6010A	2	Soil/Solids	1	G/P	10 to 500 g	None	None	6 months
Chromium hex – 7196	4	Soil/Solids	1	G/P	5 to 500 g	None	Cool 4 °C	30 days
Mercury – 7471 – (CVAA)	5	Soil/Solids	1	G	5 to 125 g	None	None	28 days
Total cyanide – 9010	11	Soil/Solids	1	G	10 to 1,000 g	None	Cool 4 °C	14 days
pH (solid) – 9045	13	Soil/Solids	1	G/P	10 to 250 g	None	None	Within 24 hrs of lab receipt
Semivolatile organic analyte – 8270A	6	Soil/Solids	1	AG	125 to 1,000 g	None	Cool 4 °C	14/40 days
VOA – 8260/5035A	7	Soil/Solids	9	AG	5 g each bottle	Methanol in 4 bottles and frozen -7 °C to -20 °C (sample) in 5 bottles	Cool 4 °C	14 days

Table C-6. Sample Preservation, Container, and Holding Time Guidelines and Analytical Priorities. (2 Pages)

Analytes	Analytical Priority[c]	Matrix	Bottle		Amount[a,b,c]	Preservation	Packing Requirements	Holding Time
			Number	Type				
Nonhalogenated VOA – 8015M – gas chromatography modified for normal paraffin hydrocarbon	9	Soil/Solids	1	AG	125 to 250 g	None	Cool 4 °C	14 days
WTPH-D	11	Soil/Solids	1	G	50 to 150 g	None	Cool 4 °C	14 days
WTPH-G	11	Soil/Solids	1	G	50 to 150 g	None	Cool 4 °C	14 days
Oil and grease	12	Soil/Solids	1	G	200 g	None	Cool 4 °C	28 days
Polychlorinated biphenyls – EPA Method 8082	10	Soil/Solids	1	G	10 to 50g	None	Cool 4 °C	14 days
Physical Properties								
Bulk density – ASTM D2937	14	Soil/Solids	1	Liner	Liner	None	None	None established for analysis
Moisture content – ASTM D2216	15	Soil/Solids	1	Moisture tin[d]	250 g	None	None	As soon as practicable
Particle size distribution – ASTM D422	16	Soil/Solids	1	G/P	100 to 4,000 g	None	None	None established for analysis

[a]Optimal volumes, which may be adjusted downward to accommodate the possibility of retrieval of small amount of sample. Minimum sample size will be defined on the Sampling Authorization Form.

[b]Should samples be liquid rather than soils, the following volumes need to be collected:

Radionuclides – 4 L for all radionuclides (except C-14, tritium, and Tc-99, which require approximately 500 mL for each sample).

Chemicals – All liquid samples require the amount as listed for soil samples. Preservation and holding times also are affected if liquid samples are collected. Consult Sample Management staff for details.

[c]Mixed soil samples may be obtained and submitted to the analytical laboratory for analyses for specific analytes, including the following:

Radionuclides – 100 g of soil for all radionuclides (except C-14, tritium, and Tc-99, which require approximately 10 g for each sample).

Chemicals – A 10 g soil sample is required for all ICP analyses, 10 g soil sample is required for IC anion analysis, 5 g soil sample for hexavalent chromium analysis, 10 g soil sample for 9010 analysis, 10 g soil sample for 8015 analysis, and 125 g soil samples for each 8270 and total organic carbon analysis.

[d]Vessel must be sealed.

[e]Analytical priority may be adjusted.

ASTM, *1993 Annual Book of ASTM Standards*, Volume 04.08.

For 4-digit methods, see SW-846, *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, Third Edition; Final Update III-B*.

For EPA Methods 300.0, 350.1, and 353.1, see EPA/600/4-79/020, *Methods of Chemical Analysis of Water and Wastes*.

AG = amber glass.
ASTM = American Society for Testing and Materials.
CVAA = cold vapor atomic absorption.
EPA = U.S. Environmental Protection Agency.
G = glass.
IC = ion chromatography.
ICP = inductively coupled plasma.
WTPH-D = Washington state total petroleum hydrocarbons – diesel range.
WTPH-G = Washington state total petroleum hydrocarbons – gasoline range.
P = plastic.
VOA = volatile organic analyte.

C2.2.3.5 Sample Shipping

The radiological control technician will measure the contamination levels on the outside of each sample jar and the dose rates on each sample jar. The radiological control technician also will measure the radiological activity on the outside of the sample container (through the container) and will document the highest contact radiological reading in millirem per hour. This information, along with other data, will be used to select proper packaging, marking, labeling, and shipping paperwork in accordance with U.S. Department of Transportation regulations (49 CFR, "Transportation") and to verify that the sample can be received by the analytical laboratory in accordance with the laboratory's acceptance criteria. Copies of the shipping documentation will be provided to Sample and Data Management within 48 hours of sample shipment. Based on the measured radiological activity, the samples will be shipped to the appropriate Hanford Site-approved laboratory.

C2.2.4 Analytical Methods

Table C-3 lists the applicable fixed-laboratory methods for analytes and target detection limits.

C2.2.5 Quality Control

C2.2.5.1 Field Quality Control

Field QC samples shall be collected to evaluate the potential for cross-contamination and laboratory performance. Field QC for sampling this 200-IS-1 RCRA TSD unit will require the collection of field duplicate, field split, equipment rinsate blank, and field blank samples. If possible, field duplicate and field split samples should be collected from contaminated areas so valid comparisons between the samples can be made. However, the samples should not be collected from zones that are expected to contain high levels of transuranic-contaminated media because of the high cost and added handling requirements associated with transuranic materials. The QC samples and the required frequency for collection are described in the following subsections.

C2.2.5.1.1 Field Duplicates

Each field duplicate shall be retrieved from the sample interval using the same equipment and sampling technique as the original sample. Field duplicates are collected and homogenized before being divided into two samples in the field. If volatile organic analyte (VOA) samples are required, they should be collected before homogenization. The duplicate samples shall be sent to the primary laboratory in the same manner as the routine site samples. Field duplicates provide information regarding the homogeneity of the sample matrix and can be used to evaluate the precision of the analysis process.

At least 5 percent of the total collected samples will be duplicated. At least one field duplicate shall be collected from the waste site. The duplicate sample(s) shall be suitable for analysis by an offsite laboratory and shall be analyzed for all of the COPCs listed in Table C-3.

C2.2.5.1.2 Field Splits

Field split samples will be collected at the same frequency as field duplicate samples from each waste site. Each split sample shall be retrieved from the same sample interval using the same equipment and sampling technique as the original sample. Samples shall be homogenized, split into two separate aliquots in the field, and sent to two independent laboratories. If VOA samples are required, they should be collected before homogenization. The splits will be used to verify the performance of the primary laboratory.

The split samples will be obtained from a sample medium that is expected to have some contamination and that is suitable for analysis in an offsite laboratory and shall be analyzed for all of the COPCs listed in Table C-3.

C2.2.5.1.3 Equipment Rinsate Blanks

Equipment rinsate blanks are used to verify the adequacy of sampling equipment decontamination procedures and shall be collected for each sampling method or from each type of nondisposable equipment used. Rinsate blanks need only be collected from equipment that undergoes decontamination and is used for repeated sample collection. An equipment rinsate blank shall be taken from each type of decontaminated sampling equipment used for the collection of samples. Rinsate blanks need only be collected from equipment that undergoes decontamination and is used for repeated sample collection. The field team lead can request that additional equipment blanks be taken. Equipment blanks shall consist of deionized water washed through decontaminated sampling equipment and placed in containers identified on the Sampling Authorization Forms. Note that the bottle and preservation requirements for water may differ from the requirements for soil. Equipment rinsate blanks shall be analyzed for the following:

- Gross alpha
- Gross beta
- Metals (excluding hexavalent chromium and mercury)
- Anions (except cyanide)
- VOAs of interest
- Semivolatile organic analytes of interest.

These analytes are considered the best indicators of decontamination effectiveness.

C2.2.5.1.4 Field Blanks

The volatile organic field blanks will constitute approximately 5 percent of all volatile organic compound samples. If applicable, at least one field blank shall be collected. Field blanks shall consist of laboratory-grade deionized water added to a clean sample container in the field during the time frame that the characterization samples are being collected. The field blanks shall travel to the field with the associated bottle sets and will be returned to the laboratory with the samples. They will remain closed during subsequent transport and handling. Field blanks are prepared as a check for possible contamination originating from ambient conditions at the site during sample collection. The field blank shall be analyzed for volatile organic compounds only.

C2.2.5.1.5 Prevention of Cross-Contamination

Special care should be taken to prevent cross-contamination of samples. Particular care will be exercised 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 them on or near potential contamination sources, such as uncovered ground
- Handling bottles or equipment with dirty hands
- Improperly decontaminating equipment before sampling or between sampling events.

C2.2.5.2 Laboratory Quality Control

The laboratory method blanks, duplicates, laboratory control sample/blank spike, and matrix spikes are defined in Chapter 1 of SW-846, *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, Third Edition; Final Update III-B*, and will be run at the frequency specified in Chapter 1 of SW-846.

C2.2.6 Instrument and Equipment Testing, Inspection, and Maintenance

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 or verify calibration of their equipment in accordance with manufacturer or other applicable guidelines. Maintenance requirements (such as parts lists and documentation of routine maintenance) will be included in the individual laboratory and the onsite organization quality assurance plan or operating procedures (as appropriate).

C2.2.7 Instrument and Equipment Calibration and Frequency

Calibration of laboratory instruments will be performed in a manner consistent with SW-846 or with auditable DOE Hanford Site-wide and contractual requirements. Calibration of radiological field instruments will be performed as indicated in the discussion regarding radiological field instrumentation data.

C2.2.8 Inspection and Acceptance of Supplies and Consumables

Supplies and consumables used in support of sampling and analysis activities are procured in accordance with internal work requirements and processes that describe the acquisition system

and the responsibilities and interfaces necessary to ensure that structures, systems, and components, or other items and services procured/acquired, meet the specific technical and quality requirements. The procurement process ensures that purchased items and services comply with applicable procurement specifications. Supplies and consumables are checked and accepted by users before use. Supplies and consumables obtained by the analytical laboratories are procured, checked, and used in accordance with the laboratories' quality assurance plans.

C2.2.9 Non-Direct Measurements

From an investigation of historical sources, including process documents, logbooks, and original plant technical manuals, a master list of potential contaminants was identified during the DQO process and was used in determining the analytical requirements.

C2.2.10 Data Management

Data generated as a result of sampling and data analysis activities will follow requirements outlined in this SAP and shall be managed and stored in accordance with applicable programmatic requirements governing data management procedures. At the direction of the task lead, all analytical data packages shall be subject to final technical review by qualified personnel before the results are submitted to the regulatory agencies or before inclusion in reports. Electronic data access, when appropriate, shall be via a database (e.g., HEIS or a project-specific database). Where electronic data are not available, hard copies shall be provided in accordance with Section 9.6 of the *Hanford Federal Facility Agreement and Consent Order* (Ecology et al., 1989).

Data will be cross-referenced between laboratory analytical data and radiation measurements to facilitate interpreting the investigation results. Errors reported by the laboratories are reported to the Sample Management Project coordinator, who initiates a Sample Disposition Record in accordance with Project Hanford Management Contractor procedures. This process is used to document analytical errors and to establish the resolution with the project task lead. In addition, the Project Hanford Management Contractor Quality Assurance engineer receives quarterly reports that provide narrative summaries and summary statistics of the analytical errors.

C2.3 ASSESSMENT AND OVERSIGHT

Routine evaluation of data quality described for this project will be documented and filed along with the data in the project file.

C2.3.1 Assessments and Response Action

The Fluor Hanford Compliance and Quality Programs group may conduct random surveillance and assessments to verify compliance with the requirements outlined in this SAP, project work packages, the project quality management plan, procedures, and regulatory requirements.

Deficiencies identified by these assessments shall be reported in accordance with existing programmatic requirements. The central quality assurance group coordinates the corrective actions/deficiencies in accordance with the Fluor Hanford Management Contractor Quality Assurance Program. When appropriate, corrective actions will be taken by the task lead.

C2.3.2 Reports to Management

Management will be made aware of all deficiencies identified by self-assessments. Identified deficiencies will be reported to the Fluor Hanford Management Contractor 200 Areas Waste Site Remediation manager, as appropriate.

C2.3.3 Changes in Workscope

Changes to the workscope detailed in the SAP may be required because of unexpected field conditions, new information, health and safety concerns, or other anomalies. Minor changes that have no adverse effect on the DQOs or project schedule can be made in the field with the approval of the project manager or assigned task lead and then documented in the daily field logbook and/or field summary reports. Changes that affect the DQOs will require concurrence by RL and the lead regulatory agency and can be documented through unit managers' meetings. Alternatively, if substantial changes are required, this SAP can be revised and reissued, requiring RL and regulator approval.

C2.4 DATA VALIDATION AND USABILITY

C2.4.1 Data Review, Verification, and Validation

Data review and verification activities include checking completeness of laboratory analytical data packages (e.g., complete laboratory QC documentation, all data results present, data narrative summary is complete, and all report pages are present). Verification shall consist of confirming the required deliverables, requested versus reported analyses, and transcription errors. Validation shall include the evaluation and qualification of results based on holding time, method blanks, matrix spikes, laboratory control samples, laboratory duplicates, and chemical and tracer recoveries, as appropriate to the methods used. No other validation or calculation checks will be performed.

C2.4.2 Verification and Validation Methods

Verification activities will be completed by qualified Groundwater Remediation Project Sample Management personnel. Validation shall be performed on completed data packages by qualified Groundwater Remediation Project Sample Management personnel or by a qualified independent contractor. At least 5 percent of all data shall be validated. Validation requirements will be consistent with Level C validation. No validation will be performed for physical data.

C2.4.3 Reconciliation With User Requirements

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. EPA/600/R-96/084, *Guidance for Data Quality Assessment, Practical Methods for Data Analysis*, EPA QA/G-9, identifies five steps for evaluating data generated from this project, as summarized below.

Step 1. Review the Sampling Design. This step requires a comprehensive review of the sampling and analytical requirements outlined in the SAP.

Step 2. Conduct a Preliminary Data Review. In this step, a comparison is made between the actual quality assurance/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, including an evaluation of the distribution of the data.

Step 3. Select the Statistical Test. Using the data evaluated in Step 2, select an appropriate statistical hypothesis test and justify the selection of this test.

Step 4. Verify the Assumptions. Assess the validity of the data analyses 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, return to Step 3.

Step 5. Draw Conclusions from the Data. The statistical test is applied in this step (if applicable to the sample design), 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 in order to assess the adequacy of the sampling design.

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C3.0 FIELD-SAMPLING PLAN

C3.1 SAMPLING OBJECTIVES

The primary objective of the field-sampling plan is to identify and describe sampling and field measurement activities that will be undertaken. The field-sampling plan describes pertinent elements of the sampling program. Sample methods, procedures, locations, and frequencies are identified in this section.

A borehole will be completed inside of the tank and will include collecting core samples from specified depth intervals within the residual waste for full-suite laboratory analysis (Table C-3). A core sampler will be the sampling device used to collect the samples from the borehole. Sampling design features are described in Table C-7. Sample collection depth intervals and sample media are illustrated in Figure C-7.

Table C-7. 241-CX-72 Storage Tank Sampling Design. (2 Pages)

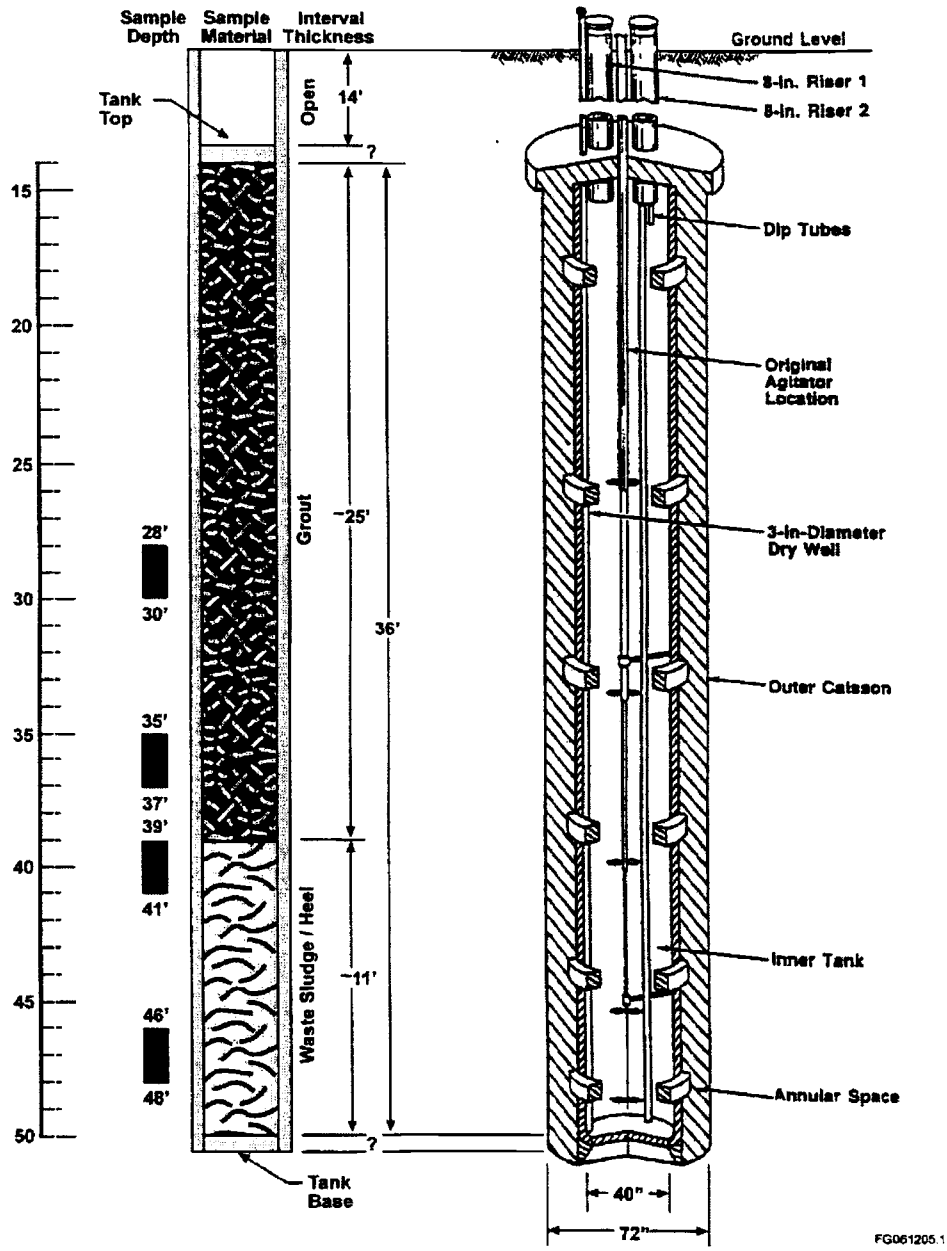
Sampling Method	Key Features of Design	Basis for Sample Design
Borehole sampling and characterization	The borehole will be positioned at a location permitting access to the entire grout and waste heel profile within the tank. The vertical borehole will be installed with a drill rig positioned within the containment building that overlies the 241-CX-72 Storage Tank.	Characterize composition of the waste within the tank.
Core samples	Collect core samples from 28-30, 35-37, 39-41, and 46-48 ft bgs and submit for laboratory analysis of COPCs.	The core samples will be collected to evaluate vertical variability in waste composition and support waste disposal and closure decisions. Sample Depth Intervals: 28-30 ft – Within grout, provide concentrations of COPCs within middle portion of grout interval that contains some waste constituents as the result of mixing. 35-37 ft – Within grout, provide concentrations of COPCs within lower portion of grout interval that contains waste constituents as the result of mixing. 39-41 ft – Within waste, provide concentrations of COPCs near top of waste interval. 46-48 ft – Within waste, provide concentrations of COPCs near base of waste interval. Radiological logging results indicate highest radionuclide concentrations within this interval.

Table C-7. 241-CX-72 Storage Tank Sampling Design. (2 Pages)

Sampling Method	Key Features of Design	Basis for Sample Design
Core samples	Collect field QC samples.	Field QC samples will be used to evaluate the potential for cross-contamination and to evaluate laboratory performance.

bgs = below ground surface.
COPC = contaminant of potential concern.
QC = quality control.

Figure C-7. Approximate Sampling Depths Within the 241-CX-72 Storage Tank.



Problems with borehole drilling, sample collection, sample custody, or data acquisition that affect the quality of data or impair the ability to acquire data due to failure to meet contract requirements, or failure to follow procedures shall be documented. When a problem is encountered with performing field measurements or conducting sampling, cognizant field personnel shall communicate the problem to the task lead for evaluation and resolution.

C3.2 FIELD MEASUREMENTS

Planned field measurements include surface radiation surveys and radiological field screening.

C3.2.1 Surface Radiation Surveys

A surface radiation survey will be performed to document existing surface contamination. This information will be used in preparing the supporting health and safety documents and in finalizing the borehole location. The surface radiation survey will be conducted by qualified radiological control technicians in accordance with applicable procedures. A survey report will be prepared. Radiation surveys will be performed in accordance with applicable approved procedures. A survey will be performed at the conclusion of fieldwork to ensure that sampling activities have not contributed to surface contamination.

C3.2.2 Screening

Using appropriate instrumentation, the radiological control technician or other qualified personnel will field screen the drill cuttings and all sample material generated from the borehole for radioactive contamination. Potential screening instruments are listed in Table C-4 with their respective detection limits. The radiological control technician will record all field measurements, noting the depth of the sample and the instrument reading.

Before drilling, a local area background reading will be taken using the field-screening instruments at a site to be selected in the field. Field screening results will assist in determining radiological activity within the grout, at the grout/waste interface, and within the waste material. These results also will assist in determining sample shipping requirements, and will support worker health and safety monitoring.

Field-screening instruments will be used, maintained, decontaminated (if applicable), and calibrated, or calibration verified, in accordance with the manufacturer's specifications and other approved procedures. Specific instrumentation information and field-screening results are recorded by the radiological control technician or other qualified personnel. The field geologist also will record field-screening results in the borehole logbook. Results are documented in the waste-site characterization summary report prepared by the field geologist.

C3.2.3 Borehole Sampling and Analysis

A borehole will be installed to characterize the composition of waste within the 241-CX-72 Storage Tank. Actual sampling intervals may vary from the table depending on the location of the top of the waste as indicated by the radiological instrument measurements.

IDW generated during this activity will be handled according to the procedures listed in Chapter C5.0 and the waste control plan (to be prepared/approved before the start of field activities).

C3.2.4 Pre-Shipment Sample Screening

A representative portion of each sample will be shipped to an offsite laboratory, or will be submitted to the Radiological Counting Facility, 222-S Laboratory, or other suitable onsite laboratory for total activity analysis before shipment. Total radiological activities will be used for sample pre-shipment characterization. Samples that slightly exceed the offsite laboratory criterion may be reduced in volume, to reduce total activity and allow offsite shipment. Onsite and offsite laboratories will be identified before initiating field activities and will be mutually acceptable to the Fluor Hanford, Inc., Sample Management group and the task lead.

C3.3 SURVEYING

The location of the borehole will be surveyed after the sampling and abandonment activities are completed. Data will be recorded in the *North American Vertical Datum of 1988* and the Washington State Plane (South Zone) *North American Datum of 1983*, with the 1991 adjustment for horizontal coordinates. All survey data will be recorded in meters and feet. Global positioning system survey instrumentation will be used.

C3.4 WASTE MANAGEMENT SAMPLING

A waste designation DQO effort will be performed immediately before the characterization activities to ensure that the proper information is collected during the field effort to support the designation of all project IDW. Any additional sampling requirements or analytes needed to support waste designation activities will be identified and implemented through the waste designation DQO summary report that will be prepared at that time.

In addition, the data needs of other core projects such as the RL Groundwater Protection Program, ORP, or the Science and Technology Project will be solicited at this time. If practicable, these data needs will be integrated into the IDW DQO as additional sampling requirements or analytes.

C4.0 HEALTH AND SAFETY

All field operations will be performed in accordance with health and safety requirements and procedures. In addition, documentation will be prepared that will further control site operations. This documentation will consist of an activity hazard analysis, a site-specific health and safety plan, and applicable work permits. Work shall be performed in accordance with site-specific health and safety plans and applicable work permits. The sampling procedures and associated activities will take into consideration exposure reduction and contamination control techniques that will minimize the sampling team's exposure.

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C5.0 MANAGEMENT OF INVESTIGATION-DERIVED WASTE

The IDW generated by characterization activities will be managed in accordance with existing approved Fluor Hanford waste management documents, which identify the requirements and responsibilities for containment, labeling, and tracking of IDW. Procedures have been prepared to implement the requirements found in Ecology et al. 1995, "Strategy for Management of Investigation Derived Waste." Management of IDW, minimization practices, and waste types applicable to 200-IS-1 OU waste control will be described in the waste control plan (to be prepared).

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

A waste designation DQO will be completed before the initiating characterization activities to ensure that information necessary to support designation of all project IDW is collected during the field effort. During the IDW DQO effort, any listed waste issues will be resolved. Additional sampling or analysis required to support designation activities will be identified in the waste designation DQO summary report.

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C6.0 REFERENCES

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APPENDIX D

SITE-SPECIFIC INFORMATION FOR 200-IS-1 OPERABLE UNIT PIPELINE-SYSTEM WASTE SITES

TABLES

Table D-1. Summary of Existing Characterization Data for Pipelines Systems. D-1

Table D-2. Waste Information Data System Summary for 200-IS-1 Operable Unit Pipeline Systems..... D-13

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	0.454	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

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PREFACE

Appendix D contains two tables that provide pipeline system information. These tables summarize the information available during preparation of the work plan. Content presented in the tables does not encompass all the pipelines, related structures and associated unplanned releases that may be considered part of the 200-IS-1 Operable Unit. Table 1-3 in Chapter 1 of the work plan identifies the 200-IS-1 Operable Unit waste sites currently listed within *Waste Information Data System* database and included in Appendix C of the *Hanford Federal Facility Agreement and Consent Order Action Plan* (Ecology et al., 1989) (Tri-Party Agreement Action Plan). Table 1-4 in Chapter 1 identifies those pipelines pending future listing within Appendix C of Tri-Party Agreement Action Plan. Candidate waste sites for inclusion in the 200-IS-1 Operable Unit include all inactive process-waste-carrying pipelines, diversion boxes, catch tanks, valve pits, related structures, and associated unplanned releases outside the tank farm waste management areas. If updates to the waste site lists occur following issuance of this work plan, the information will be shared with regulators through the Unit Managers meetings. As indicated in the Tri-Party Agreement Action Plan, the mechanism for official dissemination of this information, addition of new waste sites and reclassification of accepted waste sites, will be conducted in accordance with RL-TPA-90-0001, TPA-MP-14 procedures.

Table D-1 indicates attributes and characterization activities for pipelines that have been described in previous Hanford documents. This table identifies the documents in which the pipeline information presented was derived.

Table D-2 summarizes information provided in *Waste Information Data System* database for those 200-IS-1 Operable Unit waste sites listed in Appendix C of the Tri-Party Agreement Action Plan at the time this work plan was being prepared. Tables D-1 and D-2 were developed independently and are limited in scope to a presentation of the information obtained from the sources identified for each table. As such, the content presented in Table D-1 may not be consistent or comparable with the information presented in Table D-2.

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APPENDIX D

SITE-SPECIFIC INFORMATION FOR 200-IS-1 OPERABLE UNIT PIPELINE-SYSTEM WASTE SITES

Table D-1. Summary of Existing Characterization Data for Pipelines Systems. (12 Pages)

Process Waste OU	Disposal Sites with Assoc. Pipe	Ref. Source (see Notes)	Summary of Applicable Information	Pipeline Attributes							Available Types of Characterization Data				Other Results/Comments
				Pipe Material Type	Pipe Depth (bgs)	Pipe Burial Config[1]	Leaks/Plugs	Pipeline Pressure Tested (Y)=yes (N)=no	Waste Stream Information	Waste Type*	Camera Surveys Inside Pipelines	Soil or Vegetation Sampling Adjacent to Pipeline	Additional Pipeline Information/Results	Related Data	
PW-1	216-Z-1, 216-Z-2, 216-Z-3, & 216-Z-1A	11	Provides data for the effluent pipeline from Z Plant (234-Z5, 236-Z, & 242-Z Buildings) into the 216-Z-2 Crib, and between the 216-Z-2 and 216-Z-1 Cribs (pp. 13-14) and summary of existing data for 216-Z-1 & -2 Cribs and Tile Field. Also 216-Z-3 overflow into 216-Z-1A Tile Field (p. 24).	8-in. SS into Crib (p. 13); 8-in. VCP from 216-Z-3 into tile field (p. 24)	not specified	direct buried	not specified	(N)	acidic process, analytical, and development laboratory wastes; aqueous and organic waste; uranium waste (pp. 14-15)	1 and possible 3	none	none	none	previous waste-site inventory, scintillation probe, and groundwater sampling data summarized (pp. 18-20, 22); previous crib plutonium/americium sampling results summarized (p. 23)	SS may degrade at low pH. Process used oxalic acid, which breaks down into chelans.
	216-Z-1A & 216-Z-3		Provides data for the effluent pipeline from the 234-Z5 Building via the 241-Z-361 Settling Tank into the 216-Z-3 Crib (p. 24) and summary of existing data for 216-Z-3 Crib. Overflow into 216-Z-1A Tile Field (p. 24).	8-in. VCP (p. 24)	not specified	direct buried	not specified	(N)	neutral/basic process, analytical, and development laboratory wastes (p. 25); low-salt (Ref. 13, p. 6)	4	none	none	none	previous waste-site inventory and scintillation probe data summarized (pp. 28-29)	none
	216-Z-9	11	Provides data for the RECUPLEX effluent pipeline from the 234-5Z Building into the 216-Z-9 Trench (pp. 52-53) and summary of existing data for the 216-Z-9 Trench.	not specified	not specified	direct buried	not specified	(N)	acidic, aqueous and organic waste; high salt	1,2,4	none	none	none	previous waste-site inventory, scintillation probe, and well groundwater sampling data summarized (pp. 53, 57, 60-61)	RECUPLEX estimates on p. 61
		12	Provides data for the pipelines from the RECUPLEX Facility in 234-5 Z Plant to the 216-Z-9 Trench.	Two 3.8 cm SS lines; one served as a spare (p. 1)	< 20 ft bgs, because trench depth was 20 ft (p. 1)	direct buried	not specified	(N)	high salt content and acidic (containing aluminum, magnesium, calcium, and other metal nitrate salt waste, degraded solvents) (p. 1)	1,2	none	none	none	summary of 1973 study of plutonium distribution in the 216-Z-9 Trench, which later was mined and 58 kg of plutonium was removed (pp. 4-5)	SS may degrade at low pH and high heat.
		19	Provides summary of existing data for the lines out to the 216-Z-9 Crib.	1.5-in. Schedule 40 SS	not specified	direct buried	not specified	(N)	not specified	1,2,4	none	none	none	none	none
	216-Z-12	13	Provides data for the pipelines from the Z Plant 234-Z, 232-Z, 236-Z, 242-Z, and RECUPLEX processes to 216-Z-12 Crib and summary of existing data for the 216-Z-12 Crib (pp. 16, 18, and 20).	4-in. VCP connected to 12-in. VCP; sections butted together but not sealed (p. 16)	17 ft (p. 6, Fig. 8)	direct buried	not specified	(N)	Low salt, slightly basic (pH ~8), aqueous plutonium-bearing laboratory and process waste containing sodium, fluoride, and nitrate (p. 1)	4	none	none	none	previous waste-site investigations summarized (pp. 33-50)	Waste from Z Plant process and labs drained to 241-Z Waste Storage Tanks, then (after neutralized) to 241-Z-361 Settling Tank, with overflow to 216-Z-12 Crib via Diversion Boxes 1 then 2 (pp. 16 & 18)
		11	Provides data for the effluent pipelines from the 241-Z Neutralization Tank via 241-Z-361 Settling Tank to the 216-Z-12 Crib (p. 68) and summary of existing data for 216-Z-12 Crib.	not specified	not specified	direct buried	not specified	(N)	slightly acidic, low salt process waste (p. 68)	4	none	none	none	previous waste-site inventory, scintillation probe, and well groundwater sampling data summarized (pp. 71, 74-75)	none

Table D-1. Summary of Existing Characterization Data for Pipelines Systems. (12 Pages)

Process Waste OU	Disposal Sites with Assoc. Pipe	Ref. Source (see Notes)	Summary of Applicable Information	Pipeline Attributes: Pipe Material Type	Pipe Depth (bgs)	Pipe Burial Config†	Leaks/Plugs	Pipeline Pressure Tested (Y)=yes (N)=no	Waste Stream Information	Waste Type*	Available Types of Characterization Data: Camera Surveys Inside Pipelines	Soil or Vegetation Sampling Adjacent to Pipeline	Additional Pipeline Information/Results	Related Data	Other Results/Comments
	216-Z-18	11	Provides data for the effluent pipeline from the 236-Z and 242-Z Buildings into the 216-Z-18 Crib (p. 92) and summary of existing data for the 216-Z-18 Crib.	not specified	not specified	direct buried	not specified	(N)	acidic, high salt waste (p. 92)	1,2	none	none	none	previous waste-site inventory, scintillation probe, and well groundwater sampling data summarized (pp. 95, 98-99)	none
PW-2	216-A-10	7	Provides existing data for the 216-A-10 Crib; mention of associated piping.	8-in. VCP; replaced in 1962 with 8-in. SS (2.2.3.5)	not specified	direct buried	Leaks suspected since acidic waste destroyed VCP integrity (2.2.3.5)	(N)	PUREX acidic process condensate, acidic process distillate (D002), and corrosive/mixed waste (D002) process distillate (2.2.3.5) containing uranium and nitrate (Table 2-1)	1 and possible 3	none	none	none	previous waste-site radionuclide inventory, sampling and logging results, and soil/vegetation contaminant concentrations summarized (2.2.3.5, 3.3.1.5, and Tables 3-4 and 3-5)	In 1987, waste stream diverted to 216-A-45 Crib ---------- See Ref. 16 for waste stream effluent samples before discharge to the crib. Process used oxalic acid, which breaks down into chelans.
PW-2	216-B-12	7	Provides existing data for the 216-B-12 Crib; mention of associated piping from 221-U, 224-U, and 221-B Buildings (2.2.3.2) into the 216-B-12 Crib.	6-in. VCP (2.2.3.2)	not specified	direct buried	not specified	(N)	low salt, neutral/basic process condensate including limestone (2.2.3.2); neutral to basic, low salt, containing large amounts of uranium, fission products and tributyl phosphate (Table 2-1)	4	none	none	none	previous waste-site radionuclide inventory and logging results summarized (2.2.3.2 and 3.3.1.2).	Operated from 1957 to 1973
	216-A-36B	7	Provides existing data for the 216-A-36B Crib; mention of associated piping from 202-A (PUREX) to the 216-A-36B Crib (southern 500 ft of original 216-B-36 Crib).	not specified	not specified	direct buried	not specified	(N)	ammonia scrubber distillate waste (2.2.3.6); neutral to basic, low salt, containing large amounts of uranium (Table 2-1)	4 and possible 2	none	none	none	previous waste-site sampling and logging results, and soil/ vegetation contaminant concentrations summarized (2.2.3.2, 3.3.1.6, and Tables 3-4 and 3-5)	See Ref. 17 for waste stream effluent samples before discharge to the 216-A-36B Crib. Process used NaOH to scrub NH_3; aqueous NH_3 is basic.
		17	Provides waste stream characterization data for PUREX ammonia scrubber condensate that flowed into storage tanks in 1990; flowed into 216-A-36-B Crib until 1987 (p. v).	not specified	not specified	direct buried	not specified	(N)	contains ammonia (p. 2-8)	not specified	none	none	none	four waste stream samples taken (p. 3-1); results reported in Tables 3-2 to 3-5	none
PW-2 & PW-4	216-A-10 & 216-A-45	16	Provides waste stream characterization data for PUREX process condensate wastewater stream flow to the 216-A-45 Crib; flowed to 216-A-10 Crib until 1987 (p. 1-4).	not specified	not specified	direct buried	not specified	(N)	process condensate	1	none	none	none	eight waste stream samples taken in 1990 (p. 3-1); results reported in Tables 3-2 to 3-6	NOTE: Diverted waste stream from 216-A-10 Crib to the 216-A-45 Crib in 1987 (p. 1-4)
PW-4	216-S-22	25	Provides information on the 216-S-22 Crib; mentions associated piping from 293-S Acid Recovery Facility (p. 2-16).	4-in. VCP (p. 2-16)	7 ft (p. 2-16)	direct buried	none mentioned	(N)	liquid waste containing nitrate and sodium (p. 2-16)	likely 1	none	none	none	none	Acid recovery process generated acidic waste.
	216-A-37-1	7	Provides existing data for the 216-A-37-1 Crib; mention of associated piping from 242-A Evaporator to the 216-A-37-1 Crib.	not specified	not specified	direct buried	not specified	(N)	process condensate (2.2.3.8) containing ammonia and mixed waste from solvents (Table 2-1)	2,4	none	none	none	results summarized for logging of groundwater wells near waste site; additional data in Section 3.3.1.8	Process knowledge: waste believed to contain Am-241, Cs-137, H-3, I-129, Pm-147, Pu-239, Ru-106, Sn-113, and Sr-90 (2.2.3.8).
PW-5	216-B-11A & 216-B-11B	24	Provides information on the 216-B-11A and 216-B-11B Reverse Wells; mentions associated pipeline from the 242-B Evaporator (p. 2-31).	3-in. steel (p. 2-31)	not specified	direct buried	not specified	(N)	low salt, neutral to basic process condensate (p. 2-31)	4	none	none	none	waste contained Cs-137, Ru-106, Sr-90, plutonium, and uranium; "these two wells are placed... in line with a 7.6 cm (3-in.) steel inlet pipe" (p. 2-31)	none

Table D-1. Summary of Existing Characterization Data for Pipelines Systems. (12 Pages)

Process Waste OU	Disposal Sites with Assoc. Pipe	Ref. Source (see Notes)	Summary of Applicable Information	Pipeline Attributes: Pipe Material Type	Pipe Depth (bgs)	Pipe Burial Config [1]	Leaks/Plugs	Pipeline Pressure Tested (Y)=yes (N)=no	Waste Stream Information	Waste Type*	Available Types of Characterization Data: Camera Surveys Inside Pipelines	Soil or Vegetation Sampling Adjacent to Pipeline	Additional Pipeline Information/Results	Related Data	Other Results/Comments
PW-6	216-Z-4	11	Provides data for the effluent pipeline from the 231-Z Building into the 216-Z-4 Trench (p. 30) and summary of existing data for 216-Z-4 Trench.	not specified	not specified	direct buried	not specified	(N)	neutral/basic process and laboratory waste (p. 30)	4	none	none	none	previous waste-site radionuclide inventory data summarized (p. 31)	none
	216-Z-5		Provides data for the effluent pipeline from the 231-Z Building into the 216-Z-5 Crib (p. 32) and summary of existing data for 216-Z-5 Crib. Pipeline also may have received 300 Area laboratory wastes (p. 33).	3-in. SS (p. 32)	~ 11 ft	direct buried	not specified	(N)	process waste (p. 32); possibly 300 Area laboratory waste (p. 33)	possible 1	none	none	none	previous waste-site radionuclide inventory, scintillation probe, and well groundwater sampling data summarized (pp. 35-36)	Process solutions were low pH.
	216-Z-6		Provides data for the effluent pipeline from the 231-Z Building, via the 231-W-151 Sump Tank into the 216-Z-6 Crib (p. 37) and summary of existing data for the 216-Z-6 Crib.	3-in. iron (p. 37)	not specified	direct buried	not specified	(N)	neutral/basic process waste (pp. 38)	4	none	none	none	previous waste-site radionuclide inventory data summarized (p. 40)	none
	216-Z-8		Provides data for the effluent pipeline from the 234-5Z Building, via the overflow from the storage tank, into the 216-Z-8 French Drain (p. 49) and summary of existing data for 216-Z-8 French Drain.	4-in. steel (p. 49)	not specified	direct buried	not specified	(N)	neutral/basic RECUPLEX filter backflush	4	none	none	none	previous waste-site radionuclide inventory data summarized (p. 51)	none
	216-Z-10		Provides data for the effluent pipelines from the 231-Z Building into the 216-Z-10 Reverse Well (p. 62) and summary of existing data for the 216-Z-10 Reverse Well.	three 3-in. pipes (p. 62)	5, 6, and 7 ft (p. 62)	direct buried	not specified	(N)	neutral/basic process and laboratory waste (p. 62)	4	none	none	none	previous waste-site inventory reported as 50 g of plutonium; no other radionuclides reported (pp. 62, 64)	
SC-1	216-T-36	6	Includes limited information on the pipeline carrying steam condensate from the 221-T and 221-U Buildings and from 2706-T Building decontamination into the 216-T-36 Crib.	not specified	15 ft or less (because the crib depth is 15 ft bgs) (Table 2-4)	direct buried	not specified	(N)	steam condensate, decontamination waste, and miscellaneous waste (Table 2-4)	2,4	none	none	none	previous waste-site radionuclide inventory data/ditch information reported (Table C-4, p. C-35/C-36)	The majority of T Plant decontamination wastes were basic. A few were acidic.
CW-1	207-B	24	Provides information on the waste pipeline from the 242-B Evaporator to the 207-B Retention Basin (p. 2-58).	4-in. cast iron (p. 2-58)	not specified	direct buried	5 leaks in 1953, UN-200-E-79 (p. 2-58)	(N)	not specified	4	none	none	unplanned release occurred when five leaks were detected in the pipeline in June 1953; up to 2,500 cpm detected at points of emission (p. 2-58)	none	none
		9	Provides data for the 200-E-112 Pipeline, which consists of two process sewer lines (2904-E-1 and 2904-E-2) that carried B Plant water to the 207-B Retention Basin (Table 2-6).	2904-E-1 is 24-in. VCP; 2904-E-2 is 15-in. VCP	not specified	direct buried	not specified for 2904-E-1; 2904-E-2 found leaking in 1985 (Table 2-6)	(N)	two process sewer waste (Table 2-6)	4	none	none	none	none	A portion of the 2904-E-2 Pipeline was found to be leaking and was repaired in 1985; operated from 1944 to 1997 (Table 2-6).
	207-B, 216-B-3 & B Ponds	9	Provides data for the 200-E-126 Pipeline, which extends eastward from the 207-B Retention Basin to the 216-B-3 Ditch and B Pond System (Table 2-6).	24- to 30-in. corrugated metal, except one connector section (36-in. diameter) made of high-density polyethylene	not specified	direct buried	leaks inferred in Table 2-6	(N)	not specified	1,4	none	none	none	none	Operated from 1945 to 1997 (Table 2-6) Received PUREX effluent, which was 1 or 4 waste type.

Table D-1. Summary of Existing Characterization Data for Pipelines Systems. (12 Pages)

Process Waste OU	Disposal Sites with Assoc. Pipe	Ref. Source (see Notes)	Summary of Applicable Information	Pipeline Attributes							Available Types of Characterization Data				Other Results/Comments
				Pipe Material Type	Pipe Depth (bgs)	Pipe Burial Config[1]	Leaks/Plugs	Pipeline Pressure Tested (Y)=yes (N)=no	Waste Stream Information	Waste Type[a]	Camera Surveys Inside Pipelines	Soil or Vegetation Sampling Adjacent to Pipeline	Additional Pipeline Information/Results	Related Data	
	216-B-3 & B Pond System		Provides data for the 200-E-126 Pipeline, which extends eastward from the 207-B Retention Basin to the 216-B-3 Ditch and B Pond System (Table 2-6).	24- to 30-in. corrugated metal, except one connector section (36-in. diameter) made of high-density polyethylene	not specified	direct buried	leaks inferred in Table 2-6	(N)	not specified	1,4	none	none	none	none	Operated from 1945 to 1997 (Table 2-6). Received PUREX effluent, which was 1 or 4 waste type.
CW-1	241-B-154 Diversion Box & 207-B Retention Basin	24	Provides information on the 221-B Building cooling water pipeline to the 241-B-154 Diversion Box, then to the 207-B Retention Basin (pp. 2-59 to 2-60).	24-in. cast iron, 24-in. VCP (p. 2-60)	not specified	direct buried	1946 (UN-200-E -80) and 1966 (UN-200-E-1) leaks (p. 2-59)	(N)	not specified	4	none	none	metal waste leaked from pipeline in 1946, containing ~10 Ci fission products; 1966 leak apparently contained similar waste liquid (p. 2-59)	none	none
CW-5	Z Ditches	5	Includes characterization of pipeline from the 231-Z Building to the Z Ditches.	18-in. VCP (2.1.5)	not specified	direct buried	leakage suspected (2.1.5)	(N)	cooling water, steam condensate, and laboratory waste (Ref. 6, 3.3.2.1)	4	remote video (2.1.5)	none	one smear sample collected from pipe interior; analyzed for 17 rad analytes (2.1.5, 3.2.2); detected 23.5 pCi Pu-238, 1210 pCi Pu-239, 226 pCi and 813 pCi Am-241; 14 radionuclides undetected (Appendix C)	none	216-Z-11 may be difficult to distinguish because ditches overlap; several sources discharged to the 216-Z-11 Ditch (Fig. 2-4 and from Ref. 6: Figure 2-9 and Section 3.3.2).
			Includes characterization of pipeline from the 234-5 Building to the Z Ditches.	15-in. VCP (2.1.5)	not specified	direct buried	leakage suspected (2.1.5)	(N)	cooling water and steam condensate; assumed to contain plutonium and other transuranic elements (Ref. 6, 3.3.2.1)	not specified	remote video (2.1.5)	none	one smear sample collected from pipe interior; analyzed for 17 rad analytes (2.1.5, 3.2.2); detected 2.45 pCi Pu-238, 94.6 pCi Pu-239, 19.5 pCi and 23.5 pCi Am-241; 14 radionuclides undetected (Appendix C)	none	216-Z-11 may be difficult to distinguish because ditches overlap; several sources discharged to the 216-Z-11 Ditch (Fig. 2-4 and from Ref. 6: Figure 2-9 and Section 3.3.2).
CW-5	216-U-14	6	Includes limited information on pipeline carrying process sewer waste from the 221-U and 271-U Buildings into the 216-U-14 Ditch.	18-in. VCP (2.2.2.2, 3.3.1.1)	4 ft or less (because ditch depth is 4 ft bgs) (Table 2-1)	direct buried	not specified	(N)	chemical sewer wastewater, steam condensate, and cooling water (3.3.1.1)	not specified	none	none	none	previous waste-site sampling information reported (Tables 3-1 to 3-4) and summarized (3.3.1.2)	The 216-U-14 Ditch is a representative waste site characterized in Ref. 5. Several pipelines from different sources carried waste to the 216-U-14 Ditch (2.2.2.2, 3.3.1.1, Table 2-9).
	216-Z-20	27	Provides information on the 216-Z-20 Crib; mentions associated piping from the Z Plant (pp. 8-8 and 8-9).	18-in. VCP (p. 8-9)	not specified	direct buried	not specified	(N)	cooling water, steam condensate, storm sewer, building drain, chemical drains, laboratory drains, and miscellaneous drain waste (p. 8-8)	1,4	none	none	none	none	Crib is classified as a low-level waste site (p. 8-8). Chemical drain would convey acidic wastes.
			Provides information on the 216-Z-20 Crib; mentions associated piping from the Z Plant (pp. 8-8 and 8-9).	15-in. VCP (p. 8-9)	not specified	direct buried	not specified	(N)	cooling water, steam condensate, storm sewer, building drain, chemical drains, laboratory drains, and miscellaneous drain waste (p. 8-8)	not specified	none	none	none	none	Crib is classified as a low-level waste site (p. 8-8). Chemical drain would convey acidic wastes.

Table D-1. Summary of Existing Characterization Data for Pipelines Systems. (12 Pages)

Process Waste OU	Disposal Sites with Assoc. Pipe	Ref. Source (see Notes)	Summary of Applicable Information	Pipeline Attributes							Available Types of Characterization Data				Other Results/Comments
				Pipe Material Type	Pipe Depth (bgs)	Pipe Burial Config [7]	Leaks/Plugs	Pipeline Pressure Tested (Y)=yes (N)=no	Waste Stream Information	Waste Type*	Camera Surveys Inside Pipelines	Soil or Vegetation Sampling Adjacent to Pipeline	Additional Pipeline Information/Results	Related Data	
LW-1	216-T-28	26	Provides information on the 216-T-28 Crib; mentions associated piping from the 221-T Buildings, 2706-T Building, and 300 Area laboratory waste from the 340 Building (pp. 2-17 & 2-18).	14-in. steel reducing to 10-in. steel (p. 2-17)	8 ft (p. 2-17)	direct buried	not specified	(N)	liquid mixed waste containing nitrate; steam condensate decon. waste, misc. effluent, decon. waste, and laboratory waste (pp. 2-17 to 2-18)	2,4	none	none	none	none	Many of the decontamination wastes at T Plant were basic.
LW-2	216-Z-7	11	Provides data for the effluent pipeline from the 231-Z Building, via the 231-W-151 Sump Tank, into the 216-Z-7 Crib (p. 42) and summary of existing data for the 216-Z-7 Crib. Also 300 Area laboratory waste from the 340 Waste Neutralization Facility (p. 42).	3-in. iron (p. 41)	not specified	direct buried	not specified	(N)	231-Z process, laboratory, and operations waste; 300 Area laboratory waste (p. 42).	4	none	none	none	previous waste-site inventory, scintillation probe, and well groundwater sampling data summarized (pp. 45, 47–48)	none
	216-Z-16		Provides data for the effluent pipeline from the 231-Z Building into the 216-Z-16 Crib (p. 82) and summary of existing data for the 216-Z-16 Crib.	not specified	not specified	direct buried	not specified	(N)	neutral/basic Pacific Northwest Laboratory operations waste (p. 82)	4	none	none	none	previous waste-site inventory, scintillation probe, and well groundwater sampling data summarized (pp. 85-86)	none
	216-Z-17		Provides data for the effluent pipeline from 231-Z Building into the 216-Z-17 Trench (p. 87) and summary of existing data for 216-Z-17 Trench.	3-in. schedule 40 carbon steel (p. 87)	not specified	direct buried	not specified	(N)	neutral/basic Pacific Northwest Laboratory operations waste (p. 87)	4	none	none	none	previous waste-site radionuclide inventory data summarized (pp. 85-86, 90)	none
MW-1	216-Z-13	11	Provides data for the effluent pipeline from the 291-Z Building into the 216-Z-13 French Drain (p. 76) and summary of existing data for the 216-Z-13 French Drain.	4-in. pipe (p. 76)	~ 14 ft	direct buried	not specified	(N)	ET-8 exhaust fan steam condensate and floor drainage (p. 76)	4	none	none	none	none	Radionuclide content is unknown; low levels are assumed (p. 76)
	216-Z-14		Provides data for the effluent pipeline from the 291-Z Building into the 216-Z-14 French Drain (p. 78) and summary of existing data for the 216-Z-14 French Drain.	4-in. pipe (p. 78)	~ 14 ft	direct buried	not specified	(N)	ET-9 exhaust fan steam condensate (p. 78)	4	none	none	none	none	Radionuclide content is unknown; low levels are assumed (p. 78)
	216-Z-15		Provides data for the effluent pipeline from the 291-Z Building into the 216-Z-15 French Drain (p. 80) and summary of existing data for the 216-Z-15 French Drain.	4-in. pipe (p. 80)	~ 14 ft	direct buried	not specified	(N)	S-12 evaporator cooler drainage (p. 80)	4	none	none	none	none	Radionuclide content is unknown; low levels are assumed (p. 80)
	216-U-7	27	Provides information on the 216-U-7 French Drain; mentions associated piping from the 221-U Counting Box (p. 9-7).	3-in. schedule 40 steel (p. 9-7)	13 ft (p. 9-7)	direct buried	not specified	(N)	liquid waste from counting box floor drain (p. 9-7)	not specified	none	none	none	Appendix B shows radionuclide inventory and hazardous chemical inventory.	none
TW-1	200-E-114 Pipeline	14	Develops conceptual approach to closure of ancillary equipment (pipelines, Diversion Boxes, and similar structures) based on C Tank Farm (p. ES-1); includes limited information on the 200-E-114 Pipeline.	two 4-in. steel lines (p. 2-20)	not specified	direct buried	leak suspected – unplanned release site (p. 2-19)	(N)	not specified	possible 2	none	none	none	none	Used for transfer of tank farm liquid waste, which was basic
	216-B-14	24	Provides information on the 216-B-14 Crib; mentions associated pipeline from 221-U Building (p. 2-20).	14-in. steel (p. 2-20)	not specified	direct buried	not specified	(N)	high salt, neutral/basic scavenged tributyl phosphate waste (p. 2-20)	2	none	none	None	waste contained Cs-137, Ru-106, Sr-90, plutonium, uranium, ferrocyanide, nitrate, phosphate, sodium, sulfate-based compounds (p. 2-20)	none

Table D-1. Summary of Existing Characterization Data for Pipelines Systems. (12 Pages)

Process Waste OU	Disposal Sites with Assoc. Pipe	Ref. Source (see Notes)	Summary of Applicable Information	Pipeline Attributes							Available Types of Characterization Data				Other Results/Comments
				Pipe Material Type	Pipe Depth (bgs)	Pipe Burial Config [1]	Leaks/Plugs	Pipeline Pressure Tested (Y)=yes (N)=no	Waste Stream Information	Waste Type*	Camera Surveys Inside Pipelines	Soil or Vegetation Sampling Adjacent to Pipeline	Additional Pipeline Information/Results	Related Data	
TW-1	216-B-15		Provides information on the 216-B-15 Crib; mentions associated pipeline from 221-U Building (p. 2-21).	14-in. steel (p. 2-21)	6 ft (p. 2-21)	direct buried	not specified	(N)	high salt, neutral/basic scavenged tributyl phosphate waste (p. 2-21)	2	none	none	none	waste contained Cs-137, Ru-106, Sr-90, plutonium, uranium, ferrocyanide, nitrate, phosphate, sodium, and sulfate-based compounds (p. 2-21)	none
	216-B-16		Provides information on the 216-B-16 Crib; mentions associated pipeline from 221-U Building (pp. 2-21 and 2-22).	14-in. steel (p. 2-21)	6 ft (p. 2-21)	direct buried	not specified	(N)	high salt, neutral/basic scavenged tributyl phosphate waste (p. 2-22)	2	none	none	none	waste contained Cs-137, Ru-106, Sr-90, plutonium, uranium, ferrocyanide, nitrate, phosphate, sodium, and sulfate-based compounds (p. 2-22)	none
	216-B-17		Provides information on the 216-B-17 Crib; mentions associated pipeline from 221-U Building (p. 2-22).	14-in. steel (p. 2-22)	6 ft (p. 2-22)	direct buried	not specified	(N)	high salt, neutral/basic scavenged tributyl phosphate waste (p. 2-22)	2	none	none	none	waste contained Cs-137, Ru-106, Sr-90, plutonium, uranium, ferrocyanide, nitrate, phosphate, sodium, and sulfate-based compounds (p. 2-22)	none
	216-B-18		Provides information on the 216-B-18 Crib; mentions associated pipeline from 221-U Building (p. 2-22).	14-in. steel (p. 2-22)	6 ft (p. 2-22)	direct buried	not specified	(N)	high salt, neutral/basic scavenged tributyl phosphate waste (p. 2-22)	2	none	none	none	waste contained Cs-137, Ru-106, Sr-90, plutonium, uranium, ferrocyanide, nitrate, phosphate, sodium, and sulfate-based compounds (p. 2-22)	none
	216-B-19		Provides information on the 216-B-19 Crib; mentions associated pipeline from 221-U Building (p. 2-23).	14-in. steel (p. 2-23)	6 ft (p. 2-23)	direct buried	not specified	(N)	high salt, neutral/basic scavenged tributyl phosphate waste (p. 2-23)	2	none	none	none	waste contained Cs-137, Ru-106, Sr-90, plutonium, uranium, ferrocyanide, nitrate, phosphate, sodium, and sulfate-based compounds (p. 2-23)	none
	216-T-18	26	Provides information on the 216-T-18 Crib; mentions associated piping from 221-T Building (p. 2-15).	14-in. steel reducing to 10-in. steel (p. 2-15)	8 ft (p. 2-15)	direct buried	not specified	(N)	first-cycle scavenged tributyl phosphate supernatant wastes (p. 2-15)	not specified	none	none	none	none	Mentions "above-ground piping was removed…at completion of discharge" (p. 2-15); reference to inlet pipeline?
	216-T-26		Provides information on the 216-T-26 Crib; mentions associated piping from the T Plant (pp. 2-16 and 2-17).	14-in. steel reducing to 10-in. steel (p. 2-16)	9 ft (p. 2-16)	direct buried	not specified	(N)	first-cycle scavenged tributyl phosphate supernatant wastes; mixed waste containing ferrocyanide and other inorganics (pp. 2-16 to 2-17)	not specified	none	none	none	none	none
TW-2	216-B-7A & 216-B-7B	24	Provides information on the 216-B-7A and 216-B-7B Cribs; mentions associated piping (pp. 2-16 to 2-17).	3-in. steel (p. 2-16)	not specified	direct buried	not specified	(N)	1946-1961, low salt, alkaline rad waste from B Plant; 1961-1967, decon. construction waste from 221-B Bldg. (p. 2-17)	4	none	none	none	waste contained Cs-137, Ru-106, Sr-90, plutonium, uranium, and transuranic waste (p. 2-17)	One pipeline supplied both cribs simultaneously (p. 2-16).
TW-2	216-B-9	24	Provides information on the waste pipeline from the 221-B Building to the 216-B-9 Crib (pp. 2-58 to 2-59).	3.5-in. SS, unencased (p. 2-59)	7 ft (p. 2-59)	direct buried	1954 leak, UN-200-E-7 (p. 2-58)	(N)	not specified	likely 1	none	none	unplanned release occurred when a leak developed in the waste line; 1.7 rem/h contamination (p. 2-58)	none	WIDS associates leak with 241-B-361 Settling Tank (see discussion on pp. 2-58 to 2-59); monitoring well 299-E28-54 is very close to leak location (p. 2-59). This crib was designed for 1st cycle precipitation waste, which was acidic.

Table D-1. Summary of Existing Characterization Data for Pipelines Systems. (12 Pages)

Process Waste OU	Disposal Sites with Assoc. Pipe	Ref. Source (see Notes)	Summary of Applicable Information	Pipeline Attributes: Pipe Material Type	Pipe Depth (bgs)	Pipe Burial Config [1]	Leaks/Plugs	Pipeline Pressure Tested (Y)=yes (N)=no	Waste Stream Information	Waste Type*	Available Types of Characterization Data: Camera Surveys Inside Pipelines	Soil or Vegetation Sampling Adjacent to Pipeline	Additional Pipeline Information/Results	Related Data	Other Results/Comments
IS-1	Cross-site transfer pipes (241-UX-154 & 241-ER-151)	15	Provides information on the cross-site transfer pipelines, between 241-UX-154 Diversion Box and 241-ER-151 Diversion Box (p. ES-1); UPR-600-20 is associated with the Cross-Site Transfer System (2-1, 2-3).	six 3-in. type 347 SS lines in steel-reinforced concrete containment structure (pp. ES-1, 2-2)	5 ft to 15 ft (p. 2-2)	Lines in steel reinforced concrete encase-ment	4 of 6 plugged (ES-1)	(Y) Lines V360 and V361 were last pres- sure tested in the early 1980s and are considered sound Lines V-363, V-364, and V-366 are considered plugged and line V-363 may have integrity issues Line V-362 is considered unserviceable and may have integrity issues (RPP-25113)	high- and low-level radioactive waste; liquid waste for evaporative concentration (2-1)	2	none	To characteriz e the integrity of the pipeline, eight boreholes were auger drilled at four locations along the transfer line in 1988 (p. 2-5).	"No contamination was found below the encasement, but contamination was found in adjacent sagebrush, indicating that the roots had penetrated the encasement" (2-5). NOTE: In May 1995, the U.S. Department of Energy tested one of the remaining lines using pressurized water; results showed the line was intact. It was used to transfer supernatant from double-shell tank 241-SY-102 to the 200 Areas in August 1995 (p. 2-1).	none	UPR-600-20 consists of contaminated pipeline and encasement, any subsurface leaks, associated surface speck contamination, and contaminated vegetation on the surface of the cross-site transfer line. The surface above the pipeline became contaminated through biological transport of radioactive materials that leaked in the pipeline encasement and windblown particulates from the vent station (2-5). Waste was adjusted to high pH before transfer.
		28	Provides information on investigation along the cross-site transfer pipelines between 241-UX-154 Diversion Box and 241-ER-151 Diversion Box (p. 2)	six 3-in. internal diameter schedule 10S type 347 SS lines in steel-reinforced concrete encasement (p. 2)	5 ft to 15 ft (p. 2)	Lines in steel reinforced concrete encase-ment	not specified	(Y) same as above.	not specified	2	none	Soil samples from eight auger holes at four locatio ns along the pipeline (p. 8)	Soils near the encasement were free from contamination (p. 11); radiation found in adjacent sagebrush indicates that the roots have penetrated the encasement; caps have been left off swab risers during sampling, which could account for some contamination near risers (p. 14). Additional results on p. 12.	Soil surveys and analysis of vegetation, animals, and feces were conducted in June 1988 to determine if encasement was leaking (pp. 5, 8, and 11).	Associated with tank farm waste, which was high pH
	241-BX-154 Diversion Box	24	Provides information on two waste pipelines (V335 and V336) from the 221-B Building to the 241-BX-154 Diversion Box (p. 2-59).	unencased (p. 2-59)	3.5 ft (p. 2-59)	Stainless steel pipeline in 6-in. carbon steel encase-ment per drawing H-2-857	1951 (UN-200-E-3) and 1972 (UN-200-E-85) leaks (p. 2-59)	(Y) Line V-335 ruptured by heavy vehicle traffic in 1950 (Johnson 2007).	not specified	2,4	none	none	pipeline was not repaired after 1951 leak, because readings of 120 rem/h were detected with 46 cm (18 in.) of soil remaining (p. 2-59)	none	Associated with tank farm waste, which was high pH
IS-1	241-B-154 Diversion Box	24	Provides information on two steam condensate waste pipelines (V200 and V334) from sections 10 and 9, respectively, of the B Plant Concentrator (221-B Bldg) to the 241-B-154 Diversion Box (p. 2-59).	3.5-n SS (p. 2-59)	~12 ft (p. 2-59)	direct buried	two 1972 leaks, UN-200-E-103 and UN-200-E-44 (p. 2-59)	(Y) V-200 failed pressure test 7-14-1974 (Johnson 2007).	not specified	2,4	none	none	second leak probably resulted from failure of repairs made after the first leak (p. 2-59)	none	Steam condensate was near neutral pH.

Table D-1. Summary of Existing Characterization Data for Pipelines Systems. (12 Pages)

Process Waste OU	Disposal Sites with Assoc. Pipe	Ref. Source (see Notes)	Summary of Applicable Information	Pipeline Attributes: Pipe Material Type	Pipe Depth (bgs)	Pipe Burial Config[1]	Leaks/Plugs	Pipeline Pressure Tested (Y)=yes (N)=no	Waste Stream Information	Waste Type*	Available Types of Characterization Data: Camera Surveys Inside Pipelines	Soil or Vegetation Sampling Adjacent to Pipeline	Additional Pipeline Information/Results	Related Data	Other Results/Comments
	200-E-111 Pipeline	14	Develops conceptual approach to closure of ancillary equipment (pipelines, diversion boxes, and similar structures) based on C Tank Farm (ES-1); includes limited information on the 200-E-111 pipeline.	three 3.5-in. SS 11-gage tubing lines numbered V108, 8618, and 8653 (p. 2-19)	not specified	encased	leak suspected – unplanned release site (p. 2-19)	No info	not specified	2,4	none	none	none	none	Associated with tank farm waste, which was high pH
IS-1	200-E-116 Pipeline to 241-C-151 and -152 Diversion Boxes	14	Develops conceptual approach to closure of ancillary equipment (pipelines, diversion boxes, and similar structures) based on C Tank Farm (p. ES-1); includes limited information on the 200-E-116 Pipeline, which transported waste from the B Plant (241-B-154 Diversion Box) to the 241-C-151 and 241-C-152 Diversion Boxes in the C Tank Farm (p. 2-20).	Two 3.5-in. SS 11-gage tubing lines marked V130 and V111 (also known as V210) (p. 2-20)	not specified	direct buried	leak suspected - unplanned release site (p. 2-19)	(N)	radioactive mixed waste (p. 2-20) originating from B Plant	2,4	none	none	none	none	The 241-C-151 Diversion Box was determined to be the source of UPR-200-E-68 (p. 2-21). Associated with tank farm waste, which was high pH.
UW-1	216-U-1 & 216-U-2	3	For pipeline from U Plant to 216-U-1/2 Cribs: provides remote camera survey for pipe integrity; sampling of liquid within pipeline (4.2).	3.5-in. outside diameter SS; joints are butt-welded (4.2)	7 ft (4.2.2)	direct buried	No	(N)	acidic and high in radionuclides (4.2)	1	Yes	none	liquid from within the pipe was collected (4.2.2); pipe was intact with liquid in low spots (5.0); last 20-30 ft went on line before the 241-U-361 Settling Tank was filled with liquid; none of the soils exterior to the pipe showed signs of contamination (5.0); results to be reported in the 200-UP-2 limited field investigation summary report (4.2.2)	Surface rad survey (3.1.4.3)	none
		4	Additional information on activities reported in Ref. 3b; also reported 216-U-1/2 characterization data and operable unit risk assessment.	3.5-in. SS pipeline	not specified	direct buried	not specified	(N)	not specified	1	none	none	Wipe samples of pipeline interior showed up to 30,000 cpm, but the exterior of the pipe and the surrounding soils showed no activity (3.2.3).	Waste-site surface rad survey and soil sampling and subsurface gamma logging and soil sampling results discussed (3.2.1 to 3.2.5 and Tables 3-1 and 3-2)	SS may degrade at low pH and high heat.
	216-U-4A	27	Provides information on the 216-U-4A French Drain; mentions associated piping from the 216-U-4 Reverse Well (p. 9-6).	3-in. SS (p. 9-6)	~6 ft (p. 9-6)	direct buried	not specified	(N)	acidic plutonium and fission product decontamination waste (p. 9-6)	1	none	none	none	Appendix B shows radionuclide inventory and hazardous chemical inventory.	SS may degrade at low pH and high heat.
	216-U-8 & 216-U-12	27	Provides information on the 216-U-8 Crib; mentions associated piping from the 221-U and 224-U Buildings and the 291-U Stack (p. 9-8).	6-in. VCP in a 12-in. concrete encasement (p. 9-8)	not specified	direct buried	not specified	(N)	acidic process condensate and stack drainage (p. 9-8)	1	none	none	none	Appendix B shows radionuclide inventory and hazardous chemical inventory.	none
			Provides information on the 216-U-8 Crib; mentions associated pipeline from the 216-U-8 Crib feed line; waste from the 224-U Buildings, 291-U Stack, and tanks C-5 and C-7 (p. 9-9).	6-in. VCP (p. 9-9)	not specified	direct buried	not specified	(N)	acidic process condensate, stack drainage, tank, and storm drain wastes (p. 9-9)	1	none	none	none	Appendix B shows radionuclide inventory and hazardous chemical inventory.	none

Table D-1. Summary of Existing Characterization Data for Pipelines Systems. (12 Pages)

Process Waste OU	Disposal Sites with Assoc. Pipe	Ref. Source (see Notes)	Summary of Applicable Information	Pipeline Attributes: Pipe Material Type	Pipe Depth (bgs)	Pipe Burial Config[1]	Leaks/Plugs	Pipeline Pressure Tested (Y)=yes (N)=no	Waste Stream Information	Waste Type*	Available Types of Characterization Data: Camera Surveys Inside Pipelines	Soil or Vegetation Sampling Adjacent to Pipeline	Additional Pipeline Information/Results	Related Data	Other Results/Comments
		3	For pipeline from 222-U and 224-U Buildings to 216-U-8/-12 Cribs: provides remote camera surveys for pipe integrity (4.1), surface soil and vegetation sampling (3.2, 4.1), subsurface soil sampling (4.1), and surface rad survey (3.1.4.3).	6-in. VCP with acid-proof joints (4.1)	7-12 ft (3.1.4.3)	direct buried	leaks suspected because of joint condition (4.1.2.1)	(N)	acidic (4.1)	1	115 m of older (to 216-U-8) pipe section and 25 m of newer (to 216-U-12) pipe section (Fig. 5)	soil samples (23) collected from seven areas at surface, at pipe depth, and midway between along the path of older (216-U-8) pipe section (4.1.2.2, Figure 7); analysis was for rad and select chemical constituents (3.0)	pipe relatively intact except joints of older section (5.0); sampling results summarized in App. A and App. B.	surface rad survey (3.1.4.3) showed clear pattern where VCP was located (4.1.1)	NOTE: Schedule 40 SS pipe routed around 2715-U Building, then changes to a 6-in. VCP as reported here (4.1).
UW-1	216-U-8 & 216-U-12	4	Reported additional information on pipeline activities reported in Ref. 3a; also reported 216-U-8/12 Crib characterization data and operable unit risk assessment.	6-in. VCP	not specified	direct buried	Leaks suspected because of joint condition (3.4.2)	(N)	not specified	1	none	18 soil and 8 vegetation samples	Maximums generally were found near VCP (except in vegetation for Sr-90); lateral movement of contaminants was minimal (3.4.3); sample results for maximum concentrations in Tables 3-4 and 3-5; many of the older (216-U-8) joints were dislodged; the degree of dislodging varied from minor to very serious (3.4.2).	waste-site sampling and borehole logging results (3.4.3 to 3.4.5 and Tables 3-4 to 3-7)	none
		7	Provides existing data for the 216-U-8 Crib, with information on the pipeline that carried waste from the 221-U and 224-U Tanks and the 291-U-1 Stack (2.2.3.3) to the 216-U-8 Crib.	6-in. VCP (2.2.3.3)	not specified	direct buried	leaks suspected because of joint condition (3.3.1.3)	(N)	acidic process condensate and stack drainage (2.2.3.3)	1	none	vegetation sampling near pipeline	detected 426 pCi/g Am-241, 49,100 pCi/g Cs-137, 70.6 pCi/g Pu-239/240, and 1,380 pCi/g Sr-90 (3.3.1.3, Tables 3-2 and 3-3)	previous waste-site logging results, borehole data, and soil/vegetation contaminant concentrations summarized (3.3.1.3 and Tables 3-2 to 3-5)	Operated from 1952 until crib was replaced by 216-U-12 in 1960 (2.2.3.3)
			Provides existing data for the 216-U-12 Crib, with information on the pipeline carrying waste from the U Plant (291-U-1 Stack drainage, 244-WR Vault waste, 224-U process condensate, storm drain, and Tank C-7 waste, 224-B waste from Tanks C-5 and C-7 [2.2.3.4]) to the 216-U-12 Crib.	6-in. VCP	17 ft at crib inlet (3.3.1.4)	direct buried	not specified	(N)	corrosive (D0002) mixed waste (2.2.3.4) containing nitrate and tributyl phosphate	not specified	none	none	none	Previous waste-site soil/vegetation sampling and logging results summarized (2.2.3.4, 3.3.1.4 and Tables 3-4 and 3-5)	Replaced 216-U-8 Crib in 1960, and was replaced by 216-U-17 Crib in 1988. Pipeline runs from 216-U-8 Crib feed line to 216-U-12 Crib.

Table D-1. Summary of Existing Characterization Data for Pipelines Systems. (12 Pages)

Process Waste OU	Disposal Sites with Assoc. Pipe	Ref. Source (see Notes)	Summary of Applicable Information	Pipeline Attributes							Available Types of Characterization Data				Other Results/Comments
				Pipe Material Type	Pipe Depth (bgs)	Pipe Burial Config†	Leaks/Plugs	Pipeline Pressure Tested (Y)=yes (N)=no	Waste Stream Information	Waste Type*	Camera Surveys Inside Pipelines	Soil or Vegetation Sampling Adjacent to Pipeline	Additional Pipeline Information/Results	Related Data	
UW-1	216-U-8	27	Provides information on the 216-U-8 Crib; mentions associated piping between the three crib structures (p. 9-8).	6-in. schedule 40 steel (p. 9-8)	not specified	direct buried	not specified	(N)	acidic process condensate and stack drainage (p. 9-8)	1	none	none	none	Appendix B shows radionuclide inventory and hazardous chemical inventory.	SS may degrade at low pH and high heat.
	216-U-16	27	Provides information on the 216-U-16 Crib; mentions associated pipeline from 224-U, 221-U, and 271-U (pp. 9-11 and 9-12).	from distribution box through two 8-in. PVC header pipes (p. 9-11)	not specified	direct buried	not specified	(N)	steam and process condensate, chemical sewer waste, and compressor cooling water (p. 9-12)	not specified	none	none	none	Appendix B shows radionuclide inventory and hazardous chemical inventory.	none
	216-U-17	27	Provides information on the 216-U-17 Crib; mentions associated pipeline from UO_3 process condensate (p. 12).	6-in. poly-ethylene	not specified	direct buried	not specified	(N)	process condensate	not specified	none	none	none	Appendix B shows radionuclide inventory and hazardous chemical inventory.	none
		18	Provides waste stream characterization data for UO_3 Plant condensate stream that flowed from 224-U to the 216-U-17 Crib until July 1989, when discharge was temporarily suspended (pp. v, 2-5).	not specified	not specified	direct buried	not specified	(N)	neutralized process condensate	not specified	none	none	none	5 waste stream samples taken in 1990 (p. 3-1); results in Appendix A, Tables 3-2 and 3-3	NOTE: Moved waste stream from 216-U-12 Crib to 216-U-17 Crib in 1988 (p. 1-4).
	241-C-152 Diversion Box	1	Provides data summary from investigation of leak in the V-122 line that carried 221-B Building cesium ion-exchange process feed from the 241-C-105 Tank to the 241-C-152 Diversion Box (p. 2).	3-in. SS to 3-in. carbon steel (p. 3)	11 ft (p. 3)	direct buried	Leak detected visually in Dec 1969 near the 241-C-152 Diversion Box; at joint with polyethylene gasket (p. 2)	(Y) Pressure tested to 200 psig for 30 minutes when installed in July 1964.	high-level liquid waste containing Cs-137 as a major constituent (p. 2)	2	none	soil samples collected from 10 wells drilled from 4 to 16 ft from pipeline leak source and to depths of 30 ft (p. 2)	radiological data used to plot three general concentration zones (Fig. 7, p. 12); radionuclides reported were Cs-137, Ce-144, Zr, Nb-95, Ru-106, and Cs-134 (p. 3); soil results summarized (p. 13)	none	none
Waste Manage-ment Area	241-C-151, -152, and -153 Diversion Boxes	20	Planned UPR-200-E-82 borehole sampling and near-surface characterization using direct pushes (pp. 6-14 & 6-17). Will provide geophysical data and soil samples near the 241-C-151, -152, and -153 Diversion Boxes (and an unplanned release site near the 241-C-152 Diversion Box – p. 6-7).	not specified	not specified	NA	Past leak event (p. 6-7)	(N)	high-activity derivatives of PUREX waste (p. 6-7)	2,4	none	samples to be collected	to be reported: data for a complete set of radiological and chemical contaminants (p. 6-14)	Samples may be collected.	Purposes: to determine extent and magnitude of vertical Tc-99 migration (p. 6-13); to provide useful indication of effects of tank structures on infiltration rates (p. 6-7; to provide pipeline status, sample the pipe, or external pipe tests (pp. 6-13 to 6-14); and to provide contaminant concentration and distribution data (p. 6-18). Field reports for geophysical logging will be prepared after direct pushes are completed.

Table D-1. Summary of Existing Characterization Data for Pipelines Systems. (12 Pages)

Process Waste OU	Disposal Sites with Assoc. Pipe	Ref. Source (see Notes)	Summary of Applicable Information	Pipeline Attributes: Pipe Material Type	Pipe Depth (bgs)	Pipe Burial Config†	Leaks/Plugs	Pipeline Pressure Tested (Y)=yes (N)=no	Waste Stream Information	Waste Type*	Available Types of Characterization Data: Camera Surveys Inside Pipelines	Soil or Vegetation Sampling Adjacent to Pipeline	Additional Pipeline Information/Results	Related Data	Other Results/Comments
Waste Manage-ment Area	241-B-151, -152, and -153 Diversion Boxes	21	Will provide geophysical data and the potential for soil samples near the 241-B-151, -152, and -153 Diversion Boxes (unplanned release site – p. 5-4).	not specified	not specified	NA	metal waste leaks in vicinity of 241-B-151, -152, and -153 Diversion Boxes (p. 5-5)	NA	metals, uranium, and possibly Tc-99 (Ref. 21, p. 4-10)	not specified	none	Samples may be collected near corners of Diversion Boxes from 10 ft bgs to base of the tanks (p. 4-10).	to be reported: gamma logging and potential soil sampling results (p. A-25)	Samples may be collected.	Purpose: to determine effectiveness of reported past clean-up and whether additional investigations are required (p. A-25). Field reports will be prepared after direct pushes are completed.
Various	Multiple	2	Provides summary of existing information on various waste sites.	not specified	not specified	NA	not specified	NA	not specified	not specified	none	none	none	none	none
	C Tank Farm	22, 23	Provides information about eight borings drilled to assess soils adjacent to leak in process transfer line from 244-AR Vault to the C Tank Farm (Ref. 22, Vol 1, p. 102; Ref. 23, p. 1).	2-in. line; carbon steel and SS (Ref. 22, Vol 1, p. 104; Ref. 23, p. 2)	8 ft (Ref. 22, Vol 1, p. 104; Ref. 23, p. 2)	direct buried	line leak (Ref. 22, Vol 1, p. 102; Ref. 23, p. 1)	(N)	process waste containing Cs-137 (Ref. 22, Vol 1, p. 102; Ref. 23, pp. 1- 2)	not specified	none	soil samples collected from eight test wells; number of samples not specified (Ref. 22, Vol 1, p. 104; Ref. 23, p. 2)	8 test wells (Ref. 22, Vol 1, p. 103; Ref. 23, p. 1); soil contamination up to 334 µCi/g Cs-137; samples near pipeline showed contamination zone near location of a carbon steel to SS joint in the pipeline (Ref. 22, Vol 1, pp. 104, 106; Ref. 23, pp. 2,4)	none	none
	Pipes under 221-U Building	8	Provides data for two (north and south) sections of drainline under 221-U Process Cells into Tank 5-6 in 221-U Process Cell 10 (2.4.4) as part of further characterization activities identified in the Phase 1 feasibility study (2.4).	24-in. VCP under building (2.4.4)	not specified	direct buried	none detected (2.4.4)	(N)	not specified	not specified	remote video and gamma (2.4.4)	none	Two (one each from south and north sections) "opportunistic" samples of residual on robotic crawler were collected from inside the pipe (2.4.4); south section sample contained rad levels ~2 orders of magnitude greater than in the north section, where transuranic activity >100 nCi/g, and elevated levels of chromium, lead, and Aroclor-1254 (expired trademark) occurred. The north section sample contained elevated mercury and phthalates (2.4.4); for both samples ("radionuclide concentrations characteristic of the 221-U facility and processes"). Overall dose rates in pipe ~100 mrem/h (2.4.4). Complete sample data in Table 2-2.	none	none

Table D-1. Summary of Existing Characterization Data for Pipelines Systems. (12 Pages)

Process Waste OU	Disposal Sites with Assoc. Pipe	Ref. Source (see Notes)	Summary of Applicable Information	Pipeline Attributes							Available Types of Characterization Data				Other Results/Comments
				Pipe Material Type	Pipe Depth (bgs)	Pipe Burial Config†	Leaks/Plugs	Pipeline Pressure Tested (Y)=yes (N)=no	Waste Stream Information	Waste Type*	Camera Surveys Inside Pipelines	Soil or Vegetation Sampling Adjacent to Pipeline	Additional Pipeline Information/Results	Related Data	
Various	Pipes under 221-U Building	10	Provides summary of existing data for a cell drainage tile line to cell 10 in 221-U.	24-in. VCP encased (within building)	not specified	Encased	not specified	no info	not specified	not specified	none	none	none	none	none

Referenced Sources:

1 ARH-1945, *B Plant Ion Exchange Feed Line Leak.*
2 ARH-2155, *Radioactive Liquid Waste Disposal Facilities 200 West Area.*
3 BHI-00033, Rev. 0, *Surface and Near-Surface Field Investigation Data Summary Report for the 200-UP-2 Operable Unit.*
4 DOE/RL-95-13, Rev. 0, *Limited Field Investigation for the 200-UP-2 Operable Unit.*
5 DOE/RL-2003-11, *Remedial Investigation for: the 200-CW-5 U Pond/Z Ditches Cooling Water Group, the 200-CW-2 S Pond and Ditches Cooling Water Group, the 200-CW-4 T Pond Cooling Water Group, and the 200-SC-1 Steam Condensate Group Operable Units.*
6 DOE/RL-99-66, Rev. 1, *U Pond/Z Ditches Cooling Water Group Operable Unit RI/FS Work Plan, Including the 200-CW-5, 200-CW-2, 200-CW-4, and 200-SC-1 Operable Units.*
7 DOE/RL-2000-60, Rev. 1, Re-issue, *Uranium-Rich/General Process Condensate and Process Waste Group Operable Unit RI/FS Work Plan and RCRA TSD Unit Sampling Plan.*
8 DOE/RL-2001-11, Rev. 0, *Final Feasibility Study for the Canyon Disposition Initiative (221-U-Facility).*
9 DOE/RL-2002-69, *Draft A Feasibility Study for the 200-CW-1 and the 200-CW-3 Operable Units and the 200 North Area Waste Sites.*
10 HW-19140, *Uranium Recovery Technical Recovery Manual.*
11 RHO-LD-114, *Existing Data On the 216-Z Liquid Waste Sites.*
12 RHO-ST-21, *Report on Plutonium Mining Activities at 216-Z-9 Enclosed Trench.*
13 RHO-ST-44, *216-Z-12 Transuranic Crib Characterization: Operational History and Distribution of Plutonium and Americium.*
14 RPP-20604, *Ancillary Equipment Disposition Study.*
15 RPP-20605, *Cross-Site Transfer System Disposition Study.*
16 WHC-EP-0342, Addendum 12, *PUREX Plant Process Condensate Stream-Specific Report.*
17 WHC-EP-0342, Addendum 14, *PUREX Plant Ammonia Scrubber Condensate Stream-Specific Report.*
18 WHC-EP-0342, Addendum 19, *UO3 Plant Process Condensate Stream-Specific Report.*
19 WHC-SD-NR-ER-103, *Final Report for the Remote CCTV Survey of Abandoned Process Effluent Drain Lines 840 and 840D in Support of the 200 West Area Carbon Tetrachloride ERA.*
20 RPP-16608, Rev. 1, *Site-Specific Single-Shell Tank Phase 1 RCRA Facility Investigation/Corrective Measures Study Work Plan Addendum for Waste Management Areas C, A-AX, and U.*
21 RPP-6072, Rev. 1, *Site-Specific SST Phase 1 RFI/CMS Work Plan Addendum for WMA-B-BX-BY.*
22,23 ARH-1972, included in RHO-CD-673 as pp. 103-106, *Handbook 200 Areas Waste Site (RHO-CD-673); PSS Line Leak (Line No. 812).*
24 DOE/RL-92-05, *B Plant Source Aggregate Area Management Study Report.*
25 DOE/RL-91-60, *S Plant Source Aggregate Area Management Study Report.*
26 DOE/RL-91-61, *T Plant Source Aggregate Area Management Study Report.*
27 BHI-00174, *U Plant Aggregate Area Management Study Technical Baseline Report.*
28 80322-88-090, *Surface Contamination Investigation Report, Cross-Country Waste Transfer Line*, letter report from R. E. Wheeler to J. C. Bergam, Westinghouse Hanford Company, Richland, Washington.
29 H-2-857, rev. 7, 1964, *Piping Layout 154 BX*, Hanford Engineering Works.
30 Johnson, M. E., 2007, *Information on Process Waste Pipeline Failures Due to Corrosion.*
31 RPP-25113, *Residual Waste Inventories in the Plugged and Abandoned Pipelines at the Hanford Site.*

† All pipeline burial configuration information was derived from design drawings available in WIDS

*Waste Stream Type No:
1= Very Acidic.
2= High Salts/Very Basic.
3= Chelates/High Salt.
4= Low Salts/Near Neutral.

OU = Operable Unit
PUREX = Plutonium-Uranium Extraction (Plant or process).
RECUPLEX = Recovery of Uranium and Plutonium by Extraction (Plant or process).
SS = stainless steel.
VCP = vitrified clay pipeline.
WIDS = *Waste Information Data System* database.

Table D-2. Waste Information Data System Summary for 200-IS-1 Operable Unit Pipeline Systems. (14 Pages)

Count	Site Code	Site Names	Location	Dates of Operation	Associated Facilities or Structures	General Description	Site Type	Associated UPR Waste Site(s)	Site Dimensions/ Area	Contaminant Inventory/Volume Released	Radiation Survey/Soil Sampling Information
1	200-W-7	200-W-7, 246-L, 241-S-TK-1, 243S-TK-1, 243-S-TK1, 200W Personnel Decontamination Facility catch tank, IMUST, Inactive Miscellaneous Underground Storage Tank	The site is located northwest of the 242-S Evaporator and just north of the MO-326 trailer.	1978 to 1988	Associated with the MO-0326 trailer. It was the personnel decontamination facility for the 200 West Tank Farms.	The underground tank is inside a chained area that measures approximately 3 by 3 m (9 by 9 ft), with three risers extending to the surface. The tank is posted with IMUST signs and radiological postings.	Catch Tank	none	3 x 3 m (10 x 10 ft)	Waste contents would contain low levels of radionuclides.	none
2	240-S-302	240-S-302, 240-S-302 Catch Tank, IMUST, Inactive Miscellaneous Underground Storage Tank	This unit is located north of the 202-S Building and east of the 240-S-151 Diversion Box.	1950 to 1987	Associated with the 240-S-151 Diversion Box.	This unit is a horizontal, cylindrical, steel tank. The 240-S-302 Catch Tank is buried underground to provide shielding from radiation. The tank is surrounded with posts and chain and is posted with radiological and IMUST signs.	Catch Tank	none	not available	Tank received leakage, spillage, line flushes, and drainage associated with waste transfers. In 1985, the tank was confirmed to be a leaker. Approximately 600 gal of rainwater were released between June 1985 and January 1986.	none
3	241-A-302A	241-A-302A, 241-A-302-A Catch Tank	The catch tank is located south of the east end of the 202-A Building and west of the 241-A-151 Diversion Box. It is located inside the PUREX security fence.	1956 to ?	Associated with the 241-A-151 Diversion Box.	The unit is an underground, cylindrical vessel made of carbon steel. It sits inside a pump pit with a riser extending to the surface. It is surrounded with posts and chain and is marked with radiological signs.	Catch Tank	none	not available	1996 waste estimated as 6418 L (1698 gal)	none
4	241-B-302B	241-B-302B, 241-B-302-B Catch Tank, 241-B-302, IMUST, Inactive Miscellaneous Underground Storage Tank	This catch tank is located north of the 241-B-154 Diversion Box, adjacent to the corner of 7th Street and Baltimore Avenue.	1945 to 1985	Associated with B Tank Farm and 241-B-154 Diversion Box.	This unit is an underground, horizontal carbon steel tank. The catch tank and the 241-B-154 Diversion Box are surrounded with post and chain. The surface of the area inside the chain has been covered with gravel and sprayed with gray weatherizing material. The site is marked with radiological and IMUST signs.	Catch Tank	none	not available	1985 estimated volume of liquid as 16,027 L (4249 gal) and sludge as 2608 L (690 gal)	none
5	241-BX-302B	241-BX-302B, 241-BX-302-B Catch Tank, IMUST, Inactive Miscellaneous Underground Storage Tank	The 241-B-302B Catch Tank is located on the south side of the 221-B Building (near section 12), and northwest of 241-BX-154 Diversion Box.	1948 to 1985	Associated with 241-BX-154 Diversion Box and BX Tank Farm.	The buried tank is covered with gravel. It is surrounded with post and chain. The tank is marked with radiological and IMUST signs.	Catch Tank	none	not available	estimated residual volume of supernate as 355 L (94 gal) and sludge as 3591 L (950 gal)	none
6	241-BX-302C	241-BX-302C, 241-BX-302-C Catch Tank, IMUST, Inactive Miscellaneous Underground Storage Tank	The 241-BX-302C Catch Tank is located southeast of 241-BX -155 Diversion Box, between Atlanta Avenue and Baltimore Avenue.	1948 to 1985	Associated with the 241-BX-155 Diversion Box and BX Tank Farm.	This catch tank is a horizontal cylinder of direct buried carbon steel. It is inside a recently graveled URM area, related to the 241-BX-155 Diversion Box surface stabilization. The tank was not covered with extra gravel and is separately posted as a CA. The tank is marked with radiological and IMUST signs.	Catch Tank	none	not available	1984 estimated volume of sludge as 2400 L (635 gal) and supernate as 862 L (228 gal)	none
7	241-ER-311	241-ER-311, 241-ER-311 Catch Tank, 241-ER-311A Replacement Tank	The tank is located south of the B Plant, and west of Atlanta Avenue, inside the 241-ER-151 Diversion Box fence.	1954 to 1991	Associated with the 241-ER-311A Catch Tank, 241-ER-151, 241-ER-152, and 241-ER-153 Diversion Boxes, automatic liquid level sensors, leak detection, and a submersible pump.	The underground tank is located inside the 241-ER-151 Diversion Box locked chain link fence. The fence is posted as a CA and a URM area, and is labeled with IMUST signs. The placement of these structures within the fence is that the 241-ER-311 Catch Tank is the furthest south, nearest the chain link fence. The 241-ER-311A Catch Tank is located adjacent to the north side of the 241-ER-311 tank (in the middle of the three structures). The 241-ER-151 Diversion Box is north of the 241-ER-311A Catch Tank.	Catch Tank	UPR-200-E-84	not available	not available	none

Table D-2. Waste Information Data System Summary for 200-IS-1 Operable Unit Pipeline Systems. (14 Pages)

Count	Site Code	Site Names	Location	Dates of Operation	Associated Facilities or Structures	General Description	Site Type	Associated UPR Waste Site(s)	Site Dimensions/ Area	Contaminant Inventory/Volume Released	Radiation Survey/Soil Sampling Information
8	241-ER-311A	241-ER-311A, 241-ER-311A Catch Tank, old 241-ER-311, original 241-ER-311 Catch Tank, IMUST, Inactive Miscellaneous Underground Storage Tank	This unit is below grade. The tank is located southwest of the B Plant. It is south of 7th Street and west of Atlanta Avenue.	1950 to 1954	Associated with the 241-ER-151 Diversion Box.	It is located within a chain link fence that is posted as a CA and a URM area, and is labeled with IMUST signs. The 241-ER-151 Diversion Box, the 241-ER-311 Catch Tank, and the 241-ER-311A Catch Tank all are located inside this chain link fence. The placement of these structures within the fence is that the 241-ER-311 Catch Tank is the furthest south, nearest the chain link fence. The 241-ER-311A Catch Tank is located adjacent to the north side of the 241-ER-311 Catch Tank (in the middle of the three structures). The 241-ER-151 Diversion Box is north of the 241-ER-311A Catch Tank.	Catch Tank	none	not available	not available	none
9	241-EW-151	241-EW-151, 241-EW-151 Vent Station Catch Tank, 241-EW-151 Vent Station, Vent Station, 200 Area East-West Vent Station	The site is located south of Route 3, approximately halfway between the 200 East and West Areas. It is south of the 609-A Fire Station.	1955 to ?	This site is part of the Cross-Site Waste Transfer System and is associated with Diversion Boxes 241-UX-154 (200 West) and 241-ER-151 (200 East). The vent station is associated with the cross-site transfer line that runs between Diversion Boxes 241-UX-154 (200 West) and 241-ER-151 (200 East).	The vent station is enclosed in a locked, chain link fence. It consists of an underground concrete structure containing a SS tank in a vault with a jumper pit above the tank. The tank has two vent risers that extend above grade and a riser for the unit's leak detection system. At the bottom of the stairwell access is a floor drain that connects to a nearby french drain. Several hazard and radiological warning signs are posted on the fence. Also, two areas outside the fence, adjacent to the northeast side of the vent station, are posted with URM area signs.	Catch Tank	UPR-600-20	not available	not available	none
10	241-TX-302B	241-TX-302B, 241-TX-302-B Catch Tank, IMUST, Inactive Miscellaneous Underground Storage Tank	This tank is located east of the TX Tank Farm, northeast of the 241-TX-155 Diversion Box.	1949 to 1982	Associated with the 241-TX-155 Diversion Box, and 241-TX-302BR Catch Tank.	This unit is an underground cylindrical tank made of steel. The ground surface around the tank has been covered with gravel. The tank is surrounded with light posts and chain and is posted with CA and IMUST signs.	Catch Tank	UPR-200-W-131	not available	1984 estimated volume waste as 4987 L (1320 gal).	Tank sampled in 1984; reported dose rate of 24 mrad/h and pH 9.95
11	241-TX-302BR	241-TX-302BR, 241-TX-302BR Catch Tank, 241-TXR-302BR, IMUST, Inactive Miscellaneous Underground Storage Tank	The 241-TX-302BR Catch Tank is located east of the 241-TX-155 Diversion Box. It is located east of Camden Avenue and south of 23rd Street.	1950 to 1954	Associated with UPR-200-W-131, 241-TX-155 Diversion Box, 241-TX-302B Catch Tank, and 216-T-20 Acid Pit.	This unit is an underground horizontal, cylindrical tank made of steel. The ground surface around the tank has been covered with gravel. The tank is surrounded with posts and chain and is labeled with IMUST signs.	Catch Tank	none	not available	not available	none
12	241-TX-302C	241-TX-302C, 241-TX-302-C Catch Tank	The 241-TX-302 Catch Tank is located southeast of the center of the 221-T Building.	1949 to ?	Associated with the 241-TX-154 Diversion Box.	This unit is an underground horizontal, cylindrical tank made of carbon steel. The tank area has been sprayed with shotcrete to control surface contamination.	Catch Tank	UPR-200-W-38	not available	not available	none
13	240-S-151	240-S-151, 240-S-151 Diversion Box	The 240-S-151 Diversion Box is located north of the 202-S Canyon Building.	1950 to 1987	Associated with the 240-S-302 Catch Tank, UPR-200-W-82, and S Tank Farm.	This unit is constructed of reinforced concrete and is rectangular. The 240-S-151 Diversion Box has been weather covered.	Diversion Box	UPR-200-W-82	not available	not available	none
14	240-S-152	240-S-152, 240-S-152 Diversion Box	The 240-S-152 Diversion Box is located north of the 202-S Canyon Building.	1977 to 1980	Associated with 240-S-302 Catch Tank and S Tank Farm.	This unit is constructed of reinforced concrete and is rectangular. The 240-S-152 Diversion Box has been weather covered.	Diversion Box	none	not available	not available	none
15	241-A-151	241-A-151, 241-A-151 Diversion Box	The diversion box is located south of the east end of the 202-A Building.	1956 to ?	Associated with 241-A-302-A Catch Tank, A and AX Tank Farms.	The site is a reinforced concrete structure with cover blocks. Most of the structure is below grade. It is marked and radiologically posted.	Diversion Box	UPR-200-E-25, UPR-200-E-26, UPR-200-E-31, UPR-200-E-42, UPR-200-E-65	not available	Multiple UPRs. Highly concentrated process wastes have contaminated the inside of the diversion box.	none
16	241-B-154	241-B-154, 241-B-154 Diversion Box	The unit is located east of 221-B, at the intersection of Baltimore Avenue and 7th Street.	1945 to 1984	Associated with B Plant, 241-B-302 Catch Tank, 241-B-151, 241-B-152, and 200-E-116.	The site is a diversion box that interconnects the 241-B-151 and 241-B-152 Diversion Boxes with the 221-B Building. The unit is a rectangular, reinforced concrete structure. It was sprayed with gray, weatherizing foam. Later, a layer of shotcrete was placed over the diversion box, extending beyond the structure to include the surrounding ground surface.	Diversion Box	UPR-200-E-45, UPR-200-E-77	not available	Diversion box may contain about 23 kg (50 lb) of lead shielding.	none

Table D-2. Waste Information Data System Summary for 200-IS-1 Operable Unit Pipeline Systems. (14 Pages)

Count	Site Code	Site Names	Location	Dates of Operation	Associated Facilities or Structures	General Description	Site Type	Associated UPR Waste Site(s)	Site Dimensions/ Area	Contaminant Inventory/Volume Released	Radiation Survey/Soil Sampling Information
17	241-BX-154	241-BX-154, 241-BX-154 Diversion Box	This Diversion Box is located south of the 221-B Building and east of the 241-BX-302B Catch Tank.	1948 to 1985	Associated with the 241-BX-302-B Catch Tank and the BX Tank Farm. This unit interconnects the 241-B-252 and 241-BX-155 Diversion Boxes and the 221-B Building.	This diversion box is a reinforced concrete structure.	Diversion Box	UPR-200-E-77	not available	not available	none
18	241-BX-155	241-BX-155, 241-BX-155 Diversion Box	This Diversion Box is located northeast of B Plant on the south side of Atlanta Avenue.	1948 to 1984	Associated with the 241-BX-302-C Catch Tank and the BX Tank Farm.	This diversion box is a reinforced concrete structure. The diversion box has been isolated and covered with waterproof foam sealant. The area around the diversion box has been surface stabilized with gravel and posted with URM area signs, except for the surface area above the 241-B-302-C Catch Tank. This area does not have the additional layer of gravel and remains posted as a CA.	Diversion Box	UPR-200-E-78	not available	not available	none
19	241-C-154	241-C-154, 241-C-154 Diversion Box	The Diversion Box is located south of 7th Street, southeast of the (demolished) 201-C Process Building and northeast of the 216-C-1 Crib.	1946 to 1985	Associated with the 201-C C-Cell, the B Plant Promethium Transfer Line (line V743), and 200-E-41 stabilized area.	The diversion box has been covered with clean backfill material (ash) and is no longer visible. It is located within the larger Hot Semiworks Facility surface stabilized area (200-E-41).	Diversion Box	none	not available	not available	none
20	241-ER-151	241-ER-151, 241-ER-151 Diversion Box	The site is located southwest of the B Plant and near the corner of 7th Street and Atlanta Avenue.	1945 to ?	Associated with the 241-ER-311 Catch Tank, the Cross-Site Transfer Line, 241-EW-151 Vent Station, the 244-BX Double Contained Receiver Tank, and the 241-ER-152, 241-ER-153, and 241-UX-154 Diversion Boxes and the 241-ER-311 Catch Tank.	The diversion box is located inside a locked chain link fence. The fence is posted with "Caution - contact Radiological Control and Tank Farm Shift Office prior to entry" signs. The diversion box is surrounded with a metal safety barricade.	Diversion Box	UPR-200-E-84, UPR-600-20	not available	Diversion box may contain about 23 kg (50 lb) of lead shielding.	September 1998 rad surveys detected up to 10,000 cpm on contaminated specks and 25,000 cpm on ant hill.
21	241-ER-152	241-ER-152, 241-ER-152 Diversion Box	This 241-ER-152 Diversion Box is southeast of the 224-B Building, and east of 241-ER-151 Diversion Box, near the corner of Atlanta Avenue and 7th Street.	1945 to ?	Associated with the 241-ER-151 and 241-ER-153 Diversion Boxes, the 241-ER-311 Catch Tank, and transfer lines. It is also associated with the stabilized contamination know as 200-E-29.	Most of the reinforced concrete diversion box structure is underground. The floor and lower portions of the walls are lined with SS. Cover blocks with lifting hooks are visible from the surface. The 241-ER-152 Diversion Box is surrounded with radiation rope and CA signs.	Diversion Box	none	~540 m^2 (6000 ft^2); in 1996, contamination spread over an area measuring approximately 0.5 ha (1.2 ac)	not available	none
22	241-TX-152	241-TX-152, 241-TX-152 Diversion Box	This unit is located east of the TX Tank Farm. It is east of Camden Avenue and south of 23rd Street. It is north of the 200 West Area Powerhouse pond.	1949 to ?	Associated with the T Plant, SY Tank Farm, UPR-200-W-113, and the 241-TX-154 Diversion Box.	The diversion box is a rectangular reinforced concrete structure. Most of the structure is below ground. A few inches of the structure that extend above ground are covered with a gray weather coating. It is surrounded with light posts and chain and is posted with various radiological postings.	Diversion Box	none	not available	Diversion box may contain about 23 kg (50 lb) of lead shielding.	none
23	241-TX-154	241-TX-154, 241-TX-154 Diversion Box	This unit is located on the east side of the 221-T Building.	1949 to ?	Associated with T Plant operations, 241-TX-152 Diversion Box, 241-TX-302C Catch Tank, and SY Tank Farm.	The diversion box is a rectangular reinforced concrete structure. Most of the structure is below ground. The diversion box is surrounded with post and chain. It is labeled and radiologically posted. The adjacent area has been covered with shotcrete.	Diversion Box	UPR-200-W-21, UPR-200-W-38, UPR-200-W-40, UPR-200-W-160	not available	Diversion box may contain about 23 kg (50 lb) of lead shielding.	none
24	241-TX-155	241-TX-155, 241-TX-155 Diversion Box	This unit is located east of the TX Tank Farm, south of 23rd Street and north of the 200 West Area Powerhouse pond.	1949 to 1980	Associated with the 241-TX-302B and 241-TX-302BR Catch Tanks, and the T, TX, and TY Tank Farms.	The diversion box is a rectangular reinforced concrete structure. Most of the structure is below ground. A few inches of the structure that extends above ground are covered with a gray weather coating. It is surrounded with light posts and chain and CA signs.	Diversion Box	UPR-200-W-5, UPR-200-W-28, UPR-200-W-76, UPR-200-W-113, UPR-200-W-131, UPR-200-W-160	9 x 30.5 m (in 1954)	Multiple releases documented, including contaminated nitric acid solution in 1952. Diversion box may contain about 23 kg (50 lb) of lead shielding.	none

Table D-2. Waste Information Data System Summary for 200-IS-1 Operable Unit Pipeline Systems. (14 Pages)

Count	Site Code	Site Names	Location	Dates of Operation	Associated Facilities or Structures	General Description	Site Type	Associated UPR Waste Site(s)	Site Dimensions/ Area	Contaminant Inventory/Volume Released	Radiation Survey/Soil Sampling Information
25	241-U-151	241-U-151, 241-U-151 Diversion Box	The 241-U-151 Diversion Box is located northeast of the intersection of Camden Avenue and 16th Street, east of the U Tank Farm.	1946 to ?	Associated with the 241-U-301 Catch Tank and the 244-S and 244-TX Double Contained Receiver Tanks. The unit also is associated with the 241-U-152 and 241-TX-152 Diversion Boxes.	The diversion box is marked and radiologically posted. This unit is constructed of reinforced concrete with multiple encased liquid waste transfer lines. The diversion box structure is mostly below ground. It has three layers of cover blocks.	Diversion Box	UPR-200-W-6	not available	Diversion box may contain about 23 kg (50 lb) of lead shielding.	none
26	241-U-152	241-U-152, 241-U-152 Diversion Box	The 241-U-152 Diversion Box is located northeast of the intersection at Camden Avenue and 16th Street, east of the U Tank Farm.	1946 to ?	The 241-U-152 Diversion Box is associated with the 241-U-301 Catch Tank, and 241-U-153 Diversion Box.	The diversion box is marked and radiologically posted. The unit is constructed of reinforced concrete with multiple encased liquid waste transfer lines. The diversion box structure is mostly below ground. It has three layers of cover blocks.	Diversion Box	UPR-200-W-6	not available	Diversion box may contain about 23 kg (50 lb) of lead shielding.	none
27	200-W-125	200-W-125, 216-Z-1 Ditch replacement pipeline	The pipeline extends east from the 231-Z Building and turns south to connect with the head end of the 216-Z-11 Ditch.	not specified	Associated with 216-Z-1 Ditch, 216-Z-11 Ditch, and the 231-Z Building.	The site is an underground buried pipeline. The pipeline is a 0.46 m (18 in.) diameter VCP.	Radioactive Process Sewer	none	not available	not available	none
28	200-W-16	200-W-16, 292-T underground tanks, IMUST, Inactive Miscellaneous Underground Storage Tank, 292-TK-1, 292-TK-2	The underground tanks are near the southeast corner of the 292-T Building addition. The 292-T Building is south of the 291-T Stack and north of the 222-T Building.	1944 to 1970	Associated with 291-T, 221-T, and the 292-T facility (200-W-40).	Two metal riser pipes extend about 0.5 m (1.5 ft) above grade near the southeast corner of the 292-T Building addition. Both are capped and one appears to have a pressure relief vent. These pipes extend from two buried tanks (292-TK-1 and 2). A chain link fence encloses the area where the tanks are located. The fence is posted with Access Restricted signs. The site is within a chained area posted "Contamination Area."	Storage Tank	none	not available	Unknown quantity of material placed into tanks.	Rad survey done in 1995 revealed a 2 mrem/h dose rate above the tanks.
29	200-E-111-PL	200-E-111-PL, encased pipeline from 241-ER-151 Diversion Box to C Tank Farm and 244-AR Vault, 3-38 encasement, V108/V837/8618/8653/8901 PAS	The encased pipeline runs eastward from the 241-ER-151 Diversion Box, south of 7th Street, and branches off in two directions (forming a "Y") at a point southeast of the 216-C-10 Crib. From the "Y," it branches to the C Tank Farm and the 244-AR Vault.	1952	Waste transfer encasement connected to the 241-ER-151 Diversion Box, 241-ER-152 Diversion Box, 241-CR-151, C Tank Farm, and the 244-AR Vault.	The site is an underground piping encasement that contains three 7.5 cm (3 in.)-diameter, stainless-steel waste transfer pipelines, numbered "V108," "8618," and "8653," which run from the 241-ER-151 Diversion Box through a "Y" that branches to the C Tank Farm and the 244-AR Vault. The section from the "Y" junction to the 244-AR Vault contains two 7.5 cm (3-in.) pipelines numbered "809" and "818." There is a posted CA on top of the line at the "Y" junction where the line branches to the C Tank Farm and the 244-AR Vault. The entire length of the pipeline is marked with steel fence posts and posted as a URM area. The ground surface above the pipeline is bare in spots; other sections are vegetated with crested wheatgrass, tumbleweeds, and native grass species.	Tank Farm Process Piping	UPR-200-E-86	not available	not available	May 2000 rad survey found growing tumbleweeds at swab riser; contamination levels measured up to 2000 dpm beta/gamma.
30	200-E-116-PL	200-E-116-PL, pipelines from 241-B-154 Diversion Box to 241-C-151 and 241-C-152 Diversion Boxes, direct buried pipeline, V111/V210/V130	The site is located north of and runs parallel to 7th Street, between B Plant and the C Tank Farm in 200 East Area.	not specified	B Plant, 241-B-154 Diversion Box, 241-C-151 Diversion Box, 241-C-152 Diversion Box, and C Tank Farm.	The pipeline is posted as "Underground Radioactive Pipeline," which extends from the 241-B-154 Diversion Box to the 241-C-151 and 241-C-152 Diversion Boxes. Vegetation over the pipeline has been crushed by vehicle traffic. An area located just north of the 241-B-154 Diversion Box was posted as a High CA in September 2000, but was covered with a biobarrier and gravel in February 2001. It is now a rectangular posted URM area over a portion of the pipeline. Another area of contamination was found on this pipeline in June 2001. This area was covered with gravel and posted as a URM in August 2001.	Tank Farm Process Piping	UPR-200-E-82	not available	radioactive mixed waste	In September 2000, rad survey revealed contamination levels to 50,000 cpm. In June 2001, rad survey found contamination levels in vegetation adjacent to the area with up to 50,000 cpm.

Table D-2. Waste Information Data System Summary for 200-IS-1 Operable Unit Pipeline Systems. (14 Pages)

Count	Site Code	Site Names	Location	Dates of Operation	Associated Facilities or Structures	General Description	Site Type	Associated UPR Waste Site(s)	Site Dimensions/ Area	Contaminant Inventory/Volume Released	Radiation Survey/Soil Sampling Information
31	200-W-78-PL	200-W-78, pipeline between TX/TY and T Tank Farms, encased pipeline	The underground line is located in 200 West Area between the T and TX/TY Tank Farms, on the west side of Camden Avenue.	1944	Associated with T and TX Tank Farms. UPR-200-W-167 also was located in the vicinity of this pipeline.	The site is an encased, underground pipeline that runs between the 241-TXR-151 Diversion Box in the TX Tank Farm and the 241-TR-153 Diversion Box in the T Tank Farm. Outside the tank farm fence, the line is marked with "Radioactive Pipeline" signs. There are several stabilized, individually radiologically posted areas on top of (or adjacent to) this pipeline, near the east side of the TY Tank Farm perimeter fence.	Tank Farm Process Piping	UPR-200-W-167	3 m x 14 m (10 ft x 45 ft)	not available	Evidence of contaminated biological intrusion above the line. Difficult to determine which line is source of the contamination. April 2001 rad survey detected soil contamination up to 4000 cpm.
32	200-W-97-PL	200-W-97, encased pipeline from 240-S-151 Diversion Box to 241-S-151 Diversion Box	The pipeline extends northwest from the REDOX facility to the S/SX Tank Farms.	not specified	Associated with 202-S, 203-S, 204-S, and 205-S and the 241-S-151 Diversion Box.	The site is an underground concrete-encased pipeline. The surface is marked with Underground Radioactive Material – Pipeline signs. Yellow swab risers are located along the pipeline. One swab riser, near the 204-S Facility, has been surrounded with posts and chain and is posted with Soil Contamination Area signs.	Tank Farm Process Piping	none	2.4 x 2.4 m (8 x 8 ft)	Soil contamination area located on the underground pipeline.	October 2001: rad survey detected up to 20,000 cpm on tumbleweed fragments and soil.
33	200-W-98-PL	200-W-98, encased pipeline from 240-S-151 to 241-U-153 Diversion Box, V458,V459,V460	The pipeline is located south of 16th Street, extending in a southeast direction from the 241-U-153 Diversion Box to 204-S and the REDOX Facility.	not specified	Associated with the 204-S Facility and the 241-U-153 Diversion Box.	The site is a cement-encased underground pipeline. The pipeline is marked with Underground Radioactive Material – Pipeline signs.	Tank Farm Process Piping	none	not available	not available	none
34	200-W-99-PL	200-W-99, encased pipeline from 241-U-151 to 241-S-151 Diversion Boxes	The pipeline is located south of 16th Street, extending from the 241-U-151 Diversion Box to the 241-S-151 Diversion Box.	not specified		The site is a cement-encased underground pipeline. The pipeline is marked with Underground Radioactive Material – Pipeline signs.	Tank Farm Process Piping	none	not available	not available	none
35	200-W-100-PL	200-W-100, Encased Pipeline from 241-UX-154 to 241-SX-152 Diversion Box, lines 4700, 4701, 4853, V762, V503 and V505	The pipeline begins on the east side of the 221-U Building and extends in a southwest direction to terminate at the 241-SX-152 Diversion Box, located on the east side of the S/SX Tank Farms.	not specified		The site is a cement-encased underground pipeline. The pipeline is marked with Underground Radioactive Material – Pipeline signs.	Tank Farm Process Piping	none	not available	not available	In 1998, ground-penetrating radar scans in the area revealed 44 linear anomalies.
36	200-W-105-PL	200-W-105, encased transfer line between 241-UX-154 Diversion Box and TX Tank Farm	The pipeline begins on the east side of the 221-U Building and extends in a northwest direction to terminate at the 241-TX-155 Diversion Box. The line continues through the Diversion Box to the TX Tank Farm.	1946	The encasement includes tank farm lines V-375, V-382, and 4859/4703.	The site is a cement-encased underground pipeline. The pipeline is marked with Underground Radioactive Material – Pipeline signs.	Tank Farm Process Piping	none	not available	not available	In 1998, ground-penetrating radar scans in the area revealed 44 linear anomalies.
37	UPR-200-E-1	UPR-200-E-1, waste line failure on south side of 221-B	The release occurred on the south side of the 221-B Building.	The release occurred in September 1946	B Plant	The UPR is not separately marked or posted.	Unplanned Release	UPR-200-E-80	not available	The original line break was waste from the metal waste line.	In 1946, area was covered to reduce surface readings to 2 mrad/h.

Table D-2. Waste Information Data System Summary for 200-IS-1 Operable Unit Pipeline Systems. (14 Pages)

Count	Site Code	Site Names	Location	Dates of Operation	Associated Facilities or Structures	General Description	Site Type	Associated UPR Waste Site(s)	Site Dimensions/ Area	Contaminant Inventory/Volume Released	Radiation Survey/Soil Sampling Information
38	UPR-200-E-3	UPR-200-E-3, line leak from 221-B to 241-BX-154, UN-200-E-3	The release occurred on the south side of 221-B, between the 221-B Building and 241-BX-154.	1951 – The exact date of the occurrence is unknown.	B Plant	The release is not separately marked or posted.	Unplanned Release	none	not available	The release consisted of B Plant first-cycle waste.	Excavation efforts abandoned when readings of 120 rad/h found with 18 in. soil remaining over pipeline.
39	UPR-200-E-42	UPR-200-E-42, 241-AX-151 Release, UN-200-E-42	The 241-AX-151 Diversion Box is located near the corner of 4th Street and Buffalo Avenue, adjacent to the 204-AR Unloading Station. The UPR site included a dirt bank east of the 241-AX-151 Diversion Box and weeds east of the established parking lot.	1972 to ?	Associated with 241-AX-151 Diversion Box and 244-AR Vault.	A WIDS sign has been placed near the diversion box structure to document the release.	Unplanned Release	none	not available	not available	In 1972, contamination of up to 300 mrad/h with spots to 20 rad/h was found. The blacktop east of the diversion box was contaminated up to 3,000 cpm. The dirt bank had contamination up to 2,000 cpm and weeds contaminated 300 to 800 cpm.
40	UPR-200-E-44	UPR-200-E-44, UN-200-E-44, B Plant Condensate Steam Waste Line Leak South of 221-B	The UPR occurred south of 221-B, near the R-17 change house, north of 7th Street. The change house no longer exists.	The release occurred in August 1972.	Associated with B Plant.	The release site is not separately marked or posted. There is no visual evidence of the area that caved in.	Unplanned Release	UPR-200-E-103	0.30 m (1.00 ft) in diameter	not available	Soil removed from excavation was contaminated up to 20,000 cpm. Dose rate on pipe was up to 20 mrad/h.
41	UPR-200-E-45	UPR-200-E-45, UN-200-E-45, contamination spread from the 241-B-154 Diversion Box	The 241-B-154 Diversion Box is located at the corner of 7th Street and Baltimore Ave. The release involved loose contamination spreading in a southeasterly direction from the 241-B-154 Diversion Box.	1974	This release is related to the 241-B-154 Diversion Box.	A large area on the northeast corner of 7th Street and Baltimore Avenue is surrounded with post and chain and is marked as a URM area. The URM surrounds the 241-B-154 Diversion Box, which has been covered with a coating of gray grout. The original UPR is not separately marked or posted.	Unplanned Release	UPR-200-E-77	Approximately 91.5 x 30.5 m (300 x 100 ft)	Contaminated particles (specks) spread from inside diversion box.	Ground surface contamination up to 50,000 cpm and up to 30,000 cpm on blacktop.
42	UPR-200-E-77	UPR-200-E-77, UN-216-E-5, 241-B-154 Diversion Box Ground Contamination, UN-200-E-77	This site is located east of 221-B Building, at the northeast corner of Baltimore Avenue and 7th Street. It surrounds the 241-B-154 Diversion Box.	1946 to ?	Site associated with the 241-B-154 Diversion Box.	A large graveled area on the northeast corner of 7th Street and Baltimore Avenue is surrounded with post and chain and is marked as a URM area. The URM surrounds the 241-B-154 Diversion Box, which has been covered with a coating of gray grout. The area appears to have been posted in stages. A large posted oval area (URM) extends north and east from the diversion box. Another posted area (URM) extends west to Baltimore Ave. and turns northward. In January 2000, a separate CA was posted around a power pole (adjacent to a manhole) within the larger URM. In 2002, the posting around the power pole was removed and a Fixed Contamination Area sign was attached to the pole.	Unplanned Release	none	125 x120 m (410 x 394 ft)	Original release involved metal waste solution from 221-B Building with about 1 Ci fission products.	1975 rad survey found surface contamination up to 80,000 cpm.

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Count	Site Code	Site Names	Location	Dates of Operation	Associated Facilities or Structures	General Description	Site Type	Associated UPR Waste Site(s)	Site Dimensions/ Area	Contaminant Inventory/Volume Released	Radiation Survey/Soil Sampling Information
43	UPR-200-E-78	UPR-200-E-78, UN-216-E-6, 241-BX-155 Diversion Box ground contamination, UN-200-E-78	This site is located in the area around the 241-BX-155 Diversion Box, south of the BX Tank Farm, northeast of B Plant between Atlanta and Baltimore Avenues.	1955 to ?		The diversion box has been isolated and covered with gray grout. The area around the diversion box and the surface area above the 241-B-302-C Catch Tank have been surface stabilized with gravel and posted with URM area signs.	Unplanned Release	none	18 m^2 (200 ft^2) area	Contaminated ground. Release involved salt-containing waste from B Plant with about 10 Ci of fission products.	At the time of the release, the maximum dose rate was 22.6 rad/h.
44	UPR-200-E-80	UPR-200-E-80, UN-216-E-8, 221-B R-3 Line Break, R-3 Radiation Zone, UN-200-E-80	The release occurred in an underground pipeline, located on the south side of the 221-B Canyon Building, near the R-3 stairwell. The leak resulted in a contaminated area measuring 30 m (100 ft) wide by 152 m (500 ft) in length, along the south side of the 221-B building.	The release occurred in June 1946.	Associated with an underground metal waste line from the 221-B Canyon Building.	The UPR is not separately marked or posted.	Unplanned Release	UPR-200-E-1	30 m (100 ft) wide by 152 m (500 ft) in length	Release of about 10 Ci of fission products from metal waste pipeline.	In 1946, the dose rate at ground surface was 400 rad/h. After covering, the dose rate was reduced to 100 mrad/h.
45	UPR-200-E-84	UPR-200-E-84, 241-ER-151 Catch Tank Leak, UN-200-E-84, UN-216-E-12	The release occurred adjacent to the 241-ER-151 Diversion Box, southwest of the 221-B Building.	1953	Associated with 241-ER-311 Catch Tank and 241-ER-151 Diversion Box.	The 241-ER-151 Diversion Box and the 241-ER-311 Catch Tank are located inside a chain link fence that is radiologically posted. A WIDS sign has been placed at the approximate location of the release.	Unplanned Release	none	not available	Contaminated acid with about 10 Ci of fission products.	In 1975, surface contamination was up to 90,000 cpm.
46	UPR-200-E-85	UPR-200-E-85, Line Leak at 221-B Stairwell R-13, UN-216-E-13, UPR-200-E-41, UN-200-E-85, UN-200-E-41	UPR-200-E-85 occurred south of the center of the 221-B Building, near the R-13 utility pit.	The release occurred in July 1972.	Associated with the (unencased transfer line from the) 18-1 Tank in the 221-B Building, the 241-BX-154 Diversion Box, and the R-13 Utility Pit. This occurrence also was given the number UPR-200-E-41.	The site was stabilized in 1984 and posted with URM area signs. The release site is not labeled. The R-13 Utility Pit was covered with a steel lid.	Unplanned Release	none	15.24 x 15.24 m (50 x 50 ft)	The waste line contained ion exchange waste from tank 18-1, located inside the B Plant canyon. Soil samples collected in 1972 identified the release as predominantly Cs-137. Approximately 30 Ci of cesium were released, but half of the release was removed with the soil that was excavated to expose the line leak.	15 rad/h, 2 in. from the source.
47	UPR-200-E-87	UPR-200-E-87, UN-216-E-15, 224-B South Side Plutonium Ground Contamination, UN-200-E-87, 216-E-15	The UPR-200-E-87 site is located on the south side of the 224-B Building in the 200 East Area.	1945 to 1953; no confirmed release occurred	Associated with the underground pipelines at the 224-B Building.	Some areas on the south side of 224-B are posted with URM area signs. The release site is not specifically marked.	Unplanned Release	UPR-200-W-102	not available	About 75 g (3 oz) Pu-239 may have leaked into the soil.	1975 rad survey reported no detectable contamination.
48	UPR-200-E-96	UPR-200-E-96, Ground Contamination SE of PUREX, UN-216-E-24, UN-200-E-96	The release site includes contaminated areas on the south and east sides of PUREX.	N/A	Associated with 200-E-103, 200-E-107, the 291-A Stack, and the 241-A-151 Diversion Box.	The site was described in 1980 as an area measuring approximately 1.0 ha (2.5 acres) located adjacent to the east and south sides of 202-A (PUREX). These areas are now covered with gravel and posted as URM areas.	Unplanned Release	none	Approximately 1 ha (2.5 ac)	Contamination consisted of low-level particles	none
49	UPR-200-W-2	UPR-200-W-2, UN-200-W-2, Underground Waste Line Leak	The cave-in occurred on the southeast side of the 221-T Facility, near stairwell R-19.	June 1947	Associated with 221-T.	The area around stairwell R-19 at the 221-T facility currently is paved with asphalt. A long, narrow URM area is posted around the R-19 area.	Unplanned Release	UPR-200-W-98	not available	Mixed process effluent	none
50	UPR-200-W-5	UPR-200-W-5, overflow at 241-TX-155, UN-200-W-5	The site consists of the 241-TX-155 Diversion Box and the adjacent hillside to the west. The diversion box is located east of Camden Avenue, east of the TX Tank Farm.	1950	Associated with the 241-TX-155 Diversion Box.	In 2000 and 2001 multiple areas of soil and vegetation contamination were identified, and all were posted. For consolidation purposes, all of the new CAs were recorded and mapped as UPR-200-W-113. A WIDS sign has been placed at the approximate location of the release.	Unplanned Release	UPR-200-W-28, UPR-200-W-113, UPR-200-W-131	not available	Contaminated soil	none

Table D-2. Waste Information Data System Summary for 200-IS-1 Operable Unit Pipeline Systems. (14 Pages)

Count	Site Code	Site Names	Location	Dates of Operation	Associated Facilities or Structures	General Description	Site Type	Associated UPR Waste Site(s)	Site Dimensions/ Area	Contaminant Inventory/Volume Released	Radiation Survey/Soil Sampling Information
51	UPR-200-W-6	UPR-200-W-6, UN-200-W-6, contamination spread from 241-U-151 and 241-U-152 Diversion Boxes	The contamination spread occurred at the 241-U-151 and -152 Diversion Boxes, located east of the U Tank Farm, near the corner of 16th Street and Camden Avenue.	1950 to ?	Associated with the 241-U-151 and 241-U-152 Diversion Boxes.	The ground around the 241-U-151 and the 241-U-152 Diversion Boxes has been covered with gravel. The diversion boxes are marked and posted. A WIDS sign has been placed at the approximate location of the release.	Unplanned Release	none	not available	Ground contamination from diversion boxes	Maximum dose rate of 20 mrad/h on the surface of the soil.
52	UPR-200-W-28	UPR-200-W-28, Release from 241-TX-155 Diversion Box, UN-200-W-28	The release site is located adjacent to the 241-TX-155 Diversion Box, approximately 244 m (800 ft) east of the TX Tank Farm and north of the 200 West Area Powerhouse Pond.	1954 to ?	Associated with the 241-TX-155 Diversion Box.	The documented contaminated area was found at the 241-TX-155 Diversion Box. There is a large posted URM area west of the diversion box and several smaller radiologically posted areas in this vicinity (see UPR-200-W-113 and UPR-200-W-135). The diversion box has been isolated and weather covered and is marked and posted with various radiological control signs. A WIDS sign has been placed at the approximate location of the release.	Unplanned Release	UPR-200-W-5, UPR-200-W-113, UPR-200-W-131, UPR-200-W-135	9.1 x 30.5 m (30 x 100 ft)	Contaminated soil	In 1970, soil samples reported less than detectable contamination. Over the years, contaminated vegetation, animal feces, and soil specks periodically have been identified.
53	UPR-200-W-29	UPR-200-W-29, transfer line leak, UN-200-W-29, UPR-200-W-27	The site is located at the southeast corner of the intersection of Camden Street and 23rd Street. The release site is located adjacent to the 241-TX-155 Diversion Box, approximately 244 m (800 ft) east of the TX Tank Farm and north of the 200 West Area Powerhouse pond.	1954 to ?	Associated with the 241-T-152 Diversion Box.	The area is currently surrounded with steel posts, covered with gravel, and posted as a URM area.	Unplanned Release	UPR-200-W-64, UPR-200-W-97	30.5 x 22.9 m (100 x 75 ft)	Less than 3800 L (1000 gal) estimated to have escaped.	Contaminated soil with a maximum dose rate of 11.5 rad/h at a distance of 5 cm (2 in.) over waste run-off area and up to 4.5 rad/h at 0.9 m (3 ft) near the cave-in. February 1998 rad survey detected no surface contamination.
54	UPR-200-W-32	UPR-200-W-32, UNH transfer line break, UN-200-W-32	The release occurred near the northwest corner of the REDOX Plant.	The release occurred in 1954.	204-S Facility	The release site is not currently marked or posted. The aboveground pipeline has been removed.	Unplanned Release	none	not available	An unknown amount of UNH	none
55	UPR-200-W-35	UPR-200-W-35, Ground Contamination Near UNH Process Line, UN-200-W-35, REDOX to 224-U UNH Line Leak	The site was located along the aboveground UNH process line that ran from REDOX to U Plant, at a location just outside and to the north of the REDOX exclusion area.	The release occurred in September 1955.	204-S Facility	Much of the area north of REDOX has been surface stabilized. The UPR site is not marked or posted.	Unplanned Release	none	not available	An unknown amount and concentration/activity of UNH solution	none

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Count	Site Code	Site Names	Location	Dates of Operation	Associated Facilities or Structures	General Description	Site Type	Associated UPR Waste Site(s)	Site Dimensions/ Area	Contaminant Inventory/Volume Released	Radiation Survey/Soil Sampling Information
56	UPR-200-W-38	UPR-200-W-38, Line Break at 241-TX-302C, UPR-200-W-160, UPR-200-W-40, UN-200-W-38, 216-T-30	The release occurred on the southeast side of T Plant (221-T), between the 241-TX-154 Diversion Box and the 241-TX-302 Catch Tank. The liquid release affected a large area between the 221-T and 222-T buildings. The release site is located adjacent to the 241-TX-155 Diversion Box, approximately 244 m (800 ft) east of the TX Tank Farm and north of the 200 West Area Powerhouse Pond.	1955	Release associated with 241-TX-154 Diversion Box and 241-TX-302C Catch Tank. UPR-200-W-21 occurred in the same vicinity in 1953.	The area around the 241-TX-154 Diversion Box and the catch tank has been stabilized with sprayed concrete (shotcrete). The area is posted with URM area signs. A WIDS sign has been placed at this location.	Unplanned Release	UPR-200-W-21	Approximately 139.35 m^2 (1500 ft^2). Cleanup activities increased the contaminated area to approximately 371.6 m^2 (4000 ft^2).	Contaminated with radioactive metal waste solution that is high salt and neutral to basic. Estimated volume of up to 19,000 L (5026 gal).	In 1968, the maximum dose rate encountered through backfill was 500 mrad/h. NOTE: It is reported that a hose with 33 rad/h contamination was buried in the backfill over the area.
57	UPR-200-W-64	UPR-200-W-64, Road Contamination at 23rd and Camden, UN-200-W-64	The release is located between the east shoulder of Camden Avenue and the posted URM area (UPR-200-W-29/UPR-200-W-97), near the corner of 23rd Street and Camden Avenue.	1969 to ?	UPR-200-W-29 and UPR-200-W-97 are the apparent source of contamination for this release.	The corner of 23rd Street and Camden Avenue has been stabilized with clean gravel because of two waste line leak events. The stabilized area is surrounded with chain and posted with URM area signs. The road shoulders are not posted. A WIDS sign has been placed at the approximate location of the release.	Unplanned Release	UPR-200-W-29, UPR-200-W-97	Approx. 15.4 x 0.6 m (50 x 2 ft) strip bordering Camden Avenue at its intersection with 23rd Street	Cs-137 was the only detectable radioactive isotope; source appears to be rain water runoff from adjacent UPR areas.	In 1969, contamination up to 600 cpm was reported.
58	UPR-200-W-97	UPR-200-W-97, Transfer Line Leak, UN-216-W-5, UN-200-W-97	The release occurred southeast of the T Tank Farm at the corner of 23rd Street and Camden Avenue.	1966	Associated with the underground pipeline connecting 241-T-152 Diversion Box and the 241-TX-153 Diversion Box. It occurred at the same location as UPR-200-W-29 and adjacent to UPR-200-W-64. The site is associated with UPR-200-W-29, because a repeat release from the same broken transfer line (documented in UPR-200-W-29 in 1954) occurred again in 1966.	The site is located at the corner of 23rd Street and Camden Avenue. It is marked and posted as "Underground Radioactive Material." The release site was stabilized with clean soil, sand, ureabore herbicide, and crushed rock.	Unplanned Release	UPR-200-W-29, UPR-200-W-64	36.6 x 1.8 m (120 x 6 ft)	Waste was a high salt, neutral to basic solution; second-cycle bismuth phosphate waste from 241-T-107 Tank; leak estimated to contain about 10 Ci of fission products.	1966 dose rate at bottom of 3 ft hole was 9 rad/h. 1990 rad survey detected subsurface contamination of 600 cpm, down from the 60,000 cpm reported in the 1978 survey.
59	UPR-200-W-98	UPR-200-W-98, UN-216-W-6, 221-T waste line break at R-19, UN-200-W-98	The release site is located near the southeast corner of the 221-T Canyon Building, at door R-19.	1945	Associated with underground pipelines near the R-19 section of the 221-T Canyon Building.	The area around door R-19 is paved with asphalt and posted as a URM area. There is no sign that specifically marks the area as a UPR site.	Unplanned Release	UPR-200-W-2	not available	Approximately 10 Ci of high-salt, neutral-to-basic fission products	Maximum dose rate of 20 rad/h (in 1945) at 5 cm (2 in.). 1975 rad survey reported 500 cpm. In 1977, test holes cut to 4 ft in release area detected no rad contamination.
60	UPR-200-W-102	UPR-200-W-102, UN-216-W-12, UN-200-W-102, 224-T Underground Line Leak	The UPR occurred adjacent to the south and east sides of the 224-T Building.	1972	Associated with underground process lines at the 224-T Building.	The east and south sides of the 224-T Building are covered with gravel. The area along the east side of the 224-T Building is posted as a URM area.	Unplanned Release	none	15.24 x 3.66 m (50.0 x 12.0 ft)	The release consisted of alpha-laden moisture from process tank lines that contaminated the soil around the pipeline. An estimated 72 g of plutonium were contained in the contaminated soil that was removed when the leak was discovered.	August 2000 rad survey detected no contamination.

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61	UPR-200-W-113	UPR-200-W-113, Soil Contamination East of the TX Tank Farm, UN-216-W-23, Contamination Areas Around 241-TX-155 Diversion Box, UN-200-W-113	The site is an area east of the TX Tank Farm, on the east side of Camden Ave. Posted CAs are located west, south, north, and east of the 241-TX-155 and 241-TX-152 Diversion Boxes.	1977 to ?	Associated with the 241-TX-155 and 241-TX-152 Diversion Boxes and associated underground pipelines going into and out of the diversion boxes.	The original contaminated area was surface stabilized in 1990 and is surrounded with concrete marker posts and posted as a URM area. In 1998, 1999, and 2000, additional surface contamination was identified adjacent to the surface stabilized area and on the north, south, east and west sides of the diversion boxes. CAs also have been identified on the surface of underground transfer lines associated with the 241-TX-155 Diversion Box. The additional CAs, also are considered a part of this site (UPR-200-W-113) and are marked with posts, chain, and CA and Soil Contamination Area signs. One small CA, southeast of 241-T (located on a transfer line to the diversion box) recently was stabilized with gravel and now is posted with URM area signs.	Unplanned Release	UPR-200-W-28, UPR-200-W-76, UPR-200-W-135	not available	Multiple UPRs. Contaminated rabbit feces and low-level beta/gamma surface contamination. Source of contamination was subsurface.	August 1998 underground pipe rad survey detected up to 80,000 cpm.; October 1999 rad survey detected 20,000 cpm on rusty railroad rail.
62	UPR-200-W-114	UPR-200-W-114, UN-216-W-24, Ground Contamination East of SX Tank Farm, UN-200-W-114	UPR-200-W-114 was located east of the SX Tank Farm.	1980	Associated with multiple releases from operation activities in the SX Tank Farm, and the 241-SX-151 and 241-S-151 Diversion Boxes. Documented operational releases extending eastward from the tank farm include UPR-200-W-20, UPR-200-W-49, UPR-200-W-50, UPR-200-W-51, UPR-200-W-52, and UPR-200-W-82.	This site is no longer marked or posted. For many years, the release site had been a large area posted with a light chain and Surface Contamination Area signs. The 216-S-8 Trench and the 216-S-1 and the 216-S-2 Cribs were located within the larger contamination zone. The surface contamination was scraped up and consolidated into other nearby waste sites. The cribs were individually surface stabilized and reposted with URM area signs.	Unplanned Release	UPR-200-W-20, UPR-200-W-49, UPR-200-W-50, UPR-200-W-51, UPR-200-W-52, UPR-200-W-82	106.68 x 137.16 m (350.0 x 450.0 ft); about 4.8 ha (11.9 ac)	Waste consists of particulate matter.	None
63	UPR-200-W-131	UPR-200-W-131, Release from 241-TX-155	The release occurred near the 241-TX-155 Diversion Box, located east of Camden Avenue and east of the TX Tank Farm.	1953	Associated with the 241-TX-155 Diversion Box, the 241-TX-302 Catch Tank.	The 241-TX-155 Diversion Box and 241-TX-302B Catch Tank are surrounded with post and chain and CA signs. Clean gravel has been placed around the diversion box, and a sign has been added to the chain boundary, identifying this to be the location of UPR-200-W-131.	Unplanned Release	UPR-200-W-113	not available	Multiple UPRs of dilute acidic waste solution. Contaminated rabbit feces and low-level beta/gamma surface contamination. Source of contamination was subsurface.	Ground contamination up to 25 rad/h at 0.6 m (2 ft).
64	UPR-200-W-135	UPR-200-W-135, Release from 241-TX-155, UN-200-W-135	The cave-in associated with UPR-200-W-135 was located approximately 46 m (150 ft) northwest of the 241-TX-155 Diversion Box. The diversion box is located east of Camden Avenue and east of the TX Tank Farm.	1954	Associated with the 241-TX-155 Diversion Box.	Three major encased transfer lines are associated with the 241-TX-155 Diversion Box. Many areas of contamination have been identified on these transfer lines during 1999, 2000, and 2001. UPR-200-W-113 is located on a transfer line directly west of the 241-TX-155 Diversion Box and is surrounded with concrete marker posts and URM area signs. An extension of UPR-200-W-113 is located northwest of the original area, surrounded with metal posts and chain, and posted with CA signs. A single metal post, labeled UPR-200-W-135, has been placed adjacent to the UPR-200-W-113 CA.	Unplanned Release	UPR-200-W-13	12.19 x 0.61 m (40 x 2 ft)	Estimated 1,000 gal of mixed waste.	Estimated 300 rad/h at a distance of 10 cm (4 in.).
65	UPR-200-W-161	UPR-200-W-161, UN-216-W-35, UN-200-W-161	The site is located east of the U Tank Farm, on the east side of Camden Ave. It extends northward from the corner of 16th Street and Camden Ave. and the 241-U-152 Diversion Box.	1990 to ?	Associated with U Tank Farm. A tank farm pipeline is buried in this approximate location.	The site is a large radiologically controlled area posted with URM area signs. A WIDS number sign has been posted at this location.	Unplanned Release	none	280 x 50 m (918.6 x 164 ft); approx. 0.77 ha (1.9 acres)	Windblown contaminated soil particles	The general contamination was 250 to 450 cpm; one area up to 8,000 cpm. 1990 soil sample results: 2,930 pCi/g strontium, 6.26 pCi/g Cs-137, 3.27 pCi/g plutonium, and 0.00000026 pCi uranium. 1990 rad survey detected up to 80,000 cpm.

Table D-2. Waste Information Data System Summary for 200-IS-1 Operable Unit Pipeline Systems. (14 Pages)

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66	UPR-200-W-164	UPR-200-W-164, Overhead UNH Line Leak, UN-216-W-29	UPR-200-W-164 affects the soil beneath the aboveground UNH pipeline that extended from 204-S to 224-U. The pipeline was attached to a steam line located north of 204-S.	The release occurred in 1952.	Associated with the aboveground UNH transfer line from the 204-S Storage Tanks to the 224-U Building.	The aboveground UNH line has been removed. The Radiation Area signs that surrounded the pipeline also were removed. A portion of the site was interim stabilized in 1993. An area of contaminated soil found under the steam line, adjacent to the 216-S-9 Crib, was covered with clean soil and posted with "Underground Radioactive Material" warning signs.	Unplanned Release	none	not available	An unknown amount of UNH	none
67	UPR-200-W-167	UPR-200-W-167, Contamination Migration from the TY Tank Farm, UN-216-W-32	UPR-200-W-167 was located adjacent to the TY Tank Farm fence, extending east and north from the fence.	1985 to ?	Associated with TY Tank Farm operations and WIDS sitecode 200-W-78.	The original release site, identified in 1985, was a Soil Contamination Area located adjacent to the east side of the TY Tank Farm. After the contamination was scraped and removed in 1986, the site was no longer marked or posted. Later, in 2000, three areas on the east and northeast sides of the TY Tank Farm (within the original boundaries of this UPR) were reposted as CAs. Contaminated ant hills and growing contaminated vegetation was found on top of a tank farm transfer line located outside the eastern tank farm fence (also see WIDS sitecode 200-W-78). In November 2000, the CAs were covered with biobarrier material and gravel. These areas were reposted with URM area signs. The underground radioactive pipeline is marked with posts and "Radioactive Pipeline" signs. The pipeline runs through the recently stabilized areas.	Unplanned Release	none	Approximately 192 m (630 ft) long and ranged from 42 m (140 ft) to 60 m (195 ft) wide; approximately 8,400 m^2 (90,000 ft^2) in an "L."	Radioactive contamination (specks) that migrated from TY Tank Farm; later, contaminated vegetation and ant hills found in this area.	1987 and 1988 rad surveys reported no detectable contamination.
68	UPR-600-20	UPR-600-20, UN-216-E-41, Cross Country Transfer Line Contamination, Cross Site Transfer Line, V360, V361	The site extends from the 241-ER-151 Diversion Box in the 200 East Area to the 241-UX-154 Diversion Box in the 200 West Area. The majority of the transfer line is located in the 600 Area between the 200 East and West Areas, south of Route 3. The pipeline is approximately 2.3 miles long.	1988 to ?	Associated with the 241-ER-151 Diversion Box (east end of the pipeline), the 241-EW-151 Vent Station (along middle of pipeline), and the 241-UX-154 Diversion Box (west end of the pipeline).	The underground transfer line extends from the U Plant in the 200 West Area to the 241-ER-151 Diversion Box in the 200 East Area. The site includes the contaminated soil and vegetation located on the surface of the cross site transfer line, as well as the pipeline itself. The surface of the underground line has been stabilized and currently is posted with "Underground Radioactive Materials" signs. There also is a large mound of soil, located south of the 241-EW-151 Vent Station, that is associated with the original transfer line surface stabilization activities. The soil mound is posted with URM area signs.	Unplanned Release	none	4,828 x 15.2 m (15,840 x 50 ft)	Contaminated pipe, any subsurface leaks, and associated surface and vegetation contamination. Contaminated soil contained Cs-137, Pu-239/240, Sr-90, and uranium.	Contamination levels to 750 mrem/h. In 1988, eight boreholes were drilled at four locations along transfer line to characterize integrity. No contamination was found to have leaked below pipeline encasement, but contaminated sagebrush was found next to encasement (indicating that roots penetrated the encasement); June 2000 rad survey detected 30,000 cpm on ant mound.
69	UPR-200-W-82	UPR-200-W-82, contamination spread at 240-S-151	The contamination spread was located on the north and east sides of the 240-S-151 Diversion Box and the 240-S-302 Catch Tank, on the north side of the REDOX facility (202-S).	1980	Associated with the 240-S-151 Diversion Box and the 240-S-302 Catch Tank.		Unplanned Release	none	Approximately 186 m^2 (610 ft^2)	not available	none

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70	200-W-58	200-W-58, Z-Plant Diversion Box #1	Z Plant Diversion Box #1 is located south of 234-5Z, in between the two fences that make up the double enclosed Z Plant exclusion area. It is directly south of the 241-Z-361 Settling Tank.	Unknown	Associated with the 241-Z-361 Settling Tank, 216-Z-1, 216-Z-2, 216-Z-3, 216-Z-1A, 216-Z-12, and 216-Z-18.	The Z Plant fenced exclusion area is covered with gravel. The concrete lid of the diversion box is visible above ground. The unit is buried to a depth of 2.7 m (9 ft), and its upper surface (a thick concrete lid) is slightly above ground level.	Valve Pit	none	not available	not available	none
71	200-W-59	200-W-59, Z-Plant Diversion Box #2	Z Plant Diversion Box #2 is located southwest of the 234-5Z Building, between the two fences that make up the double enclosed Z Plant exclusion area. It is west of the 241-Z-361 Settling Tank and directly north of the 216-Z-12 Crib.	N/A	Associated with 216-Z-361, 216-Z-12, and 200-W-58.	The structure is buried with its concrete lid slightly above ground level. The Z Plant fenced exclusion area is covered with gravel.	Valve Pit	none	not available	not available	1976: 5000 dpm at 17 ft bgs found when drilled two wells near the crib pipelines and Diversion Box
72	HSVP	HSVP, Hot Semiworks Valve Pit, 201-C Diversion Box, Semiworks Valve Pit	This valve pit is adjacent to the remains of the 201-C Building and southeast of the main canyon area. It is located within the 200-E-41 surface stabilized area.	1951 – 1986 or 1952 to 1963	Associated structures include the 201-C Building, valves, transfer lines, the 244-CR Vault, C Tank Farm, and the 241-CX-70 Tank. Also associated with 200-E-41 Stabilized Area.	The site is a sealed, concrete-filled, vertically configured, stainless-steel cylinder that is buried beneath the ash barrier that was placed over the decommissioned 201-C Process Building (see 200-E-41). The surface-stabilized area is posted with URM area signs. The valve pit is not separately marked or posted.	Valve Pit	none	not available	Diversion box may contain about 23 kg (50 lb) of lead shielding.	none
73	200-E-56	200-E-56, 241-C Waste Line Leak adjacent to 201-C, Waste Line Leak #1	The waste line leak was adjacent to the east side of the 201-C Building.	not specified	The site is associated with 200-E-41.	HW-52860 states that Teflon flange gaskets on the SS underground waste line from 201-C to the C Tank Farm developed leaks. The leaks caused the underground area next to the east side of the 201-C Building and an underground area near the east facility fence to become contaminated (see 200-E-57). Radiation readings in 1957 were greater than 100 rad/h at a depth of 3.66 m (12 ft) adjacent to the 201-C Building and near the fence. The underground waste line was abandoned, and bypass sections were installed. New sections of pipeline were installed south of the leaking sections. The area adjacent to the 201-C Building has been surface stabilized with fly ash. The stabilized area has been given the site code 200-E-41 and is posted as a URM. The release site is not separately marked or posted and may be combined with 200-E-41. When the facility was operating, the area was enclosed in a fence. A second fence, attached to the 201-C Building, formed areas known as the "A" Court Yard and "C" Court Yard.	Unplanned Release	200-E-57	not available	not available	Maximum contamination levels in 1957 were greater than 100 rad/h at a depth of 3.66 m (12 ft). Some contaminated soil was removed when the bypass pipelines were installed.
74	200-E-57	200-E-57, 241-C Waste Line Leak east of 201-C, Waste Line Leak #2	This release occurred at an underground waste line located east of the 201-C Building, adjacent to the east Hot Semiworks Facility fence. The fence no longer exists.	not specified	The site is associated with 200-E-41.	HW-52860 states that Teflon flanges on the 5 cm (2-in.) SS underground waste line from 201-C to the C Tank Farm leaked and caused the soil beneath the line to become contaminated. One leaking flange was located near the Hot Semiworks Facility fence. The sketch attached to HW-52860 indicates an underground contaminated area measuring 9 m (30 ft) long. Radiological readings in 1957 ranged from 6 rad/h at a depth of 0.3 m (1 ft) to greater than 100 rad/h at a depth of 4.5 m (15 ft) at this location. The document states that the line also leaked in an area adjacent to the east side of the 201-C Building (see 200-E-56). The underground waste line was abandoned, and bypass sections were installed. New sections of pipeline were installed south of the leaking sections. The area around the Hot Semiworks Facility has been surface stabilized with fly ash. The stabilized area is known as 200-E-41 and is posted with URM signs. This release site is not separately marked or posted and may be combined with 200-E-41. When the facility was operating, the area was enclosed in a fence. A second fence, attached to the 210-C Building, formed areas known as "A" Court Yard and "C" Court Yard.	Unplanned Release	200-E-56	area 9 m (30 ft) long	not available	Maximum contamination levels in 1957 were greater than 100 rad/h at a depth of 4.5 m (15 ft). Some contaminated soil was removed when the bypass pipelines were installed.

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Count	Site Code	Site Names	Location	Dates of Operation	Associated Facilities or Structures	General Description	Site Type	Associated UPR Waste Site(s)	Site Dimensions/ Area	Contaminant Inventory/Volume Released	Radiation Survey/Soil Sampling Information
75	200-E-135	200-E-135, Contamination Area South of C Tank Farm	The site is located south of 7th Street and southwest of the C Tank Farm.	not specified	One direct-buried 12-in. cooling water pipeline is known to be in area; other sources are likely.	An abandoned, aboveground steam pipe is located inside the posted area. The DynCorp ISVAC group submitted this CA as a Discovery Site because of growing contaminated vegetation. Growing contaminated vegetation usually suggests the presence of an underground pipeline. The drawings reviewed found one 30 cm (12-in.) diameter "Direct Buried" cooling water line near where one of the tumbleweeds was found. The line passes through the eastern end of the posted CA. It may be a contributing source of contamination. However, the large size of the posted area indicates that other sources (currently unknown) are likely. In September 2000, three growing, contaminated tumbleweeds were found inside the posted area. The maximum contamination level was 1000 c/min above background. All of the contaminated weeds were detached from the ground and removed by the DynCorp ISVAC group in September 2000. An assessment survey was performed in April 2002 and found maximum direct readings of 5,000 and 100,000 c/min inside the posted area. In July 2002, the area was surface stabilized and downposted to a URM.	Unplanned Release	none	102.4 x 50 m (336 x 164 ft); irregular	not available	April 2002: maximum direct readings up to 100,000 cpm.
76	200-W-9	200-W-9, Project W291 Excavation VCP Contamination	The site is located in the 200 West Area, near the southeast corner of the 221-T Building. It is 42 m (138 ft) north of 23rd Street.	1994	The 25 cm (10-in.) VCP carried chemical sewer effluent from 291-T, 222-T, and 224-T to the 216-T-3 Crib.	An old VCP was uncovered while excavating for the T Plant manhole MH T-2 for the new waste line from T Plant to the 200 Areas Treated Effluent Disposal Facility (Project W-291). The pipeline was left in the excavation. The site currently is a gravel area with two metal caissons. The area is not marked or posted. The tops of the caissons are labeled MH T-1 and MH T-2. The contamination was found on October 11, 1994. The old VCP is assumed to be a 222-T chemical sewer.	Unplanned Release	none	1.83 x 1.52 m (6 x 5 ft)	not available	1994 rad survey reported 3000 dpm beta/gamma on 100 cm^2 (15.5 in^2) smear. 5500 dpm direct reading.
77	200-W-15	200-W-15, S-Plant Project W-087 Hexone Discovery	The site is located ~18 m (59 ft) southwest of the southwest corner of REDOX (202-S).	not specified	202-S REDOX, 222-S, and the 244-S Double-Contained Receiver Tank are associated with the site.	In June 1995, while excavating pipe trench for Project W-087 (new transfer lines from 222-S to the 244-S Double-Contained Receiver Tank), a dark 4.6 cm (3-in.) thick layer of soil was noted at about 0.6 m (2 ft) depth. It was determined to be hexone and surfactants. The hexone soil was stockpiled and returned to the excavation after the pipe was installed in the trench. The pipe trench where the hexone soil was found has been backfilled to grade with soil originally removed from the excavation. Hexone-contaminated soil also was put back into the excavation. Currently there is no visual evidence of this excavation on the surface. The area is now under asphalt. It is not marked or posted. Hexone was used in the adjacent facility (202-S REDOX).	Unplanned Release	none	12.19 x 2.44 m (40 x 8 ft)	not available	none
78	UPR-200-E-79	UPR-200-E-79, UN-216-E-7, 242-B to 207-B Line Break, UN-200-E-79	The area where the release occurred is delineated by light-duty posts and chain measuring approximately 7.6 m (25 ft) wide and 61 m (200 ft) long. It is posted with URM area signs.	1953	The site is associated with the 207-B Building; leaking waste line (4-in. cast iron) that runs from 242-B to 207-B.	In June 1953, five leaks were discovered in the waste line that runs from 242-B to 207-B. Contamination levels up to 2,500 c/min were measured at the points of emission of water from the ground. The area where the release occurred is delineated.	Unplanned Release	none	61 x 7.6 m (200 x 25 ft)	Release consisted of 10 Ci of mixed fission products from the pipeline.	none

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79	UPR-200-W-14	UPR-200-W-14, Waste Line Leak at 242-T Evaporator, UN-200-W-14	The 1952 release occurred in an underground pipeline, causing water to be observed on the surface, east of the TY Tank Farm. The exact location was not documented. The mapping coordinates have been estimated.	1952	The release is associated with the 242-T Evaporator, 207-T Basin, and 200-W-78.	In October 1952, a steam coil in the 242-T Waste Evaporator Tank caused ground contamination along the surface above the leaking cast-iron pipe that carries cooling water and steam condensate from the Waste Evaporator Building to the 207-T Retention Basin. The site is described as the surface above the waste line between the 242-T Evaporator and the 207-T Retention Basin. H-2-44511 shows a cast-iron pipeline connecting the evaporator with the retention basin. The pipeline carried steam condensate from the building to the basin. The line runs north to south along the east side of the TY Tank Farm, parallel to an encased waste transfer line. The release site is not specifically marked or posted. However, several areas of contamination were identified along the east side and northeast of the TX/TY Tank Farms in 2000 and 2001 by the DynCorp ISVAC group (site code 200-W-78). The areas were stabilized with clean dirt and posted as a URM area. Because the exact location of this 1952 UPR is not documented, it is possible that one of the areas stabilized in 2001 is in the same location as the 1952 line leak. The mapping coordinates for the 1952 line leak have been estimated from the limited information provided. HW-60807, written in 1959, states that the area was posted at intervals with Underground Contamination signs. The document provided a hand-drawn sketch of the 200 West Area with a dot indicating UPR locations. This release is indicated on the sketch as being located east of the TY Tank Farm, but it cannot be precisely located from this sketch. The coordinates for this UPR have been estimated. In 1999, 2000, and 2001, the DynCorp ISVAC group attempted to mark all underground lines in the 200 East and 200 West Area. During their activities, many areas of contamination were identified above the underground lines being marked. The CAs were posted and later stabilized and changed to URMs. It is possible that one of these areas is in the same location as this 1952 release. The leak in the line was repaired in 1952, and the contaminated areas were covered with about a foot of clean soil and gravel.	Unplanned Release	none	not available	not available	none
80	UPR-200-W-99	UPR-200-W-99, UN-216-W-7, 241-153-TX Diversion Box Contamination Spread, UN-200-W-99	The release site is located east of the TX Tank Farm, extending approximately 69 to 91 m (75 to 100 yd) east of Camden Avenue.	1966	Associated with the 241-TX-153 Diversion Box and Camden Avenue	UPR-200-W-99 occurred on September 21, 1966. Two plumes of airborne contamination from the 241-TX-153 Diversion Box floated northeast and southeast. The releases contaminated the ground and road on both sides of Camden Avenue. The total length of contamination was identified to be 228 m (750 ft) north and south along Camden Avenue. The contamination extended a maximum of 91 m (300 ft) east of Camden Avenue. The maximum contamination found was 700 mrem/h. The area on the east of Camden Avenue, east of the TX Tank Farm, was stabilized with soil and grass. It is marked with URM signs. In 1966, the road contamination was covered with a new tar mat, and the sides of the road were fixed with tar. The area on the west side of Camden Avenue, adjacent to the tank farm fence, was covered with gravel, but was recontaminated by windblown particulates from the TX Tank Farm in 1993. In 2001, this area was no longer marked or posted. In 1976, a road grader was used on the soil east of Camden Avenue to push the contamination into windrows. Test plots in this area revealed a thin layer of Sr-90 particles present. The area east of Camden Avenue was surface stabilized in 1990 with clean backfill and grass. This area is surrounded with URM signs and is maintained by Bechtel Hanford, Inc.	Unplanned Release	none	228.6 x 91.44 m (750 x 300 ft); stabilized area measures approximately 228 x 44 m.	Airborne particles containing approximately 1 Ci Sr-90, with maximum readings up to 700 mrad/h.	none

Teflon is a trademark of E.I. du Pont de Nemours and Company, Wilmington, Delaware.
H-2-44511 Series, *Area Map – 200 West Area Facilities*.
HW-52860, *Standby Status Report Hot Semiworks Facility*.
HW-60807, *Unconfined Underground Radioactive Waste and Contamination in the 200 Areas - 1959*.

CA = Contamination Area.
cpm = counts per minute.
dpm = disintegrations per minute.
DynCorp = DynCorp Tri-Cities Services, Inc.
HSVP = Hot Semiworks Valve Pit.
IMUST = Inactive Miscellaneous Underground Storage Tank.
ISVAC = Integrated Soil, Vegetation, and Animal Control.
MH = manhole.
N/A = not applicable.
PUREX = Plutonium-Uranium Extraction Plant.
REDOX = Reduction-Oxidation Plant.
SS = stainless steel.
UNH = uranyl nitrate hexahydrate.
UPR = unplanned release.
URM = Underground Radioactive Material (area).
VCP = vitrified clay pipeline.
WIDS = *Waste Information Data System* database.

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