DOE/RL-2015-22
Revision 0

Sampling and Analysis Plan for the 200-CW-5, 200-PW-1, and 200-PW-6 Operable Units

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

U.S. DEPARTMENT OF ENERGY | Richland Operations Office

P.O. Box 550
Richland, Washington 99352

Approved for Public Release;
Further Dissemination Unlimited

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Date Published
April 2016

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APPROVED
By Julia Raymer at 9:49 am, May 02, 2016

Release Approval Date

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Title DOE/RL-2015-22, Rev. 0, *Sampling and Analysis Plan for the 200-CW-5, 200-PW-1, and 200-PW-6 Operable Units*

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Terms

ALARA	as low as reasonably achievable
bgs	below ground surface
CAS	Chemical Abstracts Service
CERCLA	*Comprehensive Environmental Response, Compensation, and Liability Act of 1980*
COC	contaminant of concern
cpm	counts per minute
CRDL	contract required detection limit
CSM	conceptual site model
DOE	U.S. Department of Energy
DOE-RL	U.S. Department of Energy, Richland Operations Office
DOT	U.S. Department of Transportation
DQA	data quality assessment
DQI	data quality indicator
DQO	data quality objective
DR	decision rule
DUP	field duplicate
Ecology	Washington State Department of Ecology
EB	equipment blank
ECO	Environmental Compliance Officer
EPA	U.S. Environmental Protection Agency
ERDF	Environmental Restoration Disposal Facility
FIDLER	field instrument for detection of low-energy radiation
FSO	Field Sampling Operations
FWS	Field Work Supervisor
HASQARD	*Hanford Analytical Services Quality Assurance Requirements Document*
HEIS	Hanford Environmental Information System
HHE	human health and the environment
LLD	lower limit of detection

LLW	low-level waste
LRA	lead regulatory agency
MDA	minimum detectable activity
NCO	nuclear chemical operator
NDA	nondestructive assay
NPL	National Priorities List
OU	operable unit
PCB	polychlorinated biphenyl
PFP	Plutonium Finishing Plant
PSQ	principal study question
PUREX	Plutonium/Uranium Extraction
QA	quality assurance
QAPjP	quality assurance project plan
QC	quality control
RAO	remedial action objective
RCT	Radiological Control Technician
RECUPLEX	Recovery of Uranium and Plutonium by Extraction
RI/FS	remedial investigation/feasibility study
ROD	record of decision
RPD	relative percent difference
RTD	removal, treatment (as needed), and disposal
SAP	sampling and analysis plan
SMR	Sample Management and Reporting
SPLIT	field split
SWOC	Solid Waste Operations Complex
TMU	total measurement uncertainty
TPA	Tri-Party Agreement
Tri-Party Agreement	*Hanford Federal Facility Agreement and Consent Order*
TRU	transuranic
UPR	unplanned release

1 Introduction

This sampling and analysis plan (SAP) presents the field sampling activities and quality assurance (QA) processes for obtaining data of sufficient quality and quantity to support remedial actions at several waste sites that are part of the 200-CW-5, 200-PW-1, and 200-PW-6 Operable Units (OUs). Sampling and analysis activities supported by this SAP include field radiological surveys, field nondestructive assay (NDA), and collection and analysis of discrete soil samples in order to guide the remedial action, appropriately segregate and manage waste materials, and document the results of remedial actions.

1.1 Project Scope and Objective

As part of the approach to waste site cleanup, the U.S. Department of Energy (DOE), U.S. Environmental Protection Agency (EPA), and Washington State Department of Ecology (Ecology), known as the Tri-Party agencies, agreed to consolidate the 23 process-based OUs in the 200 Area National Priorities List (NPL) (40 CFR 300, "National Oil and Hazardous Substances Pollution Contingency Plan," Appendix B, "National Priorities List") site into 12 groups based on similarities in contaminant sources. Of the 12 waste groups, 2 are addressed in this document. The Z Ditches Waste Group includes waste sites in the 200-CW-5 OU. The Plutonium/Organic-Rich Waste Group includes waste sites in the 200-PW-1, 200-PW-3, and 200-PW-6 OUs. The 21 waste sites in these OUs are associated with subsurface liquid waste handling and disposal at these sites that were engineered and constructed to receive liquid waste and discharge it into the soil beneath the sites. The source facilities are primarily the Plutonium Finishing Plant (PFP) and the Plutonium/Uranium Extraction (PUREX) Plant. Pipes that conveyed the liquid waste from nuclear processing facilities to the waste sites are also included in this SAP.

Final remedial actions were selected for the 200-CW-5, 200-PW-1, 200-PW-3, and 200-PW-6 Source OUs in accordance with the *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* (CERCLA), Tri-Party Agreement (TPA) (Ecology et al., 1989a, *Hanford Federal Facility Agreement and Consent Order*), and National Contingency Plan (40 CFR 300). The remedial actions are described in EPA et al., 2011, *Record of Decision Hanford 200 Area, Superfund Site 200-CW-5 and 200-PW-1, 200-PW-3, and 200-PW-6 Operable Units*, hereinafter called the record of decision (ROD). The purpose of the remedial actions is to address source contamination that poses threats to human health and the environment (HHE).

The selected remedy for the sites addresses soils and subsurface disposal structures, two settling tanks, and associated pipelines contaminated primarily with radioactive plutonium and cesium. Some of the waste materials are considered principal threat wastes. Principal threat waste is defined as source material that is considered highly toxic or highly mobile and that generally cannot be reliably contained or would present a significant HHE threat should exposure occur. Structures and other debris that must be removed in order to conduct required remediation will be excavated. The remedy includes a combination of removal, treatment (as needed), and disposal (RTD); construction of evapotranspiration barriers; soil covers; and institutional controls.

The remedial action for the five waste sites in the 200-PW-3 OU involves enhancing and/or maintaining existing soil covers. These sites will not require excavation and sampling. Therefore, these sites will not be addressed in this SAP.

1.2 Background

The Hanford Site is a 1,517 km^2 (586 mi^2) federal facility located along the Columbia River in southeastern Washington State. From 1943 until 1990, the primary mission of the Hanford Site was to

produce nuclear materials for the nation's defense mission. In July 1989, the Hanford Site was listed on the NPL (40 CFR 300, Appendix B) under CERCLA. The Hanford Site was divided up and listed as four NPL (40 CFR 300, Appendix B) sites consisting of the 100 Area, 200 Areas, 300 Area, and 1100 Area. The 200 Areas are composed of the 200 East and 200 West Areas.

The main function of the facilities in the 200 East and 200 West Areas was to remove plutonium from the uranium fuel rods after they had been subjected to a nuclear chain reaction in the 100 Area reactors. Large volumes of liquid waste were generated from the separation of plutonium at the various processing plants in the 200 East and 200 West Areas. Billions of gallons of process wastewater were both intentionally and unintentionally put into the ground in the 200 Areas. The processes were intended to recover as much plutonium as possible prior to discharge of the waste liquids, but the waste streams still contained low levels of plutonium and other contaminants.

Waste sites in the 200-CW-5, 200-PW-1, and 200-PW-6 OUs are associated with subsurface liquid waste handling and disposal. The 200-CW-5, 200-PW-1, and 200-PW-6 OU waste sites are all located within the approximately 52 km^2 (20 mi^2) Central Plateau area that has been designated as an industrial land use area for the treatment, storage, and disposal of hazardous, dangerous, radioactive, and nonradioactive wastes and related industrial activities.

1.2.1 200-CW-5 Operable Unit

The 200-CW-5 OU waste sites include the 216-Z-1D Ditch, 216-Z-11 Ditch, 216-Z-19 Ditch, 216-Z-20 Tile Field, and an unplanned release (UPR) (UPR-200-W-110). Remediation of waste sites in this OU will also address the 200-W-207 Pipeline. This pipeline was used to transfer waste to 216-Z-1D Ditch, 216-Z-11 Ditch, 216-Z-19 Ditch, and 216-Z-20 Tile Field. Figure 1-1 shows the location of the 200-CW-5 OU waste sites in the 200 West Area.

The Z Ditches are a series of three parallel, shallow, unlined, open air ditches that operated in chronological sequence from 1944 to 1981. The ditches routed cooling water and other wastewaters from the 234-5Z Facility (Z Plant) to the 216-U-10 Pond for disposal. From 1944 to 1956, the ditch system was used to convey cooling water effluents from the 231-Z Plutonium Isolation Plant, where concentrated plutonium from the bismuth phosphate process at the 221-T Plant was processed from a wet nitrate form to a solid plutonium nitrate form for offsite shipment. UPR-200-W-110 did not receive effluent but was a single use disposal trench for spoils from the 216-Z-1D Ditch and contained the same waste stream contaminants.

1.2.2 200-PW-1 Operable Unit

From 1949 until May 1973, effluents from chemical processes and plutonium finishing activities that, under normal operating conditions contained low levels of plutonium and other contaminants, were discharged to the soil column at subsurface engineered waste sites. These engineered waste sites were designed to provide effective disposal of effluent to the soil column and were operated in a manner intended to limit adverse impacts to groundwater. Six subsurface engineered waste sites and an associated subsurface settling tank that received these contaminated process waste streams comprise the 200-PW-1 OU. Figure 1-2 shows the location of the 200-PW-1 OU waste sites in the 200 West Area.

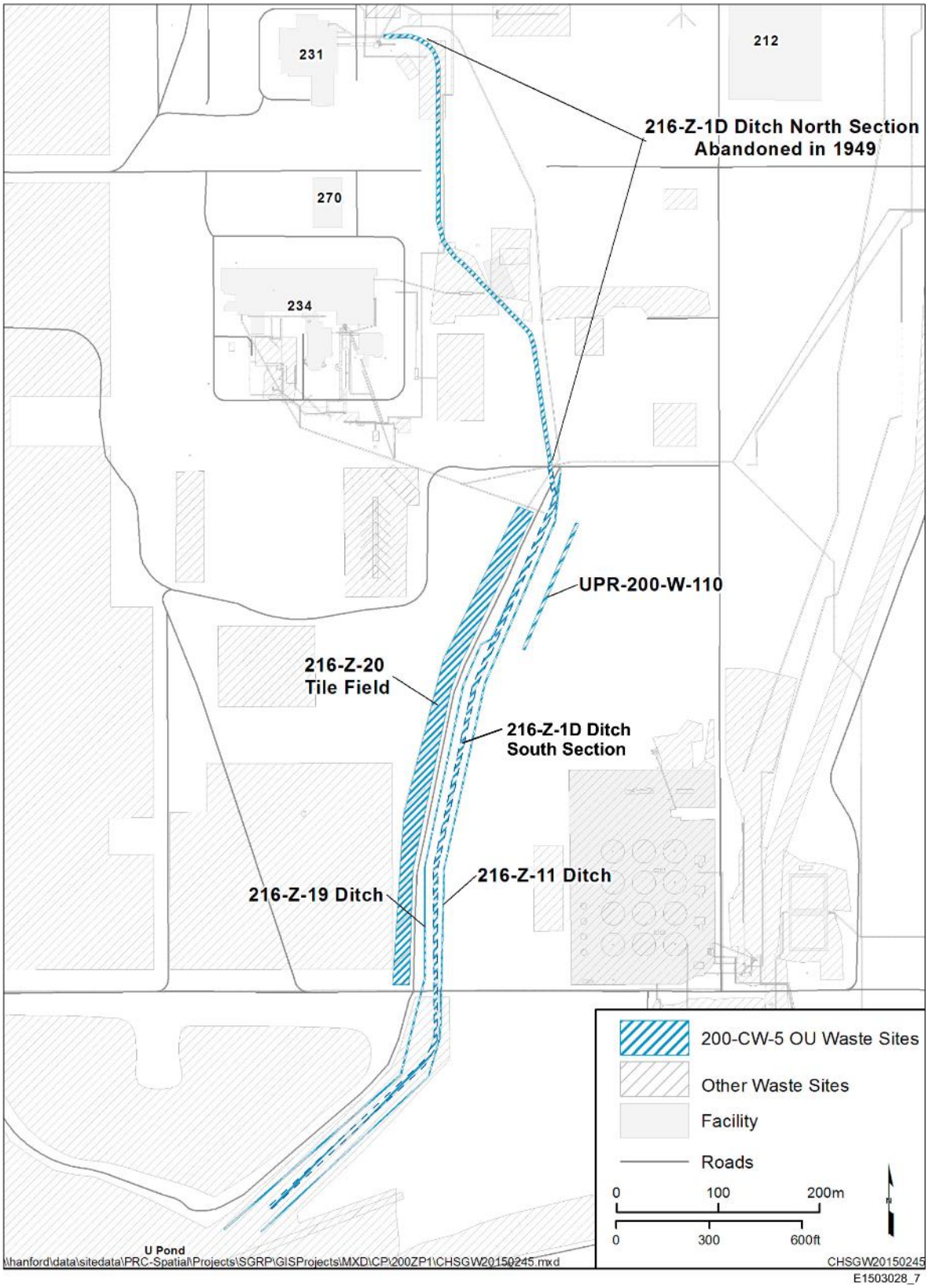

Figure 1-1. Location of the 200-CW-5 Operable Unit Waste Sites

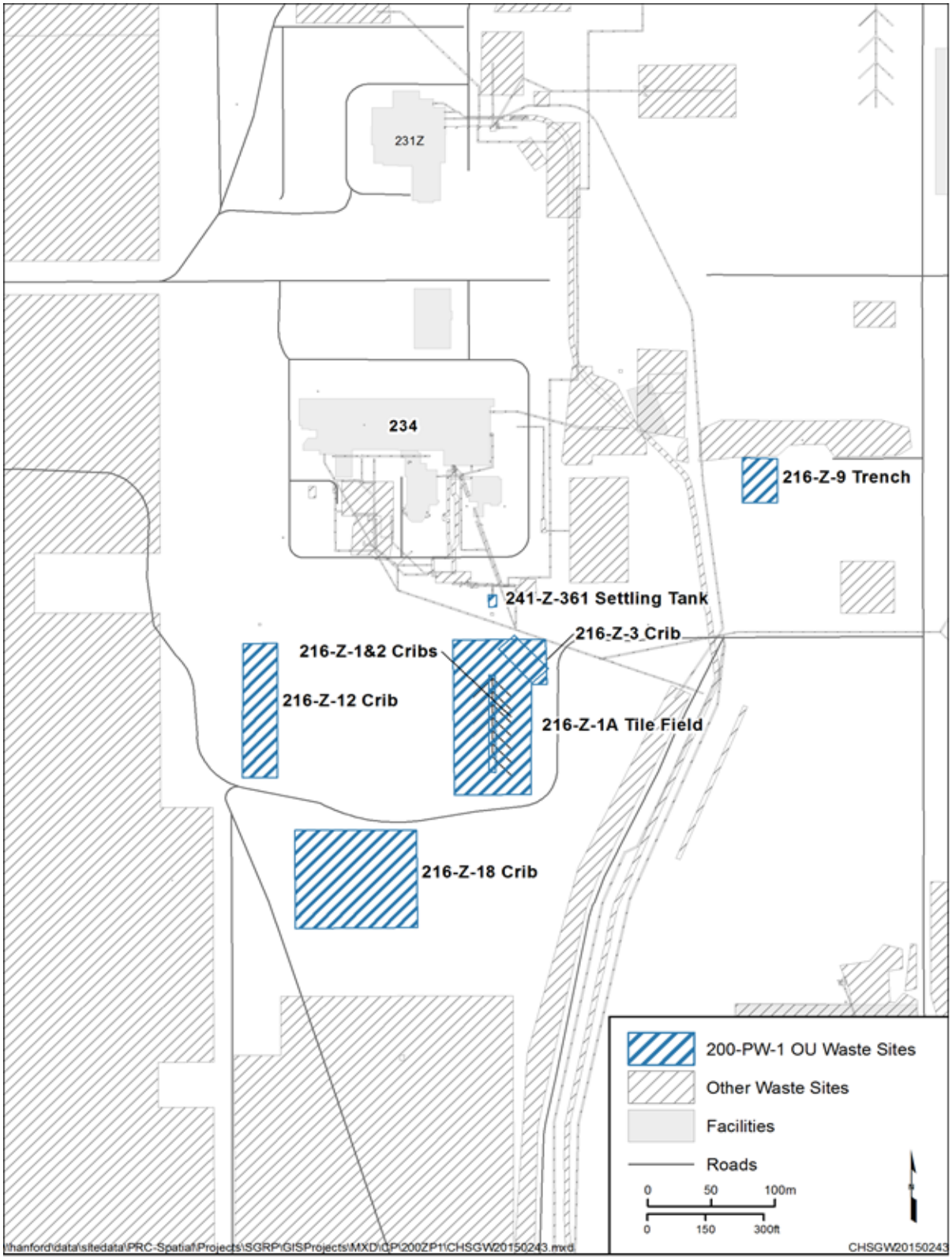

Figure 1-2. Location of the 200-PW-1 Operable Unit Waste Sites

The 216-Z-9 Trench primarily received waste streams from the Recovery of Uranium and Plutonium by Extraction (RECUPLEX) process, and the 216-Z-18 Crib primarily received waste streams from the Plutonium Reclamation Facility solvent extraction systems. These waste streams included acidic aqueous phase process wastes containing plutonium and americium. This aqueous waste, referred to as high-salt waste, was a concentrated nitrate solution containing dissolved metal (aluminum, calcium, sodium, and magnesium) nitrates. The sites also received significant volumes of organic wastes (principally carbon tetrachloride, tributyl phosphate, and lard oil), both entrained in the aqueous-phase waste streams and as separate, nonaqueous-phase waste streams. The sites were operated sequentially, starting with the 216-Z-9 Trench being replaced when conditions warranted.

Other 200-PW-1 OU waste sites (216-Z-1&2 Cribs, 216-Z-3 Crib, 216-Z-12 Crib, and 241-Z-361 Settling Tank) primarily received neutral to basic aqueous waste streams that contained plutonium and americium, with negligible amounts of organics and no nonaqueous phase liquids. This aqueous waste, referred to as low-salt waste, was primarily a dilute sodium fluoride and sodium nitrate solution when discharged. These cribs were operated sequentially, being replaced when conditions warranted. The 241-Z-361 Settling Tank remained online for discharges to all four cribs, limiting pass through of suspended solids with no design capability to discharge wastes directly to the soil column.

The 216-Z-1A Tile Field operated from 1949 through 1969 and received high-salt waste from the 234-5Z\Facility (Z Plant) solvent extraction systems and low-salt waste via the 241-Z-361 Settling Tank.

1.2.3 200-PW-6 Operable Unit

The 200-PW-6 OU contains four waste sites located in the 200 West Area. These include the 216-Z-10 Injection/Reverse Well, 216-Z-5 Crib, 216-Z-8 French Drain, and 241-Z-8 Settling Tank. Figure 1-3 shows the location of the 200-PW-6 OU waste sites in the 200 West Area. These waste sites received wastes from the Plutonium Isolation Facility or the PFP Complex, which contained plutonium but did not include organics. The 216-Z-10 Injection/Reverse Well and 216-Z-5 Crib received aqueous, neutral to basic process and laboratory wastes from the Plutonium Isolation Facility (231-Z Building). The 241-Z-8 Settling Tank received aqueous silica gel waste from back flushes of the feed filters at RECUPLEX. Overflow from the 241-Z-8 Settling Tank went into the 216-Z-8 French Drain.

1.3 Systematic Planning

The overarching requirement in the ROD (EPA et al., 2011) is to meet the soil cleanup levels designated for industrial use. Remedial action objectives (RAOs) are narrative statements that define the extent to which the sites require cleanup to meet the objective to protect HHE. The following RAOs are from the ROD (EPA et al., 2011):

- **RAO 1:** Prevent unacceptable risk to human health and ecological receptors associated with radiological exposure to waste, soil, or debris contaminated above risk-based criteria by removing the source or eliminating the pathway.
- **RAO 2:** Prevent unacceptable risk to human and ecological receptors associated with nonradiological exposure to waste, soil, or debris contaminated above risk-based criteria by removing the source or eliminating the pathway.
- **RAO 3:** Control the sources of potential groundwater contamination to support the Central Plateau groundwater goal of protecting the beneficial uses of groundwater, including protecting the Columbia River from adverse impacts.

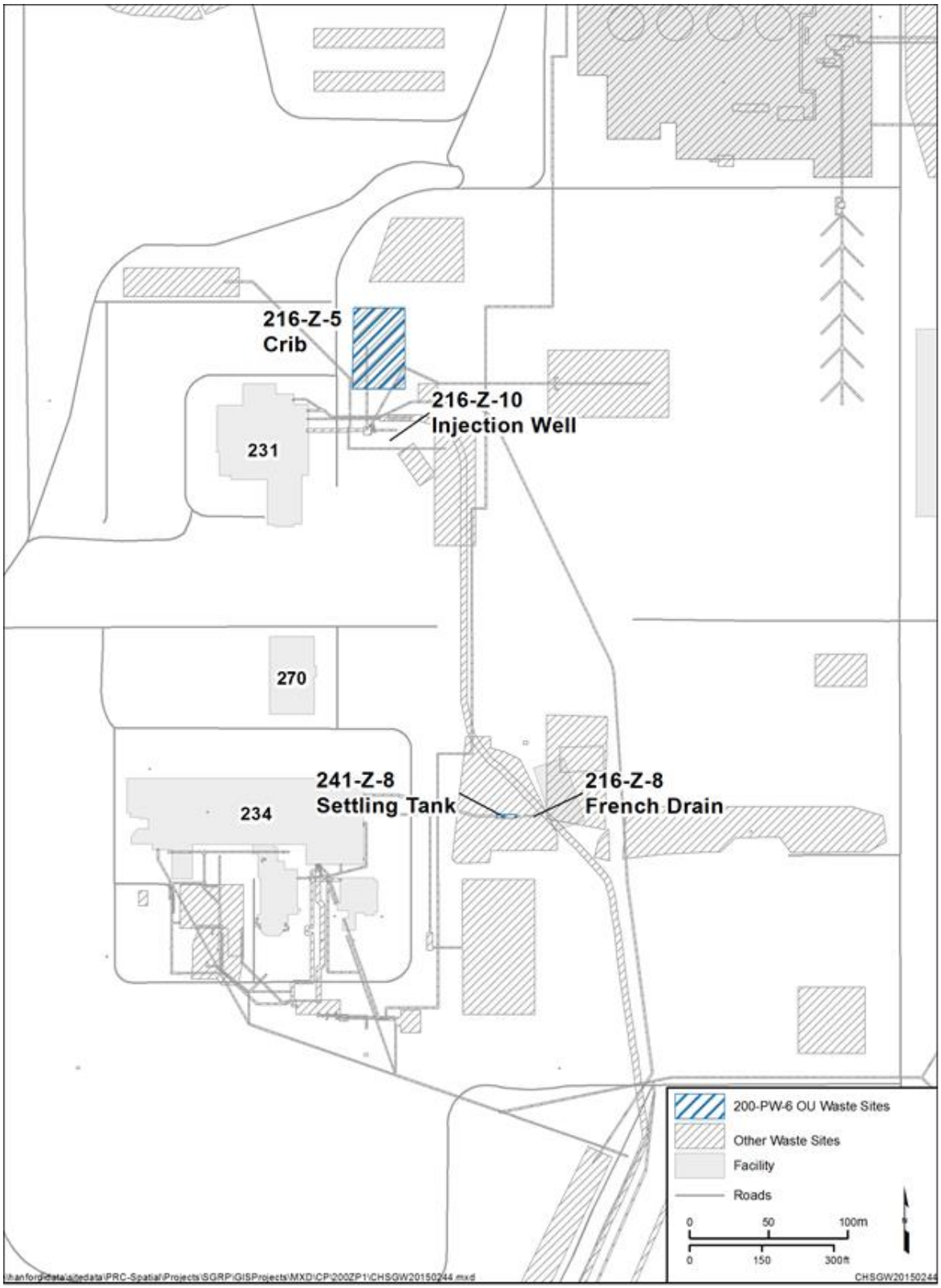

Figure 1-3. Location of the 200-PW-6 Operable Unit Waste Sites

A data quality objectives (DQOs) process, as described in EPA/240/B-06/001, *Guidance on Systematic Planning Using the Data Quality Objectives Process* (EPA QA/G-4), was used to develop the sampling and analytical design to manage waste materials, guide the remediation, and determine that RAOs are achieved. The DQO process is documented in SGW-58692, *Data Quality Objectives for the 200-CW-5, 200-PW-1, and 200-PW-6 Operable Units*.

Using the DQO process (EPA/240/B-06/001), three problem statements were identified. Data collected during the remedial actions are targeted to resolve these problem statements.

1.3.1 Problem Statement 1

Sufficient information on the nature and extent of contamination must be available in order to guide the remediation process and correctly segregate and manage waste.

Problem statement 1 involves using field radiological surveys to characterize the waste materials and residual soils for the major radionuclides of concern in order to guide the remedial action activities. Two principal study questions (PSQs) were developed to address problem statement 1. PSQ 1a involves characterizing the waste materials as they are generated in order to segregate low-level waste (LLW) from transuranic (TRU) waste and manage them appropriately. PSQ 1b involves using field radiological surveys to guide the excavation and determine when applicable cleanup levels have been met, and excavation may stop. Table 1-1 provides a summary of the PSQs to be resolved, data needs, measurements, and data use for problem statement 1.
The following decision rules (DRs) describe what actions will be taken when sufficient information has been collected to resolve problem statement 1:

- **DR 1a** – If the maximum concentrations of TRU radionuclides in the wastes exceed Environmental Restoration Disposal Facility (ERDF) waste acceptance criteria (WCH-191, *Environmental Restoration Disposal Facility Waste Acceptance Criteria*), segregate the waste and manage it for storage at the Solid Waste Operations Complex (SWOC), pending disposal at the Waste Isolation Pilot Plant. Otherwise, manage the waste for disposal at ERDF and proceed to DR 2a.

- **DR 1b** – If radiological survey measurements at depths ≤4.6 m (15 ft) below ground surface (bgs) indicate that contaminants of concern (COCs) do not exceed ROD (EPA et al., 2011) cleanup levels, then provide the data to EPA and DOE and evaluate stopping the excavation. Otherwise, if <4.6 m (15 ft) bgs, continue excavation or, if ≥4.6 m (15 ft) bgs, provide the data to EPA for discussion with DOE.

Table 1-1. Summary of Problem Statement 1

Problem Statement 1	Sufficient information on the nature and extent of contamination must be available in order to guide the remediation process and correctly segregate/manage waste.
PSQ 1a	Are the waste materials properly segregated and managed as LLW as it is generated (segregate LLW from TRU)?
Discussion	Process knowledge and historical data from the RI/FS for these OUs indicate large amounts of TRU waste were disposed to the waste sites. To protect workers and the environment, much of the remedial action will need to be conducted in containment and enclosures. Remote monitoring of radiological contaminants will be needed to guide waste management decisions.

Table 1-1. Summary of Problem Statement 1

Data Need	Measurement/Observation and Location/Frequency	Data Use
Total concentration of TRU radionuclides in waste soil and debris	Use field portable sodium iodide detector (or other suitable instrument) to monitor waste materials for radiological activity. A dose-to-curie conversion (cpm-to-pCi/g activity) will be developed for the field survey instrumentation. Waste materials will be monitored at the point of generation.	Use real-time measurements to segregate and manage waste soil and debris for disposal at the appropriate disposal facility. • TRU waste (>100 nCi/g) will be managed and packaged for storage at SWOC, pending disposal at Waste Isolation Pilot Plant. • LLW (≤100 nCi/g) will be managed and packaged for disposal at ERDF. Note: LLW <5 nCi/g will be loaded into roll-on/roll-off containers for disposal at ERDF. LLW >5 nCi/g and <100 nCi/g will be loaded into 2.7 x 2.7 x 1.5 m (9 x 9 x 5 1.5 ft) boxes for disposal at ERDF.
PSQ 1b	Are the residual contaminant levels at depths ≤4.6 m (15 ft) bgs in the excavation less than the applicable cleanup levels of the ROD (EPA et al., 2011)?	
Discussion	Field radiological measurements of the excavation need to be provided in a timely manner in order to determine when remedial action objectives have been met and excavation may stop.	
Data Need	**Measurement/Observation and Location/Frequency**	**Data Use**
Concentration of radiological COCs in soil at depths ≤4.6 m (15 ft) bgs in the waste site excavation	Conduct a systematic radiological survey of waste site excavation at depths of ≤4.6 m (15 ft) bgs using a field portable sodium iodide detector (or other suitable instrument). A dose-to-curie conversion (cpm-to-pCi/g activity) will be developed for the field survey instrumentation.	Use systematic radiological survey results to determine when the ROD (EPA et al., 2011) cleanup levels have been achieved in soils at depths of ≤4.6 m (15 ft) bgs, and excavation may stop.

Source: EPA et al., 2011, *Record of Decision Hanford 200 Area Superfund Site 200-CW-5 and 200-PW-1, 200-PW-3, and 200-PW-6 Operable Units.*

bgs = below ground surface
COC = contaminant of concern
cpm = counts per minute
ERDF = Environmental Restoration Disposal Facility
LLW = low-level waste
OU = operable unit
PSQ = principal study question
RI/FS = remedial investigation/feasibility study
SWOC = Solid Waste Operations Complex
TRU = transuranic

1.3.2 Problem Statement 2

Waste material (soil, debris, and sludge) resulting from remediation of the 200-CW-5, 200-PW-1, and 200-PW-6 OU waste sites must be properly designated and packaged to meet disposal facility requirements. No waste will be generated for the 200-PW-3 OU.

Problem statement 2 involves using NDA and focused/judgmental sampling in order to designate the waste soil and debris for proper packaging, treatment (if needed), and disposal. Eight PSQs were developed to address problem statement 2. PSQ 2a involves assaying the waste containers to confirm whether the contents are LLW or TRU waste. The remaining seven PSQs (2b through 2h) involve using process knowledge, historical data, and/or focused sampling, as needed, to designate the waste materials for disposal at ERDF. Table 1-2 provides a summary of the PSQs to be resolved, data needs, measurements, and data use for problem statement 1.

Table 1-2. Summary of Problem Statement 2

Problem Statement 2	Waste material (soil, debris, and sludge) resulting from remediation of the 200-CW-5, 200-PW-1, and 200-PW-6 OU waste sites must be properly designated and packaged to meet the disposal facility requirements.	
PSQ 2a	Is the material radiologically contaminated above ERDF disposal criteria?	
Discussion	Process knowledge and historical data from the RI/FS for these OUs indicate that large amounts of TRU waste were disposed of to the waste sites. TRU and LLW are expected to be generated. TRU levels will need to be confirmed in the field to ensure compliance with the waste acceptance criteria of the disposal facilities.	
Data Need	**Measurement/Observation and Location/Frequency**	**Data Use**
Total activity of radiological contaminants in waste containers	Conduct field NDA on waste containers prior to disposal.	Confirm that radiological composition and concentration levels comply with the waste acceptance criteria of the selected waste disposal facility (ERDF or Waste Isolation Pilot Plant).
PSQ 2b	Is the material a listed dangerous waste?	
Discussion	Process knowledge and historical data from the RI/FS for these OUs have been used to prepare preliminary waste designations for the waste sites. Additional sampling may be needed to confirm and/or adjust the waste designations.	
Data Need	**Measurement/Observation and Location/Frequency**	**Data Use**
Concentration of listed dangerous waste materials	Apply process knowledge and historical data to determine listed dangerous waste codes for waste shipments. Collect focused samples, as needed, for laboratory analysis to confirm designation.	Determine if the material is a listed dangerous waste and can be evaluated for treatment/disposal at ERDF or managed at SWOC.

Table 1-2. Summary of Problem Statement 2

PSQ 2c	Is the material a characteristic waste (e.g., ignitable, corrosive, reactive, or toxic)?	
Discussion	Process knowledge and historical data from the RI/FS for these OUs have been used to prepare preliminary waste designations for the waste sites. Additional sampling may be needed to confirm and/or adjust the waste designations.	
Data Need	**Measurement/Observation and Location/Frequency**	**Data Use**
Concentration of characteristic waste materials	Apply process knowledge and historical data to determine characteristic waste codes for waste shipments. Collect focused samples, as needed, for laboratory analysis to confirm designation.	Determine if the material is a characteristic waste and can be evaluated for treatment/disposal at ERDF or managed at SWOC.
PSQ 2d	Is the material a toxic dangerous waste as defined by Washington State criteria?	
Discussion	Process knowledge and historical data from the RI/FS for these OUs have been used to prepare preliminary waste designations for the waste sites. Additional sampling may be needed to confirm and/or adjust the waste designations.	
Data Need	**Measurement/Observation and Location/Frequency**	**Data Use**
Concentration of toxic dangerous waste materials	Apply process knowledge and historical data to determine toxic dangerous waste codes for waste shipments. Collect focused samples, as needed, for laboratory analysis to confirm designation.	Determine if the material is a toxic dangerous waste and can be evaluated for treatment/disposal at ERDF or managed at SWOC.
PSQ 2e	Is the material a persistent waste as defined by Washington State criteria?	
Discussion	Process knowledge and historical data from the RI/FS for these OUs have been used to prepare preliminary waste designations for the waste sites. Additional sampling may be needed to confirm and/or adjust waste designations.	
Data Need	**Measurement/Observation and Location/Frequency**	**Data Use**
Concentration of persistent waste materials	Apply process knowledge and historical data to determine persistent waste codes for waste shipments. Collect focused samples, as needed, for laboratory analysis to confirm designation.	Determine if the material is a persistent waste and can be evaluated for treatment/disposal at ERDF or managed at SWOC.
PSQ 2f	Is the material a PCB waste?	
Discussion	Process knowledge and historical data from the RI/FS for these OUs have been used to prepare preliminary waste designations for the waste sites. Additional sampling may be needed to confirm and/or adjust the waste designations.	
Data Need	**Measurement/Observation and Location/Frequency**	**Data Use**
Concentration of PCBs	Apply process knowledge and historical data to determine if PCBs are regulated in waste shipments. Collect focused samples, as needed, for laboratory analysis to confirm designation.	Determine if the material is a PCB waste and can be evaluated for treatment/disposal at ERDF or managed at SWOC.

Table 1-2. Summary of Problem Statement 2

PSQ 2g	Is the material an asbestos waste?	
Discussion	Process knowledge and historical data from the RI/FS for these OUs have been used to prepare preliminary waste designations for the waste sites. Additional sampling may be needed to confirm and/or adjust the waste designations.	
Data Need	**Measurement/Observation and Location/Frequency**	**Data Use**
Concentration of asbestos	Apply process knowledge and historical data to determine if asbestos is regulated in waste shipments. Collect focused samples, as needed, for laboratory analysis to confirm designation.	Determine if the material is asbestos waste and requires proper handling.
PSQ 2h	Is the material land disposal restricted?	
Discussion	Process knowledge and historical data from the RI/FS for these OUs have been used to prepare preliminary waste designations for the waste sites. Additional sampling may be needed to confirm and/or adjust the waste designations.	
Data Need	**Measurement/Observation and Location/Frequency**	**Data Use**
Concentration of land disposal-restricted materials	Apply process knowledge and historical data to determine if land disposal-restricted materials are regulated in waste shipments. Collect focused samples, as needed, for laboratory analysis to confirm designation.	Determine if the material is land disposal restricted and requires treatment before disposal.

Source: EPA, *Record of Decision Hanford 200 Area Superfund Site 200-CW-5 and 200-PW-1, 200-PW-3, and 200-PW-6 Operable Units.*

ERDF = Environmental Restoration Disposal Facility
LLW = low-level waste
NDA = nondestructive assay
OU = operable unit
PCB = polychlorinated biphenyl
PSQ = principal study question
RI/FS = remedial investigation/feasibility study
SWOC = Solid Waste Operations Complex
TRU = transuranic

The following DRs describe what actions will be taken when sufficient information has been collected to resolve problem statement 2:

- **DR 2a** – If the maximum concentrations of radionuclides in the soil and debris exceed the ERDF waste acceptance criteria (WCH-191), evaluate other storage and disposal options, including SWOC. Proceed to DR 2b.

- **DR 2b** – If soil and debris are a listed dangerous waste, then evaluate for treatment/disposal at ERDF or perform treatment at an onsite or offsite facility prior to ERDF disposal. If treatment options are not available, the waste may be managed within SWOC. Otherwise, if the soil and debris are not a listed dangerous waste, then evaluate for treatment/disposal at ERDF. Proceed to DR 2c.

- **DR 2c** – If chemical concentrations in the soil and debris exceed the criteria for being a characteristic dangerous waste, treat the material as a radiologically contaminated characteristic dangerous waste and evaluate for treatment/disposal at ERDF, or perform treatment at an onsite or offsite facility prior to ERDF disposal. If treatment options are not available, the waste may be managed within SWOC. Otherwise, if the chemical concentrations in the soil and debris do not exceed the criteria for being a characteristic dangerous waste, do not treat the material as a characteristic dangerous waste, and evaluate for treatment/disposal at ERDF. Proceed to DR 2d.

- **DR 2d** – If chemical concentrations in the soil and debris exceed the criteria for being a toxic dangerous waste, then treat the material as a radiologically contaminated toxic dangerous waste, and evaluate for treatment/disposal at ERDF, or perform treatment at an onsite or offsite facility prior to ERDF disposal. If treatment options are not available, the waste may be managed within SWOC. Otherwise, if chemical concentrations in the soil and debris do not exceed the criteria for being a toxic dangerous waste, then do not treat the material as a toxic dangerous waste, and evaluate for treatment/disposal at ERDF. Proceed to DR 2e.

- **DR 2e** – If chemical concentrations in the soil and debris exceed the criteria for being a persistent dangerous waste, then treat the material as a radiologically contaminated persistent dangerous waste, and evaluate for treatment/disposal at ERDF, or perform treatment at an onsite or offsite facility prior to ERDF disposal. If treatment options are not available, the waste may be managed within SWOC. Otherwise, if the chemical concentrations in the soil and debris do not exceed the criteria for being a persistent dangerous waste, then do not treat the material as a persistent dangerous waste, and evaluate for treatment/disposal at ERDF. Proceed to DR 2f.

- **DR 2f** – If chemical concentrations in the soil and debris exceed the criteria for being a polychlorinated biphenyl (PCB) waste, treat the material as a radiologically contaminated PCB waste, and evaluate for treatment/disposal at ERDF, or perform treatment at an onsite or offsite facility prior to ERDF disposal. If treatment options are not available, the waste may be managed within SWOC. Otherwise, if chemical concentrations in the soil and debris do not exceed the criteria for being a PCB waste, do not treat the material as a PCB waste, and evaluate for treatment/disposal at ERDF. Proceed to DR 2g.

- **DR 2g** – If asbestos concentrations exceed the criteria for being an asbestos waste, treat the material as a radiologically contaminated asbestos waste, and evaluate for treatment/disposal at ERDF. Otherwise, if asbestos concentrations do not exceed the criteria for being an asbestos waste, do not treat the material as an asbestos waste, and evaluate for treatment/disposal at ERDF. Proceed to DR 2h.

- **DR 2h** – If process knowledge or analytical results dictate land disposal restriction imposed treatment, the material shall be treated/disposed of at ERDF, or perform treatment at an onsite or offsite facility prior to ERDF disposal. Otherwise, if treatment options are not available, the waste may be managed within SWOC.

1.3.3 Problem Statement 3

Sufficient information on the nature and extent of residual contamination in the remediated waste sites must be available for decision making and long-term stewardship documentation:

- Residual contamination levels at depths ≤4.6 m (15 ft) bgs in the remediated waste sites will be compared to the applicable cleanup levels of the ROD (EPA et al., 2011).

- Residual contamination levels at depths >4.6 m (15 ft) bgs in the remediated 216-Z-9, 216-Z-1A, and 216-Z-18 waste sites will be evaluated by EPA and DOE to determine if additional soil removal is warranted. Criteria will be developed in time to support the evaluation.

Problem statement 3 involves statistical sampling and a combination of gridded radiological surveys and focused/judgmental sampling to determine the nature and extent of residual contamination in the remediated waste sites. Three PSQs were developed to address problem statement 3. PSQ 3a involves collecting discrete samples using a statistical sample design in order to compare the contaminant concentrations at depths ≤4.6 m (15 ft) bgs to the applicable cleanup levels in the ROD (EPA et al., 2011). PSQ 3b involves using a combination of gridded radiological surveys and focused samples to determine the nature and extent of residual contamination at depths >4.6 m (15 ft) bgs in the remediated waste sites. PSQ 3c involves using gridded radiological surveys to determine the nature and extent of residual plutonium-239/240 and americium-241 in the bottom of the remediated 216-Z-9, 216-Z-1A, and 216-Z-18 waste sites. Table 1-3 provides a summary of the PSQs to be resolved, data needs, measurements, and data use for problem statement 3.

Table 1-3. Summary of Problem Statement 3

Problem Statement 3	Sufficient information on the nature and extent of residual contamination in the remediated waste sites must be available for decision making and long-term stewardship documentation.	
PSQ 3a	Are the residual soil concentrations of COCs at depths to ≤4.6 m (15 ft) bgs in the remediated waste sites below the applicable cleanup levels of the ROD (EPA et al., 2011)?	
Discussion	The ROD (EPA et al., 2011) provides cleanup levels for several COCs based on an industrial scenario and protection of ecological receptors. The cleanup levels apply to soils at depths to ≤4.6 m (15 ft) bgs. Contaminant concentrations in the completed excavations are needed to compare to the cleanup levels.	
Data Need	**Measurement/Observation and Location/Frequency**	**Data Use**
Concentration of Sr-90, Cs-137, Ra-226, Pu-239/240, Am-241, boron, mercury, PCBs, and nitrate at depths of ≤4.6 m (15 ft) bgs in the excavated 200-CW-5 OU waste sites	Conduct systematic radiological surveys using field portable instrumentation (sodium iodide scintillation or other suitable instrument). Collect discrete soil samples for laboratory analysis using a systematic grid. The number of samples may be based on the contaminant variability from the systematic radiological surveys.	Compare the concentration of Sr-90, Cs-137, Ra-226, Pu-239/240, Am-241, boron, mercury, PCBs, and nitrate at depths of ≤4.6 m (15 ft) bgs in the excavated 200-CW-5 OU waste sites to the ROD (EPA et al., 2011) cleanup levels. Provide concentration data and analysis to DOE and EPA.
Concentration of Pu-239/240 and Am-241 at depths ≤4.6 m (15 ft) bgs in the excavated 216-Z-1&2, 216-Z-3, 216-Z-5, 241-Z-8, 216-Z-12, and 241-Z-361 waste sites	Conduct systematic radiological surveys using field portable instrumentation (sodium iodide scintillation or other suitable instrument). Collect discrete soil samples for laboratory analysis using a systematic grid. The number of samples may be based on the contaminant variability from the systematic radiological surveys.	Compare the concentration of Pu-239/240 and Am-241 at depths of ≤4.6 m (15 ft) bgs in the excavated 216-Z-1&2, 216-Z-3, 216-Z-5, 241-Z-8, 216-Z-12, and 241-Z-361 waste sites to the ROD (EPA et al., 2011) cleanup levels. Provide concentration data and analysis to DOE and EPA.

Table 1-3. Summary of Problem Statement 3

Concentration of Tc-99, Pu-239/240, Am-241, and nitrate at depths ≤4.6 m (15 ft) bgs in the excavated 216-Z-9, 216-Z-1A, and 216-Z-18 waste sites	Conduct systematic radiological surveys using field portable instrumentation (sodium iodide scintillation or other suitable instrument). Collect discrete soil samples for laboratory analysis using a systematic grid. The number of samples may be based on the contaminant variability from the systematic radiological surveys.	Compare the concentration of Tc-99 and nitrate at depths of ≤4.6 m (15 ft) bgs in the excavated 216-Z-9, 216-Z-1A, and 216-Z-18 waste sites to the ROD (EPA et al., 2011) cleanup levels. Provide concentration data and analysis to DOE and EPA.
PSQ 3b	What is the nature and extent of residual soil concentrations of the applicable COCs at depths >4.6 m (15 ft) bgs in the remediated waste sites?	
Discussion	The ROD (EPA et al., 2011) provides several contaminants that are of interest for the protection of groundwater. The nature and extent of these contaminants at depths >4.6 m (15 ft) bgs is needed to evaluate the remedial action.	
Data Need	**Measurement/Observation and Location/Frequency**	**Data Use**
Concentration of Sr-90, Cs-137, Ra-226, Pu-239/240, Am-241, boron, mercury, PCBs, and nitrate at depths of >4.6 m (15 ft) bgs in the excavated 200-CW-5 OU waste sites	Conduct gridded radiological surveys using field portable instrumentation (sodium iodide scintillation or other suitable instrument). Focused samples will be collected for laboratory analysis of Sr-90, Cs-137, Ra-226, Pu-239/240, Am-241, boron, mercury, PCBs, and nitrate.	Determine the nature and extent of Sr-90, Cs-137, Ra-226, Pu-239/240, Am-241, boron, mercury, PCBs, and nitrate at depths >4.6 m (15 ft) bgs in the excavated 200-CW-5 OU waste sites. Provide nature and extent data to DOE and EPA to evaluate if additional remedial action is needed.
Concentration of Pu-239/240 and Am-241 at depths >4.6 m (15 ft) bgs in the excavated 216-Z-1&2, 216-Z-3, 216-Z-5, 241-Z-8, 216-Z-12, and 241-Z-361 waste sites	Conduct gridded radiological surveys using field portable instrumentation (sodium iodide scintillation or other suitable instrument). Focused samples will be collected for laboratory analysis of Pu-239/240 and Am-241.	Determine the nature and extent of Pu-239/240 and Am-241 at depths >4.6 m (15 ft) bgs in the excavated 216-Z-1&2, 216-Z-3, 216-Z-5, 241-Z-8, 216-Z-12, and 241-Z-361 waste sites. Provide nature and extent data to DOE and EPA.
Concentration of Tc-99, Pu-239/240, Am-241, and nitrate at depths >4.6 m (15 ft) bgs in the excavated 216-Z-9, 216-Z-1A, and 216-Z-18 waste sites	Focused samples will be collected for laboratory analysis of Tc-99, Pu-239/240, Am-241, and nitrate.	Determine the nature and extent of Tc-99 and nitrate at depths >4.6 m (15 ft) bgs in the excavated 216-Z-9, 216-Z-1A, and 216-Z-18 waste sites. Provide nature and extent data to DOE and EPA to evaluate if additional remedial action is needed.
PSQ3c	What are the residual soil concentrations of Pu-239/240 and Am-241 at the bottom of the remediated 216-Z-9, 216-Z-1A, and 216-Z-18 waste sites?	
Discussion	Process knowledge and historical data from the RI/FS for these OUs indicate large amounts of TRU waste were disposed to the 216-Z-9, 216-Z-1A, and 216-Z-18 waste sites. When excavated to the depths specified in the ROD (EPA et al., 2011), high levels of Pu-239/240 and Am-241 may still be present at the bottom of the waste sites.	

Table 1-3. Summary of Problem Statement 3

Data Need	Measurement/Observation and Location/Frequency	Data Use
Concentration of Pu-239/240 and Am-241 in the bottom of the excavated 216-Z-9, 216-Z-1A, and 216-Z-18 waste sites	Conduct gridded radiological surveys using field portable instrumentation (sodium iodide scintillation or other suitable instrument).	Determine the nature and extent of Pu-239 and Am-241 in the bottom of the excavated 216-Z-9, 216-Z-1A, and 216-Z-18 waste sites. Provide nature and extent data to DOE and EPA to evaluate if additional remedial action is needed.

Source: EPA et al., 2011, *Record of Decision Hanford 200 Area Superfund Site 200-CW-5 and 200-PW-1, 200-PW-3, and 200-PW-6 Operable Units*.

Am-241 = americium-241
COC = contaminant of concern
Cs-137 = cesium-137
DOE = U.S. Department of Energy
EPA = U.S. Environmental Protection Agency
PCB = polychlorinated biphenyl
PSQ = principal study question
Pu-239/240 = plutonium-239/240
Ra-226 = radium-226
RI/FS = remedial investigation/feasibility study
ROD = record of decision
Sr-90 = strontium-90
Tc-99 = technetium-99
TRU = transuranic

The following DRs describe what actions will be taken when sufficient information has been collected to resolve problem statement 3:

- **DR 3a** – If residual concentrations of COCs at depths ≤4.6 m (15 ft) bgs in the remediated waste site soils do not exceed the applicable cleanup levels of the ROD (EPA et al., 2011), then provide the data to EPA and DOE, and begin preparations to complete the remedial action. Otherwise, if <4.6 m (ft) bgs, continue excavation or, if >4.6 m (ft) bgs, provide the data to EPA for discussion with DOE.
- **DR 3b** – If the nature and extent of COCs at depths >4.6 m (15 ft) bgs in the waste site soils are acceptable, then begin preparations to complete the remedial action. Otherwise, provide the data to EPA for discussion with DOE.
- **DR 3c** – If residual concentrations of plutonium-239/240 and americium-241 at the bottom of the 216-Z-9, 216-Z-1A, and 216-Z-18 Waste Sites are acceptable, then begin preparations to complete the remedial action. Otherwise, provide the data to EPA for discussion with DOE. Criteria to determine if further excavation is warranted will be developed in time to support this discussion.

1.4 Target Analytes

Remedial investigation (RI) activities for the 200-CW-5 OU were conducted in 2002. The 200-CW-5 RI (DOE/RL-2003-11, *Remedial Investigation Report 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 200-SC-1 Steam Condensate Group Operable Units) focused on characterization of the 216-Z-11 Ditch, which was identified as the representative waste site for the 200-CW-5 OU. The 200-CW-5 RI used soil probe investigations to optimize placement of a single borehole at the highest anticipated contamination area of the 216-Z-11 Ditch. These data supplemented existing historical characterization data.

RI activities for the 200-PW-1, 200-PW-3, and 200-PW-6 OUs were conducted in 2006 and 2007. Five representative soil sites, located in the 200-PW-1, 200-PW-3 and 200-PW-6 OUs, were characterized as part of 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*. The representative soil sites included the 216-A-8 Crib, 216-Z-1A Tile Field, 216-Z-8 French Drain, 216-Z-9 Trench, and 216-Z-10 Injection/Reverse Well. RI activities for these OUs were conducted primarily from 1999 to 2007. Characterization activities also took place to define the nature and extent of carbon tetrachloride contamination around the 200-PW-1 OU waste sites. To gather additional information about contamination at the 216-Z-1A Crib and 216-Z-9 Trench, characterization activities included drilling vadose boreholes, subsurface soil and soil vapor sampling, and geophysical logging of the boreholes and nearby wells.

1.4.1 Contaminants for Waste Management Decisions

A list of contaminants was developed for the project based on historical process operation information for the former plutonium processing and finishing activities that discharged to the 200-CW-5, 200-PW-1, and 200-PW-6 OU waste sites and the characterization data from the RI. Table 1-4 contains contaminants for the 200-CW-5, 200-PW-1, and 200-PW-6 OU waste sites that will be used for evaluating waste management decisions.

1.4.2 Contaminants of Concern

The list of COCs for the waste sites was derived from the ROD (EPA et al., 2011). Table 1-5 presents the list of COCs for final cleanup of the 200-CW-5 OU waste sites as established in the ROD (EPA et al., 2011). Table 1-6 presents the list of COCs for final cleanup of the 200-PW-1 and 200-PW-6 OU waste sites, as established in the ROD (EPA et al., 2011).

1.5 Sampling and Analysis Plan Scope

The scope of this SAP includes the waste sites identified for remediation by RTD in the ROD (EPA et al., 2011). The waste sites consist predominantly of liquid waste disposal sites associated with PFP and PUREX operations, some associated pipelines and settling tanks, and UPRs. The scope of the proposed sampling and analysis includes the following activities:

- Characterization of soil and debris excavated from the sites to support remediation waste management and disposal
- Characterization of soil at depths of ≤4.6 m (15 ft) bgs in the excavations to determine that RAOs have been achieved and excavation may stop
- Development of verification work instructions, which will present a waste site-specific sampling approach and methods that will support site closure
- Demonstration that post-remediation objectives in the ROD (EPA et al., 2011) have been met for residual soil in the ditches and cribs and overburden soil intended for use as clean backfill

Table 1-4. 200-CW-5, 200-PW-1, and 200-PW-6 Operable Unit Contaminants for Waste Management Decisions

Nonradioactive Contaminants		Radioactive Contaminants
Acetone	Arsenic	Potassium-40
Butyl Alcohol	Barium	Strontium-90
Carbon Tetrachloride	Beryllium	Technetium-99
Chlorobenzene	Boron	Cesium-137
Chloroform	Cadmium	Cerium-139
1, 1-Dichloroethane	Chromium	Radium-226
Methyl Ethyl Ketone	Copper	Radium-228
Methyl Isobutyl Ketone	Hexavalent Chromium	Thorium-228
Methylene Chloride	Lead	Thorium-230
Tetrachloroethene	Lithium	Thorium-232
Toluene	Manganese	Uranium-233/234
Trichloroethene	Mercury	Uranium-238
Tributyl Phosphate	Molybdenum	Plutonium-238
Aroclor 1248	Nickel	Plutonium-239
Aroclor 1254	Selenium	Plutonium-239/240
Aroclor 1260	Silver	Americium-241
Oil and Grease	Vanadium	
2-Butanone	Zinc	
2-Pentanone	Ammonium Ion	
	Fluoride	
	Sulfate	
	Nitrate	
	Nitrite	

Table 1-5. 200-CW-5 Operable Unit Contaminants of Concern for Final Cleanup Decisions

Nonradioactive Contaminants of Concern	Radioactive Contaminants of Concern
Aroclor 1254	Strontium-90
Aroclor 1260	Cesium-137
Boron	Radium-226
Mercury	Plutonium-239/240
Nitrate*	Americium-241

* Constituent was requested by the Washington State Department of Ecology; data were collected for information purposes.

Table 1-6. 200-PW-1 and 200-PW-6 Operable Unit Contaminants of Concern for Final Cleanup Decisions

Nonradioactive Contaminants of Concern	Radioactive Contaminants of Concern
Nitrate*	Technetium-99*
	Plutonium-239/240
	Americium-241

* Constituent was requested by the Washington State Department of Ecology; data were collected for information purposes for the 216-Z-9, 216-Z-1A, and 216-Z-18 waste sites only.

1.6 Project Schedule

Figure 1-4 shows a preliminary summary schedule for the remedial action for the 200-CW-5, 200-PW-1, 200-PW-3, and 200-PW-6 OU waste sites. The overall project is anticipated to take 20 years. Sampling and analysis would take place primarily during the RTD phases of the project.

No.	Task Name
1	Remediate 200-CW-5 and 200-PW-1/3/6 Operable Units
1.1	Manage 200-CW-5 and 200-PW-1/3/6 Remediation
1.1.1	Project Management and Support for 200-CW-5 and 200-PW-1/3/6 Remediation
1.1.2	Acquire Remediation System for 200-CW-5 and 200-PW-1/3/6
1.1.2.1	Request and Obtain Project Funding
1.1.2.2	CD-0, Approve Mission Need
1.1.2.3	CD-0 to CD-1, Approve Alternative Selection and Cost Range
1.1.2.4	CD-1 to CD-2, Approve Performance Baseline
1.1.2.5	CD-2 to CD-3, Approve Start of Construction/Execution
1.1.2.6	CD-3 to CD-4, Approve Start of Operations or Project Completion
1.1.3	Mobilize Remediation System for 200-CW-5 and 200-PW-1/3/6
1.2	Remove, Treat, and Dispose of Contaminated Soil and Debris
1.2.1	Manage RTD of Contaminated Soil and Debris
1.2.2	RTD of Soil and Debris from Z Ditches
1.2.3	RTD of Soil and Debris from 216-Z-5
1.2.4	RTD of Soil and Debris from 216-Z-18
1.2.5	RTD of Soil and Debris from 216-Z-9
1.2.6	RTD of Soil and Debris from 216-Z-12
1.2.7	RTD of Soil and Debris from 216-Z-1A, Z-1, Z-2, and Z-3
1.3	Remove, Treat, and Dispose of Settling Tanks
1.3.1	Manage RTD of Settling Tanks
1.3.2	RTD of Tank 241-Z-8
1.3.3	RTD of Tank 241-Z-361
1.4	Enhance Soil Cover, Install ET Barriers, and Demobilize the Project
1.4.1	Manage Enhance Soil Cover, Install ET Barriers, and Demobilize the Project
1.4.2	Enhance Soil Cover for Cs-137 Waste Sites
1.4.3	Install ET Barriers
1.4.4	Demobilize the Project
1.5	Long-Term Stewardship
1.5.1	Manage Long-Term Stewardship
1.5.2	Institutional Controls
1.5.3	Surveillance, Operations, and Maintenance
1.5.4	CERCLA 5-Year Review

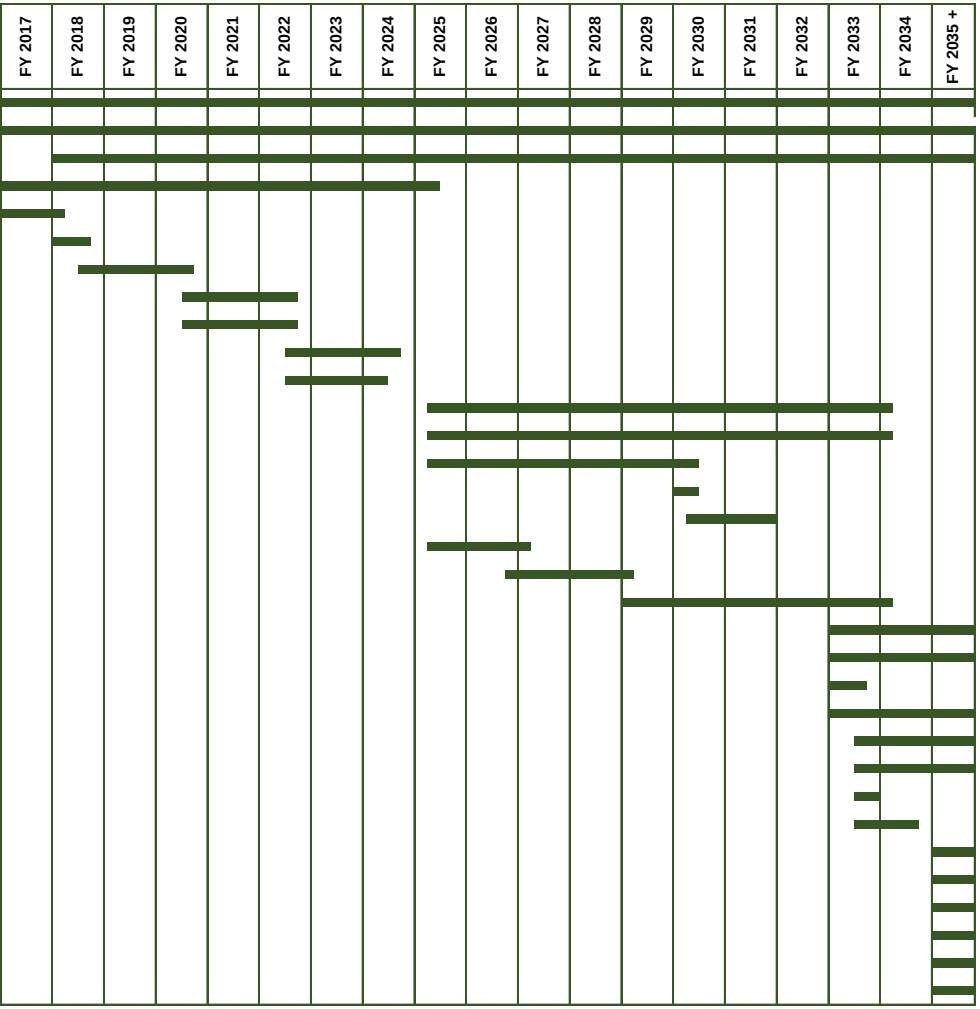

Figure 1-4. Remedial Action Preliminary Schedule for the 200-CW-5 and 200-PW-1/3/6 Operable Units

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2 Quality Assurance Project Plan

A quality assurance project plan (QAPjP) establishes the quality requirements for environmental data collection. It includes planning, implementation, and assessment of sampling tasks, field measurements, laboratory analysis, and data review. This chapter describes the applicable environmental data collection requirements and controls based on the QA elements found in EPA/240/B-01/003, *EPA Requirements for Quality Assurance Project Plans* (EPA QA/R-5), and DOE/RL-96-68, *Hanford Analytical Services Quality Assurance Requirements Document* (HASQARD). This QAPjP also describes the applicable requirements and controls based on guidance found in EPA/240/R-02/009, *Guidance for Quality Assurance Project Plans* (EPA QA/G-5). This QAPjP is intended to supplement the contractor's environmental QA program plan.

This QAPjP is divided into the following four sections, which describe the quality requirements and controls applicable to Hanford Site OU sampling and field measurement: Project Management, Data Generation and Acquisition, Assessment and Oversight, and Data Review and Usability.

2.1 Project Management

This section addresses the basic aspects of project management, to ensure that project roles and responsibilities are understood, and describes quality specifications, training, and management of project documents.

2.1.1 Project/Task Organization

The contractor, or its approved subcontractor, is responsible for planning, coordinating, sampling, preparing, packaging, and shipping samples to the laboratory. The contractor is responsible for managing all interfaces among subcontractors involved in executing the work described in this SAP. The project organization (in regard to sampling and characterization) is described in the following subsections and is shown graphically in Figure 2-1.

2.1.1.1 Regulatory Lead

EPA is responsible for regulatory oversight of cleanup projects and activities. EPA, as lead regulatory agency (LRA) for the 200-CW-5, 200-PW-1, 200-PW-3, and 200-PW-6 OUs, has approval authority for the work being performed under this SAP. The LRA will work with the DOE Richland Operations Office (DOE-RL) to resolve concerns over the work described in this SAP in accordance with the TPA (Ecology et al., 1989a).

2.1.1.2 DOE-RL Project Manager

DOE is responsible for Hanford Site cleanup. The DOE-RL Project Manager is responsible for monitoring the contractor's performance of activities for the Hanford Site under CERCLA, the *Resource Conservation and Recovery Act of 1976*, the *Atomic Energy Act of 1954*, and the TPA (Ecology et al., 1989a). The DOE-RL Project Manager is also responsible for obtaining LRA approval of the SAP authorizing the field sampling activities.

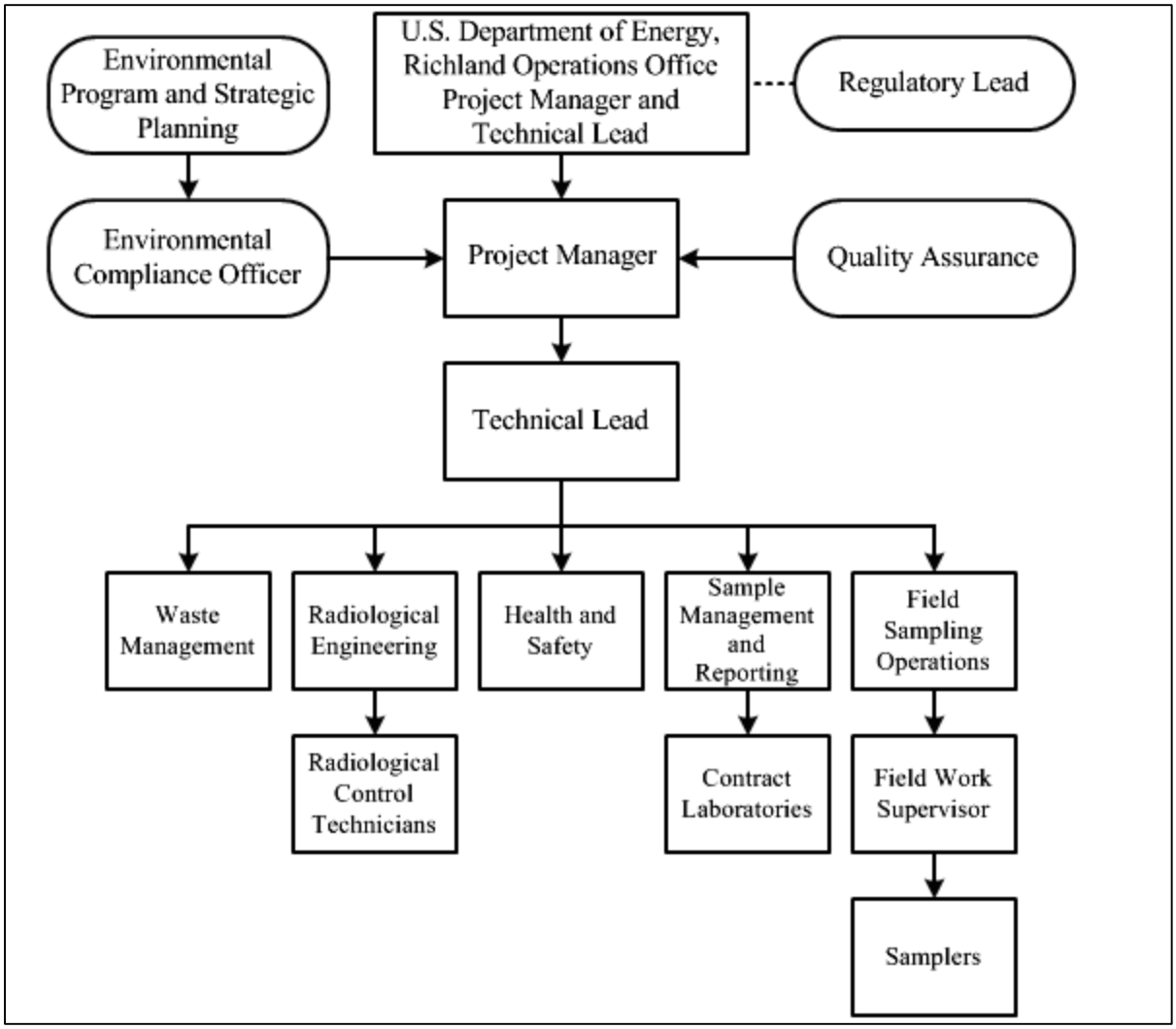

Figure 2-1. Project Organization

2.1.1.3 Project Manager

The contractor Project Manager is responsible and accountable for project related activities and coordinates with DOE-RL, regulators, and contactor management in support of sampling activities. Support is provided to the Technical Lead to ensure that work is performed safely and cost effectively. The Project Manager (or designee) is responsible for managing sampling documents and requirements, field activities, and subcontracted tasks and for ensuring that the project file is properly maintained. The Project Manager is responsible for ensuring that project personnel are working according to the current version of the SAP. The Project Manager ensures that the sampling design requirements are converted into field instructions providing specific direction for all field activities. The Project Manager works closely with the Environmental Compliance Officer (ECO), QA, Health and Safety, the Field Work Supervisor (FWS), and the Sample Management and Reporting (SMR) organization to integrate these and other lead disciplines in planning and implementing the work scope. The Project Manager maintains a list of individuals or organizations filling each of the functional elements of the project organization.

2.1.1.4 Technical Lead

The Technical Lead is responsible for the development of specific sampling design, analytical requirements, and QC requirements, either independently or as defined through a systematic planning process. The Technical Lead ensures that sampling and analysis activities, as delegated by the Project Manager, are carried out in accordance with the SAP.

2.1.1.5 Environmental Compliance Officer

The ECO, from the Environmental Program and Strategic Planning organization, provides technical oversight, direction, and acceptance of project and subcontracted environmental work and also develops appropriate mitigation measures with a goal of minimizing adverse environmental impacts. The ECO also reviews plans, protocols, and technical documents to ensure that environmental requirements have been addressed; identifies environmental issues that affect operations and develops cost effective solutions; and responds to environmental/regulatory issues or concerns raised by DOE-RL and/or regulatory agencies. The ECO also oversees project implementation for compliance with applicable internal and external environmental requirements.

2.1.1.6 Quality Assurance

The QA point of contact is matrixed from the QA organization to the Project Manager and is responsible for QA issues on the project. Responsibilities include overseeing implementation of the project QA requirements, reviewing project documents (including the DQO summary report, QAPjP, and SAP), reviewing data validation reports from third-party data validation contractors, and participating in QA assessments on sample collection and analysis activities, as appropriate.

2.1.1.7 Health and Safety

The Health and Safety organization responsibilities include coordinating industrial safety and health support within the project in accordance with the health and safety program, job hazard analyses, and other pertinent federal regulations. The Health and Safety organization also assists project personnel in complying with the applicable health and safety program. The Health and Safety organization coordinates with the Radiological Engineering organization to determine personal protective clothing requirements.

2.1.1.8 Radiological Engineering

The Radiological Engineering organization is responsible for 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. Radiological hazards are identified, and appropriate controls are implemented, to maintain worker exposures to hazards at ALARA levels. Additional responsibilities include developing project documentation and instructions for use of field radiological survey instruments and implementing the radiological surveys and measurements specified in the sampling plan. The Radiological Engineering organization interfaces with the project Health and Safety representative and other appropriate personnel, as needed, to plan and direct Radiological Control Technician (RCT) support for activities.

2.1.1.9 Sample Management and Reporting

The SMR organization is responsible for interfacing among the project, Field Sampling Operations (FSO), and analytical laboratories. The SMR organization generates field sampling documents, labels, and instructions for field sampling personnel; monitors the entire sample and data process; coordinates laboratory analytical work; and ensures that the laboratories conform to Hanford Site internal laboratory QA requirements (or their equivalent), as approved by DOE, EPA, and Ecology. SMR resolves sample documentation deficiencies or issues associated with FSO, laboratories, or other

entities to ensure that project needs are met; receives analytical data from the laboratories; performs data entry into the Hanford Environmental Information System (HEIS); and arranges for and oversees data validation. The SMR organization is responsible for informing the Project Manager of any issues reported by the analytical laboratory. The SMR organization develops the Sample Authorization Form, which provides information and instructions to the analytical laboratories; oversees data validation; and works with the Project Manager to prepare a characterization report on the sampling and analysis results. The SMR organization also provides instructions to FSO on the collection of samples, as specified in the SAP.

2.1.1.10 Analytical Laboratories

Onsite analytical laboratories and offsite contract laboratories analyze samples in accordance with established methods, provide data packages containing analytical and QC results, and provide explanations in response to resolution of analytical issues. Laboratories must meet site-specific QA requirements and have an approved QA plan in place.

2.1.1.11 Waste Management

The Waste Management organization communicates policies and protocols and ensures project compliance for storage, transportation, disposal, and waste tracking in a safe and cost effective manner. Waste Management is also responsible for identifying waste management sampling/characterization requirements to ensure regulatory compliance, interpreting characterization data to generate waste designations and profiles, and preparing and maintaining other documents confirming compliance with waste acceptance criteria.

2.1.1.12 Field Sampling Operations

FSO is responsible for planning and coordinating field sampling resources. The FWS ensures that samplers are appropriately trained and available. Additional related responsibilities include ensuring that the sampling design is understood and can be performed as specified by directing training, performing mockups, and holding practice sessions with field personnel.

The FWS directs the samplers, who are nuclear chemical operators (NCOs). NCOs collect groundwater, soil, vapor, and multimedia samples, including replicates/duplicates; collect field parameters; and prepare QC samples in accordance with the SAP, corresponding standard methods, and field and sample instructions. NCOs complete field logbook entries, chain-of-custody forms, and shipping paperwork and ensure delivery of samples to the analytical laboratory.

The FWS acts as a technical interface between the Project Manager and the field crew supervisors and ensures that technical aspects of the field work will be met. The FWS reviews the SAP for field sample collection concerns, analytical requirements, and special sampling requirements. The FWS, in consultation with the Project Manager and the SMR organization, resolves issues arising from translation of technical requirements to field operations and coordinates resolution of sampling issues.

2.1.2 Quality Assurance Objectives and Criteria

The QA objective of this plan is to ensure that the generation of analytical data of known and appropriate quality is acceptable and useful for decision making. In support of this objective, statistics and data descriptors, known as data quality indicators (DQIs), are used to determine the acceptability and utility of data to the user. The principal DQIs are precision, accuracy, representativeness, comparability, completeness, bias, and sensitivity. They are defined for the purposes of this document in Table 2-1.

Data quality is defined by the degree of stringency in the acceptance criteria assigned to these parameters. Typically, the acceptance criteria are set by the analytical method itself; however, project-specific requirements, as indicated by DQOs, may result in more stringent acceptance criteria. The applicable QC

guidelines, DQI acceptance criteria, and levels of effort for assessing data quality are dictated by the intended use of the data and the requirements of the analytical method. DQIs are evaluated during the data quality assessment (DQA) process (Section 2.4.3).

2.1.3 Special Training/Certification

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. The FWS, in coordination with line management, will ensure that special training requirements for field personnel are met.

Typical training requirements or qualifications have been instituted by the primary contractor management team to meet training requirements imposed by the contract, regulations, DOE orders, DOE contractor requirement documents, American National Standards Institute/American Society of Mechanical Engineers, and the *Washington Administrative Code*. For example, the environmental, safety, and health training program provides workers with the knowledge and skills necessary to execute assigned duties safely. Field personnel typically 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
- Hanford General Employee Training
- Radiological Worker Training

The following project-specific safety training, geared specifically to the project and the day's activity, will be provided:

- Training requirements or qualifications needed by sampling personnel in accordance with QA requirements.
- Training and required certifications for sampling personnel for the type of sampling that is being performed in the field.
- Required qualification for RCTs as established by the Radiation Protection Program; RCTs assigned to these activities will be qualified through the prescribed training program and will undergo ongoing training and qualification activities.

Table 2-1. Data Quality Indicators

Data Quality Indicator	Definition	Determination Methodologies	Corrective Actions
Precision	Precision measures the agreement among a set of replicate measurements. Field precision is assessed through the collection and analysis of field duplicates. Analytical precision is estimated by duplicate/ replicate analyses, usually on LCSs, spiked samples, and/or field samples. The most commonly used estimates of precision are the relative standard deviation and, when only two samples are available, the RPD. Precision for field radiological measurements is assessed by duplicate measurements and performance checks.	Use the same analytical instrument to make repeated analyses on the same sample. Use the same method to make repeated measurements of the same sample within a single laboratory. Acquire replicate field samples for information on sample acquisition, handling, shipping, storage, preparation, and analytical processes and measurements. Use the same radiological instrument/ detector to make repeated measurements at the same location.	If duplicate data do not meet the objective: • Evaluate the apparent cause (e.g., sample heterogeneity). • Request reanalysis or re-measurement. • Qualify the data before use.
Accuracy	Accuracy is the closeness of a measured result to an accepted reference value. Accuracy is usually measured as a percent recovery. Quality control analyses used to measure accuracy include standard recoveries, LCSs, spiked samples, and surrogates. Accuracy for field radiological measurements is addressed through the calibration and maintenance of the radiological instrument/detector.	Analyze a reference material, or reanalyze a sample to which a material of known concentration or amount of pollutant has been added (a spiked sample). Initial calibration (and after repair or maintenance) of the radiological instrument/detector and source check daily to within ±20% of source activity.	If recovery does not meet the objective: • Qualify the data before use. • Request reanalysis or re-measurement. • Take the radiological instrument out of service.
Representativeness	Sample representativeness expresses the degree to which data accurately and precisely represents a characteristic of a population, parameter variations at a sampling point, a process condition, or an environmental condition. It is dependent on the proper design of the sampling program and will be satisfied by ensuring the approved plans were followed during sampling and analysis.	Evaluate whether measurements are made and physical samples are collected in such a manner that the resulting data appropriately reflect the environment or condition being measured or studied.	If results are not representative of the system sampled: • Identify the reason for the results not being representative. • Reject the data, or if data are otherwise usable, qualify the data for limited use and define the portion of the system that the data represent. • Redefine sampling and measurement requirements and protocols.

Table 2-1. Data Quality Indicators

Data Quality Indicator	Definition	Determination Methodologies	Corrective Actions
			• Resample and reanalyze.
Comparability	Comparability expresses the degree of confidence with which one data set can be compared to another. It is dependent upon the proper design of the sampling program and will be satisfied by ensuring that the approved plans are followed and that proper sampling and analysis techniques are applied.	Use identical or similar sample collection and handling methods, sample preparation and analytical methods, holding times, and QA protocols.	If data are not comparable to other data sets: • Identify appropriate changes to data collection and/or analysis methods. • Identify quantifiable bias, if applicable. • Qualify the data, as appropriate. • Resample and/or reanalyze if needed. • Revise sampling/analysis protocols to ensure future comparability.
Completeness	Completeness is a measure of the amount of valid data collected compared to the amount planned. Measurements are considered to be valid if they are unqualified or qualified as estimated data during validation. Field completeness is a measure of the number of samples collected versus the number of samples planned. Laboratory completeness is a measure of the number of valid measurements compared to the total number of measurements planned.	Compare the number of valid measurements completed (samples collected or samples analyzed or radiological survey measurements collected) with those established by the project's quality criteria (data quality objectives or performance/acceptance criteria). The objective for field measurement completeness is 100%.	If the data set does not meet the completeness objective: • Identify appropriate changes to data collection and/or analysis methods. • Identify quantifiable bias, if applicable. • Qualify the data, as appropriate. • Resample and/or reanalyze if needed. • Revise sampling/analysis protocols to ensure future comparability. • Revise the radiological survey measurement plan.
Bias	Bias is the systematic or persistent distortion of a measurement process that causes error in one direction (e.g., the sample measurement is consistently lower than the sample's true value). Bias can be introduced during sampling, analysis, and data evaluation. Analytical bias refers to deviation in one direction (i.e., high, low, or unknown) of the measured value from a known spiked amount.	Sampling bias may be revealed by analysis of replicate samples. Analytical bias may be assessed by comparing a measured value in a sample of known concentration to an accepted reference value or by determining the recovery of a known amount of contaminant spiked into a sample (matrix spike).	For sampling bias: • Properly select and use sampling tools. • Institute correct sampling and subsampling procedures to limit preferential selection or loss of sample media. • Use random sampling designs. • Use sample handling procedures, including proper sample preservation, that

Table 2-1. Data Quality Indicators

Data Quality Indicator	Definition	Determination Methodologies	Corrective Actions
			limit the loss or gain of constituents to the sample media. Analytical data that are known to be affected by either sampling or analytical bias are flagged to indicate possible bias. Laboratories that are known to generate biased data for a specific analyte are asked to correct their methods to remove the bias as best as practicable. Otherwise, samples are sent to other labs for analysis.
Sensitivity	Sensitivity is an instrument's or method's minimum concentration that can be reliably measured (i.e., instrument detection limit or limit of quantitation). Sensitivity for radiological instruments/ detectors is the minimum radiological activity that can be reliably detected or measured.	Determine the minimum concentration or attribute to be measured by an instrument (instrument detection limit) or by a laboratory (limit of quantitation). The lower limit of quantitation is the lowest level that can be routinely quantified and reported by a laboratory. Determine the minimum detectable activity that can be measured by the radiological instrument/detector.	If detection limits do not meet the objective: • Request reanalysis or re-measurement using methods or analytical conditions that will meet required detection or limit of quantitation. • Qualify/reject the data before use.

Source: SW-846, Pending, Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, Third Edition; Final Update V, as amended.

QA = quality assurance

RPD = relative percent difference

Pre-job briefings will be performed in accordance with work management and work release documents to evaluate an activity and associated hazards by considering the following factors:

- Objective of the activities
- Individual tasks to be performed
- Hazards associated with the planned tasks
- Controls applied to mitigate hazards
- Environment in which the job will be performed
- Facility where the job will be performed
- Equipment and material required
- Safety protocols applicable to the job
- Training requirements for individuals assigned to perform the work
- Level of management control
- Proximity of emergency contacts

Training records are maintained for each individual employee in an electronic training record database. The contractor's training organization maintains the training records system. Line management will be used to confirm that an individual employee's training is appropriate and up-to-date prior to performing any field work.

2.1.4 Documents and Records

The Project Manager is responsible for ensuring that the current version of the SAP is being used and for providing any updates to field personnel. Version control is maintained by the administrative document control process. Changes to the SAP affecting DQOs will be reviewed and approved by DOE and EPA, as LRA, prior to implementation. Table 2-2 defines the types of changes that may be made to the sampling design and documentation requirements.

The Project Manager is responsible for tracking all changes and obtaining appropriate reviews by contractor staff. The Project Manager will discuss the change with DOE-RL. DOE-RL will then discuss significant and fundamental changes with the LRA, as described in Sections 9.3 and 12.4 of the TPA Action Plan (Ecology et al., 1989b). Appropriate documentation will follow, in accordance with the requirements for the type of change.

SMR and the FWS is responsible for ensuring that field instructions are maintained and aligned with any revisions or approved changes to the SAP. SMR will ensure that any deviations from the SAP are reflected in revised paperwork as applicable for the samplers and the analytical laboratory. The FWS will ensure that deviations from the SAP or problems encountered in the field are documented appropriately (e.g., in the field logbook or on nonconformance report forms) in accordance with internal corrective action protocols.

Table 2-2. Change Control for Sampling Projects

Type of Change[a]	Type of Change (TPA Action Plan[b])	Action	Documentation
Minor Change. The change has no impact on the sample or field analytical result, and little or no impact on performance or cost. Furthermore, the change does not affect the DQOs specified in the SAP.	**Minor Field Change.** Changes that have no adverse effect on the technical adequacy of the job or the work schedule.	The field personnel recognizing the need for a field change will consult with the Project Manager prior to implementing the field change.	Minor field changes will be documented in the field logbook. The logbook entry shall include the field change, the reason for the field change, and the names and titles of those approving the field change.
Significant Change. The change has a considerable effect on performance or cost, but still allows for meeting the DQOs specified in the SAP.	**Minor Change.** Changes to approved plans that do not affect the overall intent of the plan or schedule.	The Project Manager will inform the DOE-RL Project Manager and the Regulatory Lead of the change and seek concurrence at a Unit Manager's Meeting or comparable forum. The LRA determines if there is no need to revise the document.	Documentation of this change approval would be in the Unit Manager's Meeting minutes or comparable record such as a change notice.[c]
Fundamental Change. The change has a significant effect on the sample or the field analytical result, performance, or cost, and the change does not meet the requirements specified in the DQOs in the sampling document.	**Revision Necessary.** The LRA determines that changes to approved plans require a revision to the document.	If it is anticipated that a fundamental change will require the approval of the Regulatory Lead, the applicable DOE-RL Project Manager will be notified by the Project Manager and will be involved in the decision prior to implementation of a fundamental change. The LRA determines if the change requires a revision to the document.	Formal revision of the sampling document.

a. Consistent with DOE/RL-96-68, Hanford Analytical Services Quality Assurance Requirements Document (HASQARD).

b. Consistent with Sections 9.3 and 12.4 of the TPA Action Plan (Ecology et al., 1989b, Hanford Federal Facility Agreement and Consent Order Action Plan).

c. The TPA Action Plan (Ecology et al., 1989b), Section 9.3, defines the minimum elements of a change notice.

DOE-RL = U.S. Department of Energy, Richland Operations Office

DQO = data quality objective

LRA = lead regulatory agency

SAP = sampling and analysis plan

TPA = Tri-Party Agreement

The Project Manager, FWS, or designee is responsible for communicating field corrective action requirements and ensuring that immediate corrective actions are applied to field activities.

The Project Manager is responsible for ensuring that a project file is properly maintained. The project file will contain the records of references to their storage locations. The project file will include the following items, as appropriate:

- Operational record and logbooks
- Data forms
- Global positioning system data (a copy shall be provided to SMR)
- Inspection or assessment reports and corrective action reports
- Interim progress reports
- Final reports

The following records are managed and maintained by SMR personnel:

- Field sampling logbooks
- Field sample reports
- Chain-of-custody forms
- Sample receipt records
- Laboratory data packages
- Analytical data verification and validation reports
- Analytical data "case file purges" (i.e., raw data purged from laboratory files) provided by offsite analytical laboratories

The laboratory is responsible for maintaining, and having available upon request, the following items:

- Analytical logbooks
- Raw data and QC sample records
- Standard reference material and/or proficiency test sample data
- Instrument calibration information

Records may be stored in either electronic or hard copy format. Documentation and records, regardless of medium or format, are controlled in accordance with internal work requirements and processes to ensure the accuracy and retrievability of stored records. Records required by the TPA (Ecology et al., 1989a) will be managed in accordance with the requirements therein.

2.2 Measurement/Data Acquisition

The following subsections present the requirements for analytical methods, measurement and analysis, data collection or generation, data handling, and field and laboratory QC. Requirements for instrument calibration and maintenance, supply inspections, and data management are also addressed.

2.2.1 Laboratory Analytical Methods

As developed from the DQO process (EPA/240/B-06/001), the quality objectives for various analyses to be performed in support of waste characterization and site closeout are presented in Tables 2-3 and 2-4. Table 2-3 provides laboratory performance requirements for waste designation samples for the 200-CW-5, 200-PW-1, and 200-PW-6 OU waste sites. Table 2-4 covers laboratory performance requirements for verification samples collected for the 200-CW-5, 200-PW-1, and 200-PW-6 OU waste sites. The listed methods were selected during the DQO process based on their ability to meet the quality objectives for the intended data uses (e.g., waste designation and/or site closeout) with respect to the applicable action levels. The analytical methods are controlled in accordance with the laboratory QA plan and the requirements of this QAPjP. The primary contractor participates in overseeing offsite analytical laboratories to qualify them for performing Hanford Site analytical work.

Deviation from the methods listed in Tables 2-3 and 2-4 may be necessary for some samples due to high levels of radioactivity, complex sample matrices, and/or small samples sizes due to ALARA concerns. These samples may need to be analyzed using appropriate alternate methodologies following specific Hanford Site procedures. If the laboratory uses an alternate method, the laboratory must provide method validation data to confirm that the method is adequate for the intended use of the data. This includes information such as determination of detection limits, quantitation limits, typical recoveries, and analytical precision and bias. Deviations from analytical methods, noted in Tables 2-3 and 2-4, must be approved by the SMR organization in consultation with the Project Manager. EPA will be informed of any deviations from the analytical methods.

Table 2-3. Analytical Performance Requirements for Waste Disposition

Contaminants of Potential Concern	CAS No.	Preliminary Action Level		Name/Analytical Technology[c]	Target Required Quantitation Limits Soil	Precision Soil	Accuracy Soil
		Toxicity Characteristic Dangerous Waste Threshold[a]	Universal Treatment Standard[b]				
Radionuclides (pCi/g)							
Potassium-40	13966-00-2	N/A	N/A	Isotopic potassium–GEA	30	≤30%	70-130%
Strontium-90	10098-97-2	N/A	N/A	Total radioactive strontium–gross proportional counting	2	≤30%	70-130%
Cesium-137	10045-97-3	N/A	N/A	Isotopic cesium–GEA	0.1	≤30%	70-130%
Radium-226	13982-63-3	N/A	N/A	Isotopic radium–alpha energy analysis	1	≤30%	70-130%
Radium-228	15262-20-1	N/A	N/A	Isotopic radium–GEA	3	≤30%	70-130%
Thorium-228	14274-82-9	N/A	N/A	Isotopic thorium–alpha energy analysis	1	≤30%	70-130%
Thorium-230	14269-63-7	N/A	N/A	Isotopic thorium–alpha energy analysis	1	≤30%	70-130%

Table 2-3. Analytical Performance Requirements for Waste Disposition

Contaminants of Potential Concern	CAS No.	Preliminary Action Level		Name/Analytical Technology[c]	Target Required Quantitation Limits Soil	Precision Soil	Accuracy Soil
		Toxicity Characteristic Dangerous Waste Threshold[a]	Universal Treatment Standard[b]				
Thorium-232	Th-232	N/A	N/A	Isotopic thorium–alpha energy analysis	1	≤30%	70-130%
Uranium-233/234	U-233/234	N/A	N/A	Isotopic uranium–alpha energy analysis	1	≤30%	70-130%
Uranium-238	U-238	N/A	N/A	Isotopic uranium–alpha energy analysis	1	≤30%	70-130%
Plutonium-238	13981-16-3	N/A	N/A	Isotopic plutonium–alpha energy analysis	1	≤30%	70-130%
Plutonium-239/240	Pu-239/240	N/A	N/A	Isotopic plutonium–alpha energy analysis	1	≤30%	70-130%
Americium-241	14596-10-2	N/A	N/A	Isotopic americium–alpha energy analysis	1	≤30%	70-130%
Inorganics (mg/kg)							
Ammonium Ion	14798-03-9	N/A	N/A	EPA Method 350.1	0.5	≤30%[e]	70-130%[e]
Arsenic	7440-38-2	100	5[d]	EPA Method 6010	10	≤30%[e]	70-130%[e]
Barium	7440-39-3	2,000	21[d]	EPA Method 6010	5	≤30%[e]	70-130%[e]
Beryllium	7440-41-7	N/A	1.22[d]	EPA Method 6020	0.2	≤30%[e]	70-130%[e]
Boron	7440-42-8	N/A	N/A	EPA Method 6010	5	≤30%[e]	70-130%[e]
Cadmium	7440-43-9	20	0.11[d]	EPA Method 6020	0.2	≤30%[e]	70-130%[e]
Chromium 6+	18540-29-9	100	0.60[d]	EPA Method 7196	0.5	≤30%[e]	70-130%[e]
Chromium (Total)	7440-47-3	100	0.60[d]	EPA Method 6020	1	≤30%[e]	70-130%[e]
Copper	7440-50-8	N/A	N/A	EPA Method 6010	2.5	≤30%[e]	70-130%[e]
Lead	7439-92-1	100	0.75[d]	EPA Method 6020	0.3	≤30%[e]	70-130%[e]
Lithium	7439-93-2	N/A	N/A	EPA Method 6010	5	≤30%[e]	70-130%[e]
Fluoride	16984-48-8	N/A	N/A	EPA Method 300	25	≤30%[e]	70-130%[e]
Manganese	7439-96-5	N/A	N/A	EPA Method 6020	1	≤30%[e]	70-130%[e]
Mercury	7439-97-6	4	0.025[d]	EPA Method 7471	0.2	≤30%[e]	70-130%[e]
Molybdenum	7439-98-7	N/A	N/A	EPA Method 6010	4	≤30%[e]	70-130%[e]
Nickel	7440-02-0	N/A	11[d]	EPA Method 6020	0.5	≤30%[e]	70-130%[e]

Table 2-3. Analytical Performance Requirements for Waste Disposition

Contaminants of Potential Concern	CAS No.	Preliminary Action Level		Name/Analytical Technology[c]	Target Required Quantitation Limits Soil	Precision Soil	Accuracy Soil
		Toxicity Characteristic Dangerous Waste Threshold[a]	Universal Treatment Standard[b]				
Nitrate	14797-55-8	N/A	N/A	EPA Method 300	12.5	≤30%[e]	70-130%[e]
Nitrite	14797-65-0	N/A	N/A	EPA Method 300	12.5	≤30%[e]	70-130%[e]
Potassium	7440-09-7	N/A	N/A	EPA Method 6010	500	≤30%[e]	70-130%[e]
Selenium	7782-49-2	20	5.7[d]	EPA Method 6020	0.4	≤30%[e]	70-130%[e]
Silver	7440-22-4	100	0.14[d]	EPA Method 6020	0.5	≤30%[e]	70-130%[e]
Sulfate	14808-79-8	N/A	N/A	EPA Method 300	27.5	≤30%[e]	70-130%[e]
Vanadium	7440-62-2	N/A	1.6[d]	EPA Method 6020	1	≤30%[e]	70-130%[e]
Zinc	7440-66-6	N/A	4.3[d]	EPA Method 6020	5	≤30%[e]	70-130%[e]
Organics (mg/kg)							
2-Pentanone	107-87-9	N/A	N/A	EPA Method 8260	0.01	≤30%[e]	[f]
2-Butanone	78-93-3	4,000	36	EPA Method 8260	0.02	≤30%[e]	[f]
1,1-Dichloroethane	75-34-3	N/A	6	EPA Method 8260	0.01	≤30%[e]	[f]
4-Methyl-2-pentanone	108-10-1	N/A	33	EPA Method 8260	0.02	≤30%[e]	[f]
n-Butyl Alcohol (1-Butanol)	71-36-3	N/A	2.6	EPA Method 8260	0.25	≤30%[e]	[f]
Acetone	67-64-1	N/A	160	EPA Method 8260	0.02	≤30%[e]	[f]
Aroclor 1248	12672-29-6	N/A	10	EPA Method 8082	0.033	≤30%[e]	[f]
Aroclor 1254	11097-69-1	N/A	10	EPA Method 8082	0.033	≤30%[e]	[f]
Aroclor 1260	11096-82-5	N/A	10	EPA Method 8082	0.033	≤30%[e]	[f]
Carbon Tetrachloride	56-23-5	10	6	EPA Method 8260	0.005	≤30%[e]	[f]
Chlorobenzene	108-90-7	2,000	6	EPA Method 8260	0.005	≤30%[e]	[f]
Chloroform	67-66-3	120	6	EPA Method 8260	0.005	≤30%[e]	[f]
Dichloromethane (Methylene Chloride)	75-09-2	N/A	30	EPA Method 8260	0.005	≤30%[e]	[f]
Tetrachloroethylene	127-18-4	14	6	EPA Method 8260	0.005	≤30%[e]	[f]
Toluene	108-88-3	N/A	10	EPA Method 8260	0.005	≤30%[e]	[f]
Tributyl Phosphate	126-73-8	N/A	N/A	EPA Method 8270	0.33	≤30%[e]	[f]
Trichloroethylene	79-01-6	10	6	EPA Method 8260	0.005	≤30%[e]	[f]

Table 2-3. Analytical Performance Requirements for Waste Disposition

Contaminants of Potential Concern	CAS No.	Preliminary Action Level		Name/Analytical Technology[c]	Target Required Quantitation Limits Soil	Precision Soil	Accuracy Soil
		Toxicity Characteristic Dangerous Waste Threshold[a]	Universal Treatment Standard[b]				
Oil and Grease	N/A	N/A	N/A	EPA Method 1664	200	≤30%	[f]

a. Waste disposition for this project will comply with the toxicity characteristic (40 CFR 268.40, "Land Disposal Restrictions," "Applicability of Treatment Standards"). This value applies to the maximum concentration of contaminants for designation as a dangerous waste under the toxicity characteristic. This value is 20 times the TCLP value. EPA allows the use of 20 times the TCLP values to determine the total action levels because of the 20 times dilution used in the TCLP process. Equivalent methods may be substituted for those listed in the table.

b. Value reflects the universal treatment standard as an underlying hazardous constituent in accordance with 40 CFR 268.48, "Land Disposal Restrictions," "Universal Treatment Standards." The unit value is in mg/kg, unless otherwise indicated.

c. For EPA Methods 300.0 and 350.1, see EPA-600/4-79-020, Methods for Chemical Analysis of Water and Wastes. For four-digit EPA methods, see SW-846, Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, Third Edition; Final Update IV-B.

d. Value reflects the universal treatment standard as an underlying hazardous constituent in accordance with 40 CFR 268.48. The unit value is in mg/L TCLP.

e. Precision and accuracy requirements are identified and defined in the referenced CHPRC-00189, CH2M HILL Plateau Remediation Company Environmental Quality Assurance Program Plan, procedures.

f. Accuracy is statistically derived as a part of the method quality control.

CAS = Chemical Abstracts Service

EPA = U.S. Environmental Protection Agency

GEA = gamma energy analysis

N/A = not applicable

TCLP = toxicity characteristic leaching procedure

Table 2-4. Standard Fixed Laboratory Performance Requirements

COCs	CAS No.	ROD Cleanup Level	Name/Analytical Technology[a]	Target Required Quantitation Limits Soil	Precision Soil	Accuracy Soil
Radionuclides (pCi/g)						
Strontium-90	10098-97-2	20	Total radioactive strontium – gas proportional counting	2	≤30%	70-130%
Technetium-99[b]	14133-76-7	N/A	Technetium-99 – liquid scintillation	5	≤30%	70-130%
Cesium-137	10045-97-3	17.7	gamma energy analysis	0.1	≤30%	70-130%
Radium-226	13982-63-3	4	gamma energy analysis	1	≤30%	70-130%
Plutonium-239/240	PU-239/240	765	Isotopic plutonium – AEA	1	≤30%	70-130%

Table 2-4. Standard Fixed Laboratory Performance Requirements

COCs	CAS No.	ROD Cleanup Level	Name/Analytical Technology[a]	Target Required Quantitation Limits Soil	Precision Soil	Accuracy Soil
Americium-241	14596-10-2	940	AEA	1	≤30%	70-130%
Inorganics (mg/kg)						
Boron	7440-42-8	0.5	EPA 6010	5	≤30%	70-130%
Mercury	7439-97-6	0.1	EPA 7471	0.2	≤30%	70-130%
Nitrate[b]	14797-55-8	N/A	EPA 300	12.5	≤30%	70-130%
Organics (mg/kg)						
PCB	Various[c]	0.65	EPA 8082	0.033	≤30%	[d]

Source: EPA et al., 2011, Record of Decision Hanford 200 Area Superfund Site 200-CW-5 and 200-PW-1, 200-PW-3, and 200-PW-6 Operable Units.

a. Where method based analysis is appropriate, additional analytes will be reported. Equivalent methods may be substituted for those listed in the table.

b. Constituent was requested by Ecology; data are collected for information purposes.

c. CAS numbers are for each PCB constituent (Aroclor 1260 [11096-82-5], Aroclor 1254 [11097-69-1], Aroclor 1221 [11104-28-2], Aroclor 1232 [11141-16-5], Aroclor 1248 [12672-29-6], Aroclor 1016 [12674-11-2], and Aroclor 1242 [53469-21-9]).

d. Accuracy is statistically derived as a part of the method quality control.

AEA = alpha energy analysis
CAS = Chemical Abstracts Service
COC = contaminant of concern
Ecology = Washington State Department of Ecology
EPA = U.S. Environmental Protection Agency
N/A = not applicable
PCB = polychlorinated biphenyl
ROD = record of decision

Laboratories providing analytical services in support of this SAP will have a corrective action program in place that addresses analytical system failures and documents the effectiveness of any corrective actions. Issues that may affect analytical results are to be resolved by the SMR organization in coordination with the Project Manager.

2.2.2 Field Radiological Methods

Field radiological methods used to support waste characterization and site closeout activities will be performed in accordance with HASQARD (DOE/RL-96-68) and project-specific radiological survey procedures, as applicable. These methods include field radiological surveys and NDAs that require use of dose-to-curie calculations and scaling factor determinations. Applicable QA procedures, quantitative target limits, and data quality are dictated by the intended use of the data and the field radiological measurement method used. Characterization methods include use of radiological survey instrumentation and field NDA equipment.

NDA equipment is required to perform in a manner that accurately and reliably provides results with sufficient confidence to distinguish TRU waste from radioactive LLW. The NDA techniques, instruments, and procedures must accomplish the following objectives:

- Provide a minimum detectable activity (MDA) sufficient to distinguish TRU waste from radioactive LLW.
- Provide monitoring for fluctuations in background radiation levels, determining if background levels impact results, and correcting for excessive background radiation, if applicable.
- Account for measurement errors from components such as internal consistency, transmission errors, self-absorption, and/or localized measurement problems.
- Result in defensible values for the activity and mass of the reported radionuclide inventory.

Many factors affect the MDA/minimum detectable concentration and total measurement uncertainty (TMU) reported by an analysis system (e.g., detector to sample calibration geometry, detector resolution, detector efficiency, sample density, sample elemental composition, spatial distribution of activity material, self-attenuation of source materials, containers, energy of the photo peak of interest, and background contributions). The terms lower limit of detection (LLD) and MDA (in units of activity) are used interchangeably. In support of the preceding requirements, the NDA unit must evaluate, document, and technically justify the following determinations:

1. *Lower Limit of Detection*. The LLD for each NDA system must be determined. Instruments performing TRU waste/LLW discrimination measurements must have an LLD of 100 nCi/g or less. Environmental background and container specific interferences must be factored into LLD determinations. LLD is the level of radioactivity that, if present, yields a measured value greater than the critical level with a 95 percent probability, where the critical level is defined as the value at which measurements of the background will exceed 5 percent probability. The method(s) for determining LLD will be documented by a qualified analyst.

2. *Quantification of Nondetectable Radionuclides*. Radionuclide quantities that cannot be determined by NDA because there is no method, or the MDA is not low enough to support decision making, may be scaled to measured radionuclides. Daughter products below the MDA that are required to be reported will be scaled from the activity of the parent or reported at the MDA (if they can be determined by NDA). The means and methods used to quantify these isotopes from other measured isotopes are to be technically justified. In such cases, the equivalent of an LLD (i.e., reporting threshold for a radionuclide, when it is technically justified) will be derived. This value may be based on decay kinetics, scaling factors, or other scientifically based relationships and must be documented.

3. *Total Measurement Uncertainty*. The method used to calculate the TMU should be documented. Reports may be combined for like or similar systems if the TMU is justified to be identical or if any differences are clearly identified and do not affect the TMU. The likeness or similarity of the systems must be technically justified.

For field NDA, the system will be operated in accordance with approved procedures.

Performance requirements for dose-to-curie calculations, which are used to convert the field radiological survey and NDA measurements to curies of key radioisotopes, will be developed in project-specific calculations and provided in procedures for using the field radiological survey instrument and NDA equipment. Scaling factors will be developed using historical information, remedial investigation/feasibility study (RI/FS) sampling data, and computer modeling. Performance requirements

associated with using these scaling factors will be developed in project-specific calculations and provided in approved procedures.

Table 2-5 provides performance requirements for field screening methods used to provide radiological measurements for onsite decisions.

Table 2-5. Field Screening Performance Requirements

Contaminant of Potential Concern	Waste Designation Action Levels	Analytical Method	RDL/MDA	Precision	Accuracy
Radiological Surveys					
Americium-241	TRU/GTCC	Sodium Iodide – Field Gamma Survey	5 nCi/g	TBD	TBD
Americium-241	TRU/GTCC	FIDLER – Low Energy Gamma Survey	50 pCi/g	TBD	TBD
NDA*					
Americium-241	TRU/GTCC	ISOCS (High Resolution Germanium Gamma Spectroscopy)	20 nCi/g	TBD	TBD
Cesium-137	TRU/GTCC		0.1 nCi/g	TBD	TBD
Plutonium-239	TRU/GTCC		30 nCi/g	TBD	TBD
Plutonium-240	TRU/GTCC	Neutron Slab – Neutron Counting	TBD	TBD	TBD

* For NDA items (e.g., drum of waste, bag of waste, and box of waste), the following data are needed:

- Weight of the item
- Dimension/geometry of the item
- Material of construction of the item
- Plutonium isotopic ratio and/or other nuclide scaling factors for nonmeasurable radionuclides
- High-resolution gamma analysis of the item

Note: In cases where both TRU and GTCC are listed as action levels, the isotope is subject to both limits, and the more limiting of the two will be considered to be the action level.

TRU: The action level "TRU" indicates that the transuranic waste definition is the limiting factor. Activities of all TRU alpha emitting isotopes with a half-life greater than 20 years must be less than 100 nCi/g in total.

GTCC: The action level "GTCC" indicates that the greater than Class C waste definition is the limiting factor. Greater than Class C is defined in 10 CFR 61.55, "Licensing Requirements for Land Disposal of Radioactive Waste," "Waste Classification." The GTCC action level is dependent upon the isotopic distribution and will likely be slightly less than 100 nCi/g.

FIDLER = field instrument for detection of low-energy radiation

GTCC = greater than Class C

ISOCS = In Situ Object Counting System

MDA = minimum detectable activity

NDA = nondestructive assay

RDL = required detection limit

TBD = to be determined

TRU = transuranic

2.2.3 Quality Control

QC protocols must be followed in the field and laboratory to ensure that reliable data are obtained. Field QC samples will be collected to evaluate the potential for cross-contamination and provide information pertinent to field sampling variability. Field QC sampling will include the collection of full trip blank, field transfer blank, equipment rinsate blank, field duplicate (DUP), and field split (SPLIT) samples. Laboratory QC samples estimate the precision and bias of the analytical data. Field and laboratory QC samples are summarized in Table 2-6.

Table 2-6. Project Quality Control Requirements

Quality Control Sample Type	Purpose	Frequency
Field Quality Control		
Equipment Blanks	Verify adequacy of sampling equipment decontamination.	One per batch,* 20 samples maximum, of each media sampled
Field Duplicates	Estimate precision, including sampling and analytical variability.	One per batch,* 20 samples maximum, of each media sampled
Field Splits	Estimate precision, including sampling, analytical, and interlaboratory variability.	At a minimum, one per analytical method, per media sampled, for analyses performed where detection limit and precision and accuracy criteria have been defined in the Performance Requirements tables
Laboratory Quality Control[a]		
Method Blanks	Assess response of an entire laboratory analytical system.	One per batch,* 20 samples maximum, or as identified by the method guidance per media sampled
Matrix Spikes	Identify analytical (preparation + analysis) bias; possible matrix effect on the analytical method used.	When required by the method guidance, 1 per batch,* 20 samples maximum, or as identified by the method guidance per media sampled
Matrix Duplicates or Matrix Spike Duplicates	Estimate analytical bias and precision.	When required by the method guidance, 1 per batch,* 20 samples maximum, or as identified by the method guidance per media sampled
Laboratory Control Samples	Assess method accuracy.	One per batch,* 20 samples maximum, or as identified by the method guidance per media sampled
Surrogates	Estimate recovery/yield.	When required by the method guidance, as identified by the method guidance

* Batching across projects is allowed for similar matrices (e.g., within one waste site).

2.2.3.1 Field Quality Control Samples

Field QC samples will be collected to evaluate the potential for cross-contamination and to provide information pertinent to field sampling variability and laboratory performance. Field blanks are typically

prepared using high-purity reagent water. Field QC samples and the required frequency for collection are described in this section.

Equipment Blanks (EBs). EBs are used to verify the adequacy of sampling equipment decontamination procedures and shall be collected at a frequency of 1 in 20 samples. The project's analytical lead may request that additional EBs be taken. EBs consist of silica sand (or other suitable media) that is run through decontaminated sampling equipment and placed in containers identical to those used for actual field samples. EB analyses include gamma spectroscopy and metals.

Field Duplicates. DUPs are independent samples collected as close as possible to the same time and same location and are intended to be identical. DUPs are two separate samples collected from the same source, placed in separate sample containers, and analyzed independently. DUPs should be collected generally from an area expected to have some contamination, so valid comparisons between the samples can be made (i.e., some constituents will likely be greater than detection limit).

DUP samples for soil will be collected and homogenized before dividing into two separate samples in the field. Volatile organic analysis soil duplicates will be sampled as collocated samples. Collocated samples are two samples, collected as close as possible to the same time and location, that are not homogenized. This sampling protocol is used when homogenizing samples for SPLITs or DUPs could impact the quality of data. DUPs will be stored and transported together and analyzed for the same constituents. DUP samples will be used to determine precision for both sampling and laboratory measurements. Evaluation of the results can provide an indication of intralaboratory variability. Large relative percent differences (RPDs) can be an indication of potential laboratory performance problems and should be investigated.

DUPs must agree within 30 percent, as measured by the RPD, to be acceptable. Only those DUPs with at least one result greater than five times the appropriate detection limit are evaluated. DUP results not satisfying evaluation criteria will be qualified and flagged in HEIS, as appropriate.

Field Split Samples. SPLIT samples are two samples collected as close as possible to the same time and same location and are intended to be identical. Volatile organic analysis soil SPLITs will be sampled as collocated samples, as described. SPLIT samples will be stored in separate containers and analyzed by different laboratories for the same or similar analytes. SPLIT samples are interlaboratory comparison samples used to evaluate comparability between laboratories. Large RPDs can be an indication of potential laboratory performance problems and should be investigated.

Verification SPLIT sample data will undergo data analysis to assist in determining verification data usability. The EPA Contract Laboratory program duplicate sample comparison methodology (OSWER 9240.1-45, *USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review: Final*) will be used as an initial test. Specifically, the following control limits will apply:

- ±35 percent for the RPD shall be used for samples greater than or equal to five times the contract required detection limit (CRDL), ***or***

- ±2 times CRDL shall be used if either the sample or a SPLIT sample value is less than five times the CRDL. In a case where only one result is above the five rimes CRDL level and the other is below, the ±2 times CRDL criterion applies. If both samples are less than detectable, RPD is not calculated.

If the data fall within one of the listed control limits, then the SPLIT data correlate and no review is required. If the data do not fall within one of the control limits, additional data review is required. A qualified person will review the SPLIT sample data in detail. This review will include detection levels,

internal laboratory SPLIT and internal laboratory DUP values, validation reports, and other data deemed relevant. A narrative will be written describing why the original data should (or should not) be used. This narrative will be included in the final closure document and will be one of the elements reviewed by regulators prior to their approval of the cleanup documentation.

2.2.3.2 Laboratory QC Samples

Laboratory QC samples (e.g., method blanks and laboratory control sample/blank spike) are defined for three-digit EPA methods (EPA-600/4-79-020, *Methods for Chemical Analysis of Water and Wastes*) and four-digit EPA methods (SW-846, *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, Third Edition; Final Update IV-B*) and will be run at the frequency specified in the respective reference unless superseded by agreement.

QC checks outside of control limits will be reflected in the narrative of the analytical report and during the DQA, if performed. For inorganics, metals, and radiochemical analyses, QC acceptance criteria for laboratory duplicate samples, matrix spike samples, matrix spike duplicate samples, surrogate recoveries, and LCSs are given in HASQARD (DOE/RL-96-68).

2.2.4 Measurement Equipment

Each user of measuring equipment is responsible for ensuring that the equipment is functioning as expected, properly handled, and properly calibrated at required frequencies in accordance with methods governing control of the measuring equipment. Onsite environmental instrument testing, inspection, calibration, and maintenance shall be recorded in accordance with approved methods. Field screening instruments will be used, maintained, and calibrated in accordance with manufacturer specifications and other approved methods.

2.2.5 Instrument/Equipment Testing, Inspection, and Maintenance

Equipment used for collection, measurement, and testing should meet applicable standards (e.g., ASTM International, formerly the American Society for Testing and Materials) or have been evaluated as acceptable and valid in accordance with the methods, requirements, and specifications. The FWS, Field Technical Representative, or equivalent will ensure that data generated from instructions using a software system are backed up and/or downloaded on a regular basis. Software configuration will be acceptance tested prior to use in the field.

Measurement and testing equipment used in the field or laboratory directly affecting the quality of analytical data will be subject to preventive maintenance measures to ensure minimization of measurement system downtime. Laboratories and onsite measurement organizations must maintain and calibrate their equipment. Maintenance requirements (e.g., documentation of routine maintenance) will be included in the QA plan, for the individual laboratory and onsite organization, or operating protocols, as appropriate. Maintenance of laboratory instruments will be performed in a manner consistent with the three-digit EPA methods (EPA-600/4-79-020) and four-digit EPA methods (SW-846), as amended, or with auditable DOE Hanford Site and contractual requirements. Consumables, supplies, and reagents will be reviewed, per SW-846 requirements, and will be appropriate for their use.

2.2.6 Instrument/Equipment Calibration and Frequency

Specific field equipment calibration information is provided in Section 3.4. Analytical laboratory instruments and measuring equipment are calibrated in accordance with the laboratory's QA plan and HASQARD (DOE/RL-96-68).

2.2.7 Inspection/Acceptance of Supplies and Consumables

Consumables, supplies, and reagents will be reviewed, in accordance with SW-846 requirements, and will be appropriate for their use. Supplies and consumables used in support of sampling and analysis activities are procured in accordance with internal work requirements and processes described in the contractor acquisition system. Responsibilities and interfaces necessary to ensure that items procured/acquired for the contractor meet the specific technical and quality requirements must be in place. The procurement system ensures that purchased items comply with applicable procurement specifications. Supplies and consumables are checked and accepted by users prior to use.

2.2.8 Nondirect Measurements

Nondirect measurements include data obtained from sources such as computer databases, programs, literature files, and historical databases. If evaluation includes use of such data, whenever possible, such data will be technically reviewed to the same extent as the data generated as part of this effort. All data used in evaluations will be identified by source.

2.2.9 Data Management

Environmental data will be managed to ensure that the integrity and quality of the data are preserved. Data processing activities will be controlled to ensure that the introduction of errors is minimized while environmental data are being collected, transferred, stored, analyzed, and reviewed. The SMR organization, in coordination with the Project Manager, is responsible for ensuring that analytical data are appropriately reviewed, managed, and stored in accordance with the applicable programmatic requirements governing data management methods. Data processing practices will include some or all of the following controls to avoid errors during data handling and manipulation:

- Perform periodic checks/reviews to ensure that data are not lost or incorrectly transcribed when transferred from one format to another.
- Minimize the number of data transfer steps and the number of personnel handling the data.
- Institute access control and accountability measures to protect hard copy and electronic database files.

Electronic data access, when appropriate, will be through a Hanford Site database (e.g., HEIS) or a project-specific database, whichever is applicable for the data being stored. Where electronic data are not available, hard copies will be provided in accordance with Section 9.6 of the TPA Action Plan (Ecology et al., 1989b).

Laboratory errors are reported to the SMR organization on a routine basis. For reported laboratory errors, a sample issue resolution form will be initiated in accordance with contractor protocols. This process is used to document analytical errors and establish their resolution with the Project Manager. The sample issue resolution forms become a permanent part of the analytical data package for future reference and records management.

Further details on documentation of field activities are provided in Section 3.3 and shall be prepared, reviewed, approved, and maintained according to prescribed processes.

2.3 Assessment and Oversight

The elements of assessment and oversight address the activities for assessing the effectiveness of project implementation and associated QA and QC activities. The purpose of assessment is to ensure that the QAPjP is implemented as prescribed.

2.3.1 Assessments and Response Actions

Random surveillances and assessments verify compliance with the requirements outlined in this SAP, project field instructions, the project quality management plan, methods, and regulatory requirements. Assessments include, but are not limited to, surveillances, management system reviews, readiness reviews, technical system audits, performance evaluations, audits of data quality, and DQAs. Assessment processes, roles, and responsibilities will be in accordance with existing QA program methods and as directed jointly by the Project Manager and the QA point of contact. Deficiencies identified by these assessments will be reported in accordance with existing programmatic requirements. The project's line management chain coordinates the corrective actions/deficiencies resolutions in accordance with the QA program, the corrective action management program, and associated methods implementing these programs. When appropriate, corrective actions will be taken by the Project Manager (or designee).

The Project Manager will determine whether a DQA will be performed for the activities identified in this SAP. The DQA process, if performed, is discussed in Section 2.4. Results of the DQA will be provided to the Project Manager. No other planned assessments have been identified. If circumstances arise in the field dictating the need for additional assessment activities, then additional assessments will be performed.

Oversight activities in the analytical laboratories, including corrective action management, are conducted in accordance with laboratory QA plans. The contractor oversees offsite analytical laboratories and qualifies the laboratories for performing Hanford Site analytical work.

2.3.2 Reports to Management

Reports to management on data quality issues will be made if and when these issues are identified. Issues reported by the laboratories are communicated to the SMR organization, which then initiates a sample issue resolution form in accordance with contractor protocols. This process is used to document analytical or sample issues and establish resolution with the Project Manager.

2.4 Data Validation and Usability

This section addresses QA activities that occur after the data collection phase of the project is completed. Implementation of these activities determines whether or not the data conform to the specified criteria, thus satisfying the project objectives.

2.4.1 Data Review and Verification

Data review and verification are performed to confirm that sampling and chain-of-custody documentation is complete. This review shall include linking sample numbers to specific sampling locations, reviewing sample collection dates and sample preparation and analysis dates to assess whether holding times have been met, and reviewing QC data to determine whether analyses have met the data quality requirements specified in this SAP.

The criteria for verification include, but are not limited to, review for contractual compliance (samples were analyzed as requested), use of the correct analytical method, transcription errors, correct application of dilution factors, appropriate reporting of dry weight versus wet weight, and correct application of conversion factors.

Errors identified by the laboratories are reported to the SMR project coordinator, who initiates a sample issue resolution form. This process is used to document analytical errors and establish resolution with the Project Manager.

Relative to analytical data in sample media, physical data and/or field screening results are of lesser importance in making inferences regarding risk. Physical data and field QA/QC results will be reviewed to ensure that physical property data and/or field screening results are usable.

2.4.2 Data Validation

Data validation activities will be based on EPA functional guidelines. Data validation qualifiers must be compatible with the HEIS database.

Data validation is an independent assessment to ensure that the reliability of data is known. Analytical data validation provides a level of assurance that an analyte is present or absent. Validation might also include verification of instrument calibrations and evaluation of analytical results based upon method blanks, recovery of various internal standards, correctness of uncertainty calculations, correctness of identification and quantification of analytes, and the effect of quality deficiencies on the reliability of the data. Data validation will be in accordance with internal methods. The criteria for data validation are based on a graded approach, using five levels of validation: Levels A through E. Level A is the lowest level and is the same as verification. Level E is a 100 percent review of all data (e.g., calibration data and calculations of representative samples from the data set).

Level C data validation will be performed for a minimum of 5 percent of the laboratory generated chemical and radiochemical data by matrix and analyte group. When outliers or questionable results are identified, additional data validation will be performed, which could involve up to 5 percent of the 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 (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 data set).

2.4.2.1 Reporting Data below Detection Levels

In instances where the laboratory does not report a value below the MDA, half of the MDA is used to calculate the 95 percent upper confidence limit value for all radionuclide sets. The 95 percent upper confidence limit on the arithmetic mean of the data is the primary statistical calculation to support cleanup verification.

2.4.2.2 Data Qualifiers

Data flagged as “J” indicate that the associated concentration is an estimate, but the data are useable for decision making purposes. Data flagged as below detection limits (i.e., “U”) indicate that the analyte was analyzed for but not detected, and the concentration shown is the MDA for radionuclides and the practical quantitation limit for nonradionuclides. Data flagged as rejected (i.e., “R”) indicate that the data are not useable due to a QA/QC deficiency. All other validated results are considered accurate within the standard errors associated with the methods.

2.4.3 Reconciliation with User Requirements

In order to determine whether data collected conform to specified criteria and satisfy the objectives of the field investigation, data review and verification activities are performed. The data review and verification activities include a review for completeness (all samples were analyzed as requested, chain-of-custody documentation is complete, and scientific studies were conducted as requested); use of the correct analytical method/procedure; review for transcription errors; correct application of dilution factors; appropriate reporting of dry weight versus wet weight; and correct application of conversion factors. Laboratory personnel may perform data verification.

The DQA 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 DQA is to

determine whether quantitative data are of the correct type and are of adequate quality and quantity to meet the project DQOs. Results of the DQA will be used in interpreting the data and determining if the objectives of this activity have been met. The following information provides the steps that are considered in the DQA.

Step 1. Review Data Quality Objectives and Sampling Design

This step requires a comprehensive review of the sampling and analytical requirements outlined in the project-specific DQO summary report (SGW-58692) and this SAP:

- List any deviations from the planned sampling design.
- Determine the potential effect of any deviations.

Step 2. Conduct a Preliminary Data Review

Identify, locate, and compile all information related to the sampling and analysis data being assessed including sample summary sheets, logbooks, chain-of-custody forms, field measurement data, laboratory analysis, field and laboratory QC samples and analysis results, flagged data, laboratory standards results, data validation reports, and various discrepancy or data reviewer reports. Perform basic statistical calculations (e.g., percentage of flagged data, percent of various QC parameters not meeting acceptance criteria, and percent of nondetects).

Step 3. Conduct a Data Usability Assessment

Summarize the usability of the data set as a whole and the quality of individual results, as appropriate. Describe the usability in terms of the following DQIs:

Precision – Primarily from DUP data but also from laboratory QC.

Accuracy/Bias – Discuss evidence of field contamination and laboratory QC.

Representativeness – Discuss the extent to which the sampling design was accomplished and the representativeness of the samples and the design as a whole. Identify any specific measurements that are not representative of the target condition, explain why they are nonrepresentative, and discuss the impact to the data set.

Comparability – If multiple laboratories were used, or if this data set is intended to be combined with others, discuss the nature of differences that may limit the comparability.

Completeness – Discuss the accomplishment of all SAP required data generating activities. This must include a comparison of samples actually collected versus those identified in the original sampling design. Comment on the impact to dataset usability of any planned samples that were not taken. Although the third-party data validation report typically includes a completeness metric that relates to the percent of data that is not rejected, the third-party data validation report generally relates only to the fraction of the dataset that was actually validated. Thus, it cannot be the only completeness evaluation of the dataset in total.

Sensitivity – Discuss any laboratory data that do not meet the SAP required reporting limits, and compare the results to any applicable decision thresholds, such as maximum contaminant levels, action levels, or other relevant levels.

For radiochemical determinations, discuss the magnitude of the total propagated uncertainty to the reported activity value and to applicable decision thresholds. Discuss uses of data where total propagated uncertainty calculations are warranted.

Describe the impacts of any deviations of the quality indicators as noted by data flags in terms of limitation of the use of the data set, or individual analytical results, for the specific question to be answered.

Step 4. Formulate Overall Conclusion as to Usability of Data Set

Based upon the usability assessments in Step 3, develop an overall conclusion as to the usability of the entire data set for its intended purpose.

3 Field Sampling Plan

The objective of the field sampling plan is to identify project sampling and analysis activities. The field sampling plan uses the sampling design identified during the systematic planning process and includes defining the number of sample locations, sampling methods, field documentation, field equipment calibration requirements, and information on the various data collection technologies.

3.1 Sampling Objectives

Final remedial actions were selected for the 200-CW-5, 200-PW-1, 200-PW-3, and 200-PW-6 Source OUs in accordance with CERCLA, the TPA (Ecology et al., 1989a), and the National Contingency Plan (40 CFR 300). The remedial actions are described in the ROD (EPA et al., 2011). The purpose of the remedial actions is to address source contamination that poses threats to HHE.

The selected remedy for the sites addresses soils and subsurface disposal structures, two settling tanks, and associated pipelines contaminated primarily with radioactive plutonium and cesium. Some of the waste materials are considered principal threat wastes. Principal threat waste is defined as source material that is considered highly toxic or highly mobile and that generally cannot be reliably contained or would present a significant risk to HHE should exposure occur. Structures and other debris that must be removed in order to conduct required remediation will also be excavated. The remedy includes a combination of RTD, construction of evapotranspiration barriers, soil covers, and institutional controls.

A combination of field radiological surveys, NDA, and focused and/or statistical sampling methods are suitable to support the remedial action decisions for the 200-CW-5, 200-PW-1, and 200-PW-6 OU waste sites:

- Field radiological survey measurements are recommended to support the decisions involving segregating waste and guiding the excavation.
- Field radiological survey measurements, field NDA, and/or focused sampling for laboratory analysis are recommended for designating waste. Focused sampling uses professional judgment to determine the areas of interest. The sampling locations may be defined using historical/ remediation process information, analogous site data, observations, and/or field surveys.
- For decisions involving comparison of residual concentrations of COCs at depths of <4.6 m (15 ft) bgs to cleanup levels, a statistical sampling approach is recommended using a systematic grid. The number of statistical samples needed for each decision unit may be adjusted using the systematic radiological survey results to calculate the statistical variation of the applicable contaminants. This information is used to determine the recommended number of samples to meet the cleanup requirements.
- For decisions involving determining the nature and extent of residual COCs at depths of >4.6 m (15 ft) bgs, a gridded radiological survey approach supplemented with focused samples for laboratory analysis is recommended. Focused samples will be collected to evaluate chemical COCs and verify radiological survey measurements.

3.2 Sampling Design

A conceptual site model (CSM) of contamination levels beneath one of the representative sites (216-Z-1A waste site) was produced using characterization data from the RI. This information is discussed in the project-specific DQO summary report (SGW-58692). The model of this high-salt waste site is useful for

understanding the nature and extent of expected contamination and how the elements of the sample design will provide information to meet RAOs.

Evaluation of the historical data, including data collected from the RI, indicates that radiological contamination associated with the 200-CW-5, 200-PW-1, and 200-PW-6 OU waste sites consists predominantly of americium-241 and isotopes of plutonium, with little contribution from mixed fission products or other gamma emitting radionuclides.

The CSM shows that distribution of plutonium and americium-241 in the soil is very similar. Although the radiological activities of these two radionuclides differ, they appear to be consistently collocated. This supports the concept that americium-241, having a low-energy gamma emission that can be detected using field radiological survey instruments, could be used as a key radionuclide for determining the activity concentrations of the other difficult to measure radionuclides, particularly the isotopes of plutonium.

The CSM also indicates that even after remediation to the design depth, a large amount of radiological contamination will remain in the soil. These remaining levels of contamination, consisting predominantly of TRU contaminants, will pose difficulty in collecting soil samples for laboratory analysis for the purpose of characterizing the residual contamination levels. Analytical costs for these samples are also likely to be high.

This CSM also supports the use of field radiological survey methods with focused sampling, as needed, to confirm field radiological measurements and concentrations of chemical constituents. Statistical sampling will be limited to sampling associated with closeout decisions where residual levels of COCs are directly compared to final cleanup levels specified in the ROD (EPA et al., 2011). Elements of the sample design are described in the following subsections.

3.2.1 Nonstatistical Design

This subsection describes nonstatistical sample design methods that will be used to segregate waste materials, guide the excavation, and characterize waste for disposal. Field NDA methods will be used to confirm if waste is radioactive LLW or TRU waste.

3.2.1.1 Field Radiological Survey Methods

Historical information and process knowledge indicate that predominant radionuclides of concern for these waste sites are isotopes of plutonium and americium-241. Sodium iodide scintillation detectors can be used to detect the 60 keV gamma ray emitted by americium-241 to indicate the presence and relative concentrations of the radionuclides of concern. Although this is not a high-energy photon and comprises only 36 percent of the radioactive decay emitted, high concentrations of americium-241 in the soil and high action levels for the decisions contribute to the effective use of americium-241 as a field indicator of the radionuclides of concern in surface soils.

Onsite radiological measurements will be performed using a field portable sodium iodide detector (or other suitable instrument) at the work site. Depending upon field conditions and instrument specific detection limits, a field instrument for detection of low-energy radiation (FIDLER) may be used for field radiological survey measurements. Standard operating procedures and a technical basis will be developed for instruments and survey methods. Focused soil samples for laboratory analysis of the radionuclides of concern may be collected as needed to verify the field radiological survey measurements and to provide dose-to-curie conversion (counts per minute [cpm]-to-pCi/g activity).

The purpose of field radiological measurements is to support excavation efforts during remediation. Two types of information provided by radiological survey measurements are gross-gamma count rates

(cpm) and radionuclide-specific activities (pCi/g). Field measurements will be calibrated against known standards. Field radiological survey instrumentation will be used in a scan mode to provide gross count rate information to guide the excavation. Longer count times may be needed to detect activities near the soil cleanup levels, dependent upon the ambient soil background.

Two applications of field radiological survey instruments are described in the following subsections.

Segregate and Manage Wastes

The feasibility of in situ radiological characterization relies on radionuclide specific scaling factors developed from the process knowledge/historical data used to convert field measured dose rates (cpm) into radionuclide specific activities (pCi/g). Scaling factors will be developed from the historical data and used to calculate the activity of radionuclides of concern based on the field radiological survey instrument measurement. A technical basis will be developed to support logic that the quantity of TRU radionuclides is strongly correlated to the quantity of americium-241, and a field exposure rate instrument can be used for segregating wastes during the excavation. A selected number of discrete samples will be collected and analyzed for radiological COCs in order to verify the correlation of americium-241 activity to the other radiological COCs.

The instrumentation would be configured to obtain survey data from the excavation using remote reading methods. Survey data would primarily be used to segregate TRU waste from LLW during excavation.

Guide the Excavation

A technical basis will also be developed to support the logic that the quantity of radionuclides of concern at the cleanup levels is correlated to the quantity of americium-241. This correlation will be used to characterize residual levels of the radionuclides of concern in surface soil and guide the extent of excavation. Instrumentation would be configured to obtain survey data from the excavation using remote reading methods, mounted on a cart or other mobile device. Survey data would be used to guide the lateral extent of the excavation and determine that cleanup levels have been obtained in the surface soils at depths of ≤4.6 m (15 ft) bgs. If these systematic field radiological surveys indicate that the areas exceed cleanup levels, additional excavation may be required. If, however, the general area contamination levels are deemed acceptable, but discrete hot spots are noted, discrete samples may be collected from the hot spots for further analysis.

In lieu of a quantified discrete sampling and fixed laboratory analysis approach during excavation, ongoing excavation guidance will rely primarily on onsite radiological measurement techniques and data as described previously.

3.2.1.2 Field Nondestructive Assay Methods

Field NDA will be used to confirm if waste is radioactive LLW or TRU waste. Assays will determine the activities of gamma emitting radionuclides and TRU nuclides. A gamma spectroscopy system and, if needed, a neutron measurement system will be used to provide isotopic ratios. Scaling factors will be developed to calculate the activity of alpha and beta emitting radionuclides not directly measured when using NDA to characterize waste. Samples for laboratory analysis will be collected, as needed, to verify field NDA measurements and support verification of chemical constituents. A QC program will be developed for use of field NDA.

Gamma detectors, such as the Canberra In Situ Object Counting System (ISOCS) high-purity germanium detector, will be used for measurements. Neutron detectors typically use a four-slab counting system. Sealed sources will be used for daily equipment checks and verification of measurements.

3.2.1.3 Focused/Judgmental Sampling

Focused/judgmental sampling is recommended, as needed, to supplement historical information and support designation of wastes. Focused samples would be collected at the discretion of waste management and used to confirm and adjust, as needed, the waste designation and shipping profile. Radiological survey readings obtained using the field radiological screening measurements may be used to adjust the shipping profile.

Discrete sampling or a more quantified systematic sampling approach may be implemented if field conditions warrant such sampling. The following field conditions are examples that may warrant a sampling effort:

- If action levels for health and safety are approached that require increased environment and worker protection, a sampling effort will be initiated. Action levels will be defined in relevant documentation (e.g., radiation work permit, health and safety plan).
- If visual anomalies are encountered during the excavation, a sampling effort may be initiated. Visual anomalies include discoloration of soils, appearance of a sheen on soil particles, obvious change in soil textural characteristics, structural materials that are uncovered unexpectedly, or other unexpected changes in site conditions.
- If the waste profile approaches the ERDF waste acceptance criteria (WCH-191), a sampling effort may be initiated.
- If not enough data are available to support development of a waste profile, a sampling effort will be initiated.

Other field conditions may be encountered in which additional sampling may be required. All sampling efforts will be evaluated by project and/or technical personnel to ensure that representative samples are taken, and appropriate analyses are performed to specifically address the field condition in a cost effective manner.

This preliminary review and designation of the available characterization results indicate that Project Management may wish to request and obtain a treatability variance for contaminated soil and debris prior to beginning the project. This should enable LLW to be accepted at ERDF and minimize handling and treatment of wastes. The process to obtain a treatability variance would likely require public involvement and a revision to the ROD (EPA et al., 2011).

3.2.2 Statistical Design

This section describes the statistical sample design methods that will be used to resolve decisions involving characterization of the nature and extent of residual contamination in the waste sites at depths of ≤4.6 m (15 ft) bgs following remediation. Figure 3-1 shows a conceptual model of the sampling and surveying methods that will be used to determine if RAOs have been achieved.

3.2.2.1 Systematic Sampling for ROD COCs

Site verification sampling starts once onsite radiological survey measurements and process knowledge provide reasonable confidence that cleanup levels can be met. Project personnel decide when to initiate verification sampling. A statistical sampling design will be used for portions of the excavations at depths of ≤4.6 m (15 ft) bgs.

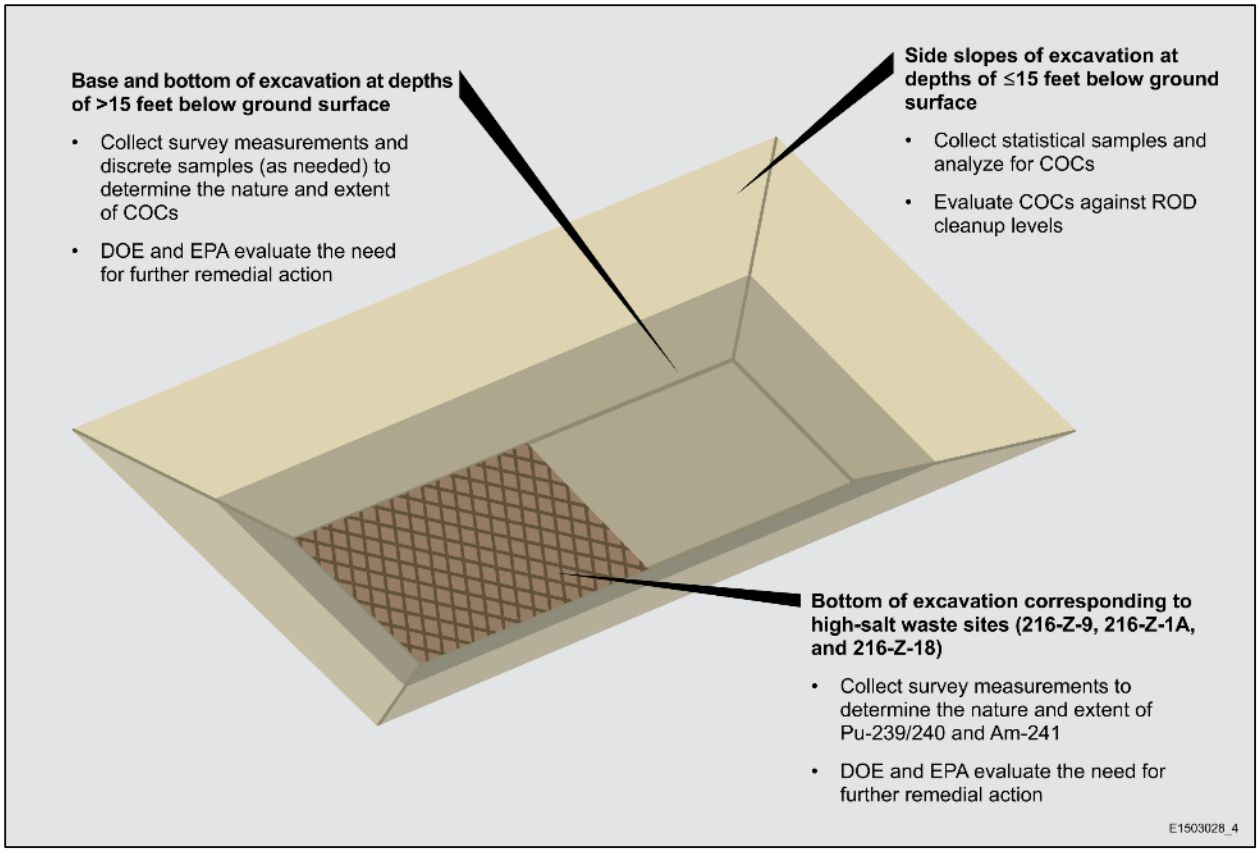

Figure 3-1. Conceptual Model for Final Sampling

Results of systematic radiological surveys of the excavation will be used to determine the standard deviation of the measured activity of americium-241. Visual Sample Plan, or a similar program, will then be used to determine the optimum number of samples to meet performance goals using site-specific americium-241 data. The minimum number of samples needed for each decision unit is determined based on the minimum detectable difference approach presented in EPA 230/02-89-042, *Methods for Evaluating the Attainment of Cleanup Standards Volume 1: Soils and Solid Media*. The minimum detectable difference approach uses the desired tolerances of false positive and false negative errors, target cleanup levels, and an estimate of variability of the contaminants within the decision unit (standard deviation).

When the site is ready for sampling, the location of analytical samples will be determined using Visual Sample Plan or other suitable planning tools. It is recommended that the statistical design uses a triangular systematic grid to provide sufficient area coverage.

Site verification sampling will be completed in accordance with a site-specific work instruction. The following decision units will be considered during the site verification sampling process:

- Shallow zone of the excavated site, which is defined as residual soil 0 to 4.6 m (0 to 15 ft) below the surrounding grade
- Overburden, which includes stockpiled soil that was segregated from contaminated materials during the excavation process with the intention of using it as backfill

A general summary of the site verification sampling design and associated basis for each of the 200-CW-5, 200-PW-1, and 200-PW-6 OU waste sites (or in some cases, groups of waste sites) is presented in Tables 3-1, 3-2, and 3-3. Where a statistical sampling design is identified, a default number of 12 statistical soil samples was used to determine the number of samples to be collected from locations identified within the decision unit using a systematic sampling grid. Because this is only an estimate, the actual number of samples will be determined using results of the systematic radiological surveys.

3.2.2.2 Overburden

Overburden is defined as material previously placed on top of the waste site. The objective for sampling and analysis of overburden is to verify that the soil piles do not contain any COCs above the cleanup levels. This verification will be accomplished using onsite radiological measurements during removal of the overburden, with discrete sampling for laboratory analyses, as needed to confirm field radiological measurements. Verification sampling of overburden piles will be based on a statistical approach. Samples will be analyzed for all COCs by the standard fixed laboratory.

3.2.2.3 Gridded Radiological Surveys

Radiological survey data will be obtained from the bottom of the waste site excavations either as the excavation progresses or after excavation. Radiological surveys will be conducted using the methodology and instrumentation discussed in Section 3.2.1.1 and an established correlation of americium-241 to the radionuclides of concern. These gridded radiological survey measurements will be obtained using a systematic survey plan and mapped to show the distribution and relative concentration of residual contaminants in the bottom of the excavation.

Survey data may be used to determine the locations for collecting focused samples for laboratory analysis of applicable COCs. The number of focused samples suggested for each waste site and applicable COCs are shown in Tables 3-1, 3-2, and 3-3. At least one focused sample is recommended for each decision unit at depths of >4.6 m (15 ft) bgs. The location of the focused sample will be selected using professional judgment and could correspond with a region of high radiological contamination or as directed by DOE and EPA.

Figure 3-2 shows the process for closeout surveys and sampling.

3.3 Documentation of Field Activities

Logbooks or data forms are required for field activities. A logbook must be identified with a unique project name and number. The individual(s) responsible for logbooks will be identified in the front of the logbook, and only authorized persons may make entries in logbooks. Logbooks entries will be reviewed by the FWS, cognizant scientist/engineer, or other responsible manager; the review will be documented with a signature and date. Logbooks will be permanently bound, waterproof, and ruled with sequentially numbered pages. Pages will not be removed from logbooks for any reason. Entries will be made in indelible ink. Corrections will be made by marking through the erroneous data with a single line, entering the correct data, and initialing and dating the changes.

Table 3-1. Sampling Needs for the 200-CW-5 Operable Unit Waste Sites

Design Parameter		216-Z-1D (North Part)[a]	UPR-200-W-110	Composite of Z Ditches
Evaluate levels of COCs at depths of ≤4.6 m (15 ft) bgs	COCs	Strontium-90, Cesium-137, Radium-226, Plutonium-239/240, Americium-241, Boron, Mercury, PCB, and Nitrate	Strontium-90, Cesium-137, Radium-226, Plutonium-239/240, Americium-241, Boron, Mercury, PCB, and Nitrate	Strontium-90, Cesium-137, Radium-226, Plutonium-239/240, Americium-241, Boron, Mercury, PCB, and Nitrate
	No. of Decision Units	13 placements[b]	8 placements[b]	22 placements[b]
	Total Area (m^2 [ft^2])	11,500 (123,785)	18,690 (201,177)	35,818 (385,542)
	No. of Samples[c]	156	96	264
Evaluate nature and extent of COCs at depths of >4.6 m (15 ft) bgs	COCs	Strontium-90, Cesium-137, Radium-226, Plutonium-239/240, Americium-241, Boron, Mercury, PCB, and Nitrate	Strontium-90, Cesium-137, Radium-226, Plutonium-239/240, Americium-241, Boron, Mercury, PCB, and Nitrate	Strontium-90, Cesium-137, Radium-226, Plutonium-239/240, Americium-241, Boron, Mercury, PCB, and Nitrate
	No. of Decision Units	13	8	22
	Total Area (m^2 [ft^2])	Excavation is not anticipated to exceed 4.6 m (15 ft) bgs	Excavation is not anticipated to exceed 4.6 m (15 ft) bgs	Excavation is not anticipated to exceed 4.6 m (15 ft) bgs
	No. of Samples	0	0	0

a. Includes pipelines.

b. Each decision unit is defined by the placement of a weather enclosure used to perform the work. The weather enclosure is approximately 73 by 55 m (240 by 180 ft).

c. Based on a minimum of 12 samples. Actual number of samples will be determined using the contaminant variance obtained from systematic radiological surveys.

bgs = below ground surface

COC = contaminant of concern

OU = operable unit

PCB = polychlorinated biphenyl

Table 3-2. Sampling Needs for the 200-PW-1 Operable Unit Waste Sites

Design Parameter		216-Z-1A Cluster[a]	216-Z-9	216-Z-12	216-Z-18[b]	241-Z-361
Evaluate levels of COCs at depths of ≤4.6 m (15 ft) bgs	COCs	Tc-99, Pu-239/240, Am-241, Nitrate	Tc-99, Pu-239/240, Am-241, Nitrate	Pu-239/240, Am-241	Tc-99, Pu-239/240, Am-241, Nitrate	Pu-239/240, Am-241
	No. of Decision Units	4 placements[c]	1 placement[c]	3 placements[c]	4 placements[c]	1 placement[c]
	Total Area (m^2 [ft^2])	4,089 (44,010)	1,552 (16,701)	2,658 (28,612)	2,748 (29,584)	476 (5,124)
	No. of Samples[d]	48	12	36	48	1
Evaluate nature and extent of COCs at depths of >4.6 m (15 ft) bgs	COCs	Tc-99, Pu-239/240, Am-241, Nitrate	Tc-99, Pu-239/240, Am-241, Nitrate	Pu-239/240, Am-241	Tc-99, Pu-239/240, Am-241, Nitrate	Pu-239/240, Am-241
	No. of Decision Units	4 (~6 to 10 m [20 to 33 ft] bgs)	1 (~7 m [23 ft] bgs)	3 (~7.3 m [24 ft] bgs)	4 (~6 m [20 ft] bgs)	1
	Total Area (m^2 [ft^2])	9,948 (107,083) (includes 216-Z-1A)	1,710 (18,403)	3,789 (40,785)	5,964 (64,200)	614 (6,609)
	No. of Samples	4	1	3	4	1
Evaluate residual Pu-239/240 and Am-241	COCs	Pu-239/240, Am-241	Pu-239/240, Am-241	N/A	Tc-99, Pu-239/240	N/A
	No. of Decision Units	2 (~6 m [20 ft] bgs) for 216-Z-1A only	1 (~7 m [23 ft] bgs)	N/A	4 (~6 m [20 ft] bgs)	N/A
	Total Area (m^2 [ft^2])	6,316 (67,985) for 216-Z-1A only	1,710 (18,403)	N/A	5,964 (64,200)	N/A
	No. of Samples	0	0	N/A	0	N/A

Source: EPA et al., 2011, Record of Decision Hanford 200 Area Superfund Site 200-CW-5 and 200-PW-1, 200-PW-3, and 200-PW-6 Operable Units.

Am-241 = americium-241
bgs = below ground surface
COC = contaminant of concern
N/A = not applicable
Pu-239/240 = plutonium-239/240
Tc-99 = technetium-99

Table 3-3. Sampling Needs for the 200-PW-6 Operable Unit Waste Sites

Design Parameter		216-Z-5[a]	241-Z-8
Evaluate levels of COCs at depths of ≤4.6 m (15 ft) bgs	COCs	Plutonium-239/240 and Americium-241	Plutonium-239/240 and Americium-241
	No. of Decision Units	1 placement[b]	1 placement[b]
	Total Area (m^2 [ft^2])	1,349 (14,525)	689 (7,420)
	No. of Samples[c]	12	12
Evaluate nature and extent of COCs at depths of >4.6 m (15 ft) bgs	COCs	Plutonium-239/240 and Americium-241	Plutonium-239/240 and Americium-241
	No. of Decision Units	1 (~6.7 m [22 ft] bgs)	1
	Total Area (m^2 [ft^2])	1,164 (12,532)	191 (2,061)
	No. of Samples	1	1

a. Includes pipelines.

b. Each decision unit is defined by the placement of a weather enclosure used to perform the work. The weather enclosure is approximately 73 by 55 m (240 by 180 ft).

c. Based on a minimum of 12 samples; actual number of samples will be determined using the contaminant variance obtained from systematic radiological surveys.

COC = contaminant of concern

OU = operable unit

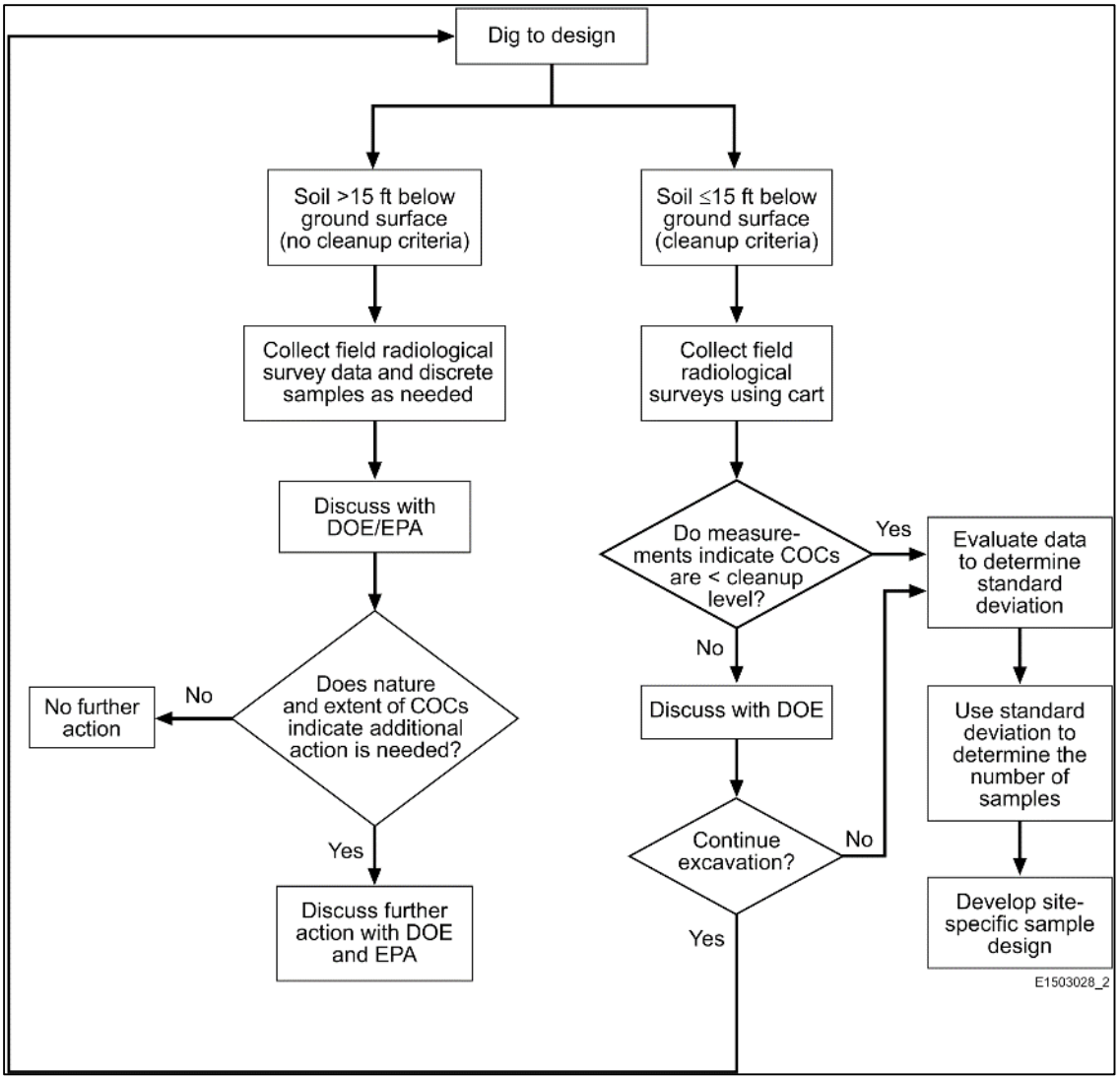

Figure 3-2. Closeout Survey/Sampling Process

Data forms may be used to collect field information; however, the information recorded on data forms must follow the same requirements as those for logbooks. The data forms must be referenced in the logbooks.

The following information is to be recorded in logbooks:

- Purpose of activity
- Day, date, time, and weather conditions
- Names, titles, and organizations of personnel present
- Deviations from the QAPjP
- All site activities, including field tests
- Materials quality documentation (e.g., certifications)

- Details of samples collected (e.g., preparation, splits, duplicates, matrix spikes, and blanks)
- Location and types of samples
- Chain-of-custody details and variances relating to chain-of-custody
- Field measurements
- Field calibrations testing, inspections, maintenance, and surveys, and equipment identification numbers, as applicable
- Equipment decontaminated, number of decontaminations, and variations to decontamination methods
- Equipment failures or breakdowns and descriptions of any corrective actions
- Telephone calls relating to field activities

3.3.1 Decontamination of Sampling Equipment

Sampling equipment shall be decontaminated in accordance with the sampling equipment decontamination protocols. To prevent potential contamination of the samples, care should be taken to use decontaminated equipment for each sampling activity.

Special care should be taken to avoid the following common ways in which cross-contamination or background contamination may compromise the samples:

- Improperly storing or transporting sampling equipment and sample containers
- Contaminating the equipment or sample bottles by setting the equipment/sample bottle on or near potential contamination sources (e.g., uncovered ground)
- Handling bottles or equipment with dirty hands or gloves
- Improperly decontaminating equipment before sampling or between sampling events

3.3.2 Corrective Actions and Deviation for Sampling Activities

The Project Manager, FWS, and SMR personnel must document deviations from protocols, problems pertaining to sample collection, chain-of-custody forms, target analytes, contaminants of potential concern, sample transport, or noncompliant monitoring. Examples of deviations include samples not collected because of field conditions, changes in sample locations because of physical obstructions, or additions of sample depth(s).

As appropriate, such deviations or problems will be documented in the field logbook or on nonconformance report forms in accordance with internal corrective action methods. The Project Manager, FWS, or SMR personnel will be responsible for communicating field corrective action requirements and for ensuring immediate corrective actions are applied to field activities.

3.3.3 Radiological Field Data

Radiological screening will be performed by the RCT or other qualified personnel in accordance with approved methods and HASQARD (DOE/RL-96-68), as applicable. The RCT will record field measurements, noting the depth of the sample and the instrument reading. Measurements will be relayed to the FWS or site analytical lead for inclusion in the field logbook or operational records daily, as applicable.

The following information will be distributed to personnel performing work in support of this SAP:

- Instructions to RCTs on the methods required to measure sample activity and media for gamma, alpha, and/or beta emissions, as appropriate
- Information regarding the portable radiological field instrumentation, including a physical description of the instruments, radiation and energy response characteristics, calibration/maintenance and performance testing descriptions, and the application/operation of the instrument (instruments are commonly used on the Hanford Site to obtain measurements of removable surface contamination measurements and direct measurements of total surface contamination)
- Instructions regarding the minimum requirements for documenting radiological controls information in accordance with 10 CFR 835, "Occupational Radiation Protection"
- Instructions for managing the identification, creation, review, approval, storage, transfer, and retrieval of radiological information
- Minimum standards and practices necessary for preparing, performing, and retaining radiological related information
- Requirements associated with preparing and transporting regulated material.
- Daily reports of radiological surveys and measurements collected during field investigation activities (data will be cross-referenced between laboratory analytical data and radiation measurements to facilitate interpreting the investigation results)

3.4 Calibration of Field Equipment

The FWS, or designated personnel, is responsible for ensuring that field equipment is calibrated appropriately. Onsite environmental instruments are calibrated in accordance with the manufacturer operating instructions, internal work requirements and processes, and/or work packages that provide direction for equipment calibration or verification of accuracy by analytical methods. Results from all instrument calibration activities are recorded in logbooks and/or work packages, in accordance with HASQARD (DOE/RL-96-68). Either hard copy or electronic calibration activity records are acceptable.

The following field instrumentation, calibration, and QA checks will be performed:

- Calibration of radiological field instruments on the Hanford Site is performed by the Mission Support Alliance prime contractor, as specified in their program documentation.
- Daily calibration checks will be performed and documented for each instrument used to characterize areas under investigation. These checks will be made on standard materials sufficiently like the matrix under consideration for direct comparison of data. Analysis times will be sufficient to establish detection efficiency and resolution.
- Standards used for calibration will be traceable to nationally or internationally recognized standard agency source or measurement system, if available.

The following field equipment requires calibrations:

- Field radiological survey instruments
- Field NDA equipment
- Nonradiological field screening equipment

3.5 Sample Location and Frequency

The general sample locations and frequencies are provided in Table 3-4. The actual number and location of samples may be adjusted in accordance with site-specific sampling instructions approved by DOE and EPA.

3.6 Sample Handling

Sample handling and transfer shall be in accordance with established methods to preclude loss of identity, damage, deterioration, and loss of sample. Custody seals or custody tape shall be used to verify that sample integrity has been maintained during sample transport. The custody seal will be inscribed with the sampler's initials and date. A sampling and data tracking database is used to track the samples from the point of collection through the laboratory analysis process.

3.6.1 Containers

Pre-cleaned sample containers with certificates of analysis denoting compliance with EPA 540/R-93/051, *Specifications and Guidance for Contaminant-Free Sample Containers*, for the intended analyses will be used for soil samples collected for chemical analysis. Container sizes may vary depending on laboratory specific volumes/requirements for meeting analytical detection limits and reducing radiological exposure. The Radiological Engineering organization will measure both the contamination levels and dose rates associated with the sample containers. This information, along with other data, will be used to select proper packaging, marking, labeling, and shipping paperwork and to verify that the sample can be received by the analytical laboratory in accordance with the laboratory's acceptance criteria. If the dose rate on the outside of a sample container or the curie content exceeds levels acceptable by an offsite laboratory, the FWS (in consultation with the SMR organization), can send smaller volumes to the laboratory. Preliminary container types and volumes are identified in Table 3-5. There may be additional requirements associated with the analytical methods specified in Tables 2-3 and 2-4.

Samples exhibiting high radioactivity will be collected and shipped in coordination with the SMR. Sample volumes and laboratory QC may need to be adjusted to reduce radiological exposure associated with sample handling, packaging, shipping, and laboratory analysis.

3.6.2 Container Labeling

The sample location, depth, and corresponding HEIS numbers are documented in the sampler's field logbook. A custody seal (e.g., evidence tape) is affixed to each sample container and/or the sample collection package in such a way as to indicate potential tampering.

Each sample container will be labeled with the following information on firmly affixed, water-resistant labels:

- Sample Authorization Form number
- HEIS number
- Sample collection date and time
- Analysis required
- Preservation method (if applicable)
- Chain-of-custody number
- Bottle type and size
- Laboratory performing the analyses
- Sample location

Table 3-4. Sample Locations, Frequencies, and Sampling Methods

Sampling Objectives	Sample Matrix	Sample Locations	Number of Samples	Number of QA Samples	Sampling Methods	Sampling Frequency
Segregate waste using radiological surveys	Soil, debris, sludge	Focused samples may be collected as needed to verify field radiological survey measurements	Will be determined based on field conditions	N/A	Grab sample as needed	TBD
Guide excavation	Soil, debris	Focused samples may be collected as needed to verify field radiological survey measurements and concentration of chemical COCs	Will be determined based on field conditions	N/A	Grab sample as needed	TBD
Characterize waste	Soil, debris, Sludge	Sample locations determined by waste specialist	Will be determined based on field conditions	N/A	Grab sample as needed	TBD
Determine if cleanup levels are met for soil <4.6 m (15 ft) bgs	Soil	Sampling locations determined using a systematic triangular grid	Number of samples will be determined based on the variance of systematic radiological survey measurements	1 duplicate per decision unit 1 EB per decision unit	Discrete grab samples	Minimum of 12 samples per decision unit
Provide concentrations (mg/kg) and activities (pCi/g) of residual COCs for soil >4.6 m (15 ft) bgs	Soil	In situ radiological surveys will be used to determine focused/judgmental sampling locations	Minimum of 1 per decision unit	N/A	Discrete grab sample	Minimum of 1 sample per decision unit
Determine residual activity of Pu-239/240 and Am-241 in bottom of 216-Z-9, 216-Z1A, and 216-Z-18	Soil	In situ radiological surveys only; no sampling needed	N/A	N/A	N/A	N/A
Overburden	Soil	Sampling locations determined using a systematic triangular grid	Number of samples will be determined based on the variance of systematic radiological survey measurements	1 duplicate per decision unit 1 EB per decision unit	Discrete grab samples	Minimum of 12 samples per decision unit

Am-241 = americium-241 bgs = below ground surface DUP = field duplicate N/A = not applicable
COC = contaminant of concern EB = equipment blank Pu-239/240 = plutonium-239/240 TBD = to be determined

Table 3-5. Soil Sample Preservation, Container, and Holding Time Guidelines

Analytes	Bottle Size/Type	Minimum Sample Size	Preservation	Holding Time
Strontium-90	60 mL, Glass/Plastic	20 g	None	6 months
Technetium-99	60 mL, Glass/Plastic	20 g	None	6 months
Cesium-137	250 mL, Glass/Plastic	200 g	None	6 months
Radium-226	250 mL, Glass/Plastic	200 g	None	6 months
Plutonium-239/240	60 mL, Glass/Plastic	20 g	None	6 months
Americium-241	60 mL, Glass/Plastic	20 g	None	6 months
Boron	60 mL, Plastic	2 g	None	6 months
Mercury	60 mL, Glass/Plastic	2 g	Cool, ≤6°C	28 days
Nitrate	60 mL, Glass/Plastic	4 g	Cool, ≤6°C	28 days
Polychlorinated Biphenyl	120 mL, Amber Glass Teflon® lined cap	50 g	Cool, <6°C	365 days for extraction/365 days for analysis after extraction

Note: Teflon is a registered trademark of DuPont, Wilmington, Delaware.

Sample records must include the following information:

- Analysis required
- Source of sample
- Matrix (e.g., water and soil)
- Field data (e.g., pH and radiological readings)

3.6.3 Sample Custody

Sample custody will be maintained in accordance with existing Hanford Site protocols to ensure the maintenance of sample integrity throughout the analytical process. Chain-of-custody protocols will be followed throughout sample collection, transfer, analysis, and disposal to ensure sample integrity is maintained. 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.

Shipping requirements will determine how sample shipping containers are prepared for shipment. The analyses requested for each sample will be indicated on the accompanying chain-of-custody form. 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 sampler will make a copy of the signed record before sample shipment and will transmit the copy to the SMR organization within 48 hours of shipping.

The following information is required on a completed chain-of-custody form:

- Project name
- Signature of sampler
- Unique sample number
- Date and time of collection
- Matrix
- Preservatives
- Signatures of individual involved in sample transfer
- Requested analyses (or reference thereto)

3.6.4 Sample Transportation

All packaging and transportation instructions shall be in compliance with applicable transportation regulations and DOE requirements. Regulations for classifying, describing, packaging, marking, labeling, and transporting hazardous materials, hazardous substances, and hazardous wastes are enforced by the U.S. Department of Transportation (DOT) as described in 49 CFR 171, "Transportation," "General Information, Regulations, and Definitions," through 177, "Carriage by Public Highway." Carrier specific requirements defined in IATA, 2013, *Dangerous Goods Regulations*, should also be considered when preparing sample shipments conveyed by air freight providers.

Samples containing hazardous constituents shall be considered hazardous material in transportation and transported according to DOT (49 CFR) requirements. If the sample material is known or can be identified, then it shall be packaged, marked, labeled, and shipped according to the specific instructions for that material.

Materials are classified by DOT as radioactive when the isotope-specific activity concentration and the exempt consignment limits described in 49 CFR 173, "Transportation," "Shippers—General Requirements for Shipments and Packagings," are exceeded. Samples shall be screened, or relevant historical data shall be used, to determine if these values are exceeded. When screening or historical data indicate that samples are radioactive, they shall be properly classified, described, packaged, marked, labeled, and transported according to DOT requirements.

Prior to shipping radioactive samples to the laboratory, the organization responsible for shipping shall notify the laboratory of the approximate number and radiological levels of the samples. This notification is conducted through the SMR project coordinator. The laboratory is responsible for ensuring that the applicable license limits are not exceeded. The laboratory shall provide the SMR organization with written acceptance for samples with elevated radioactive contamination or dose.

4 Management of Waste

Waste materials are generated during sample collection, processing, and subsampling activities. The method of identification, storage, and disposition of hazardous, radioactive, or mixed waste materials and unused samples (including unexpected waste) generated by sampling activities will be managed in accordance with an approved waste management plan.

Offsite analytical laboratories are responsible for disposal of unused sample quantities. On a monthly basis, the laboratory will coordinate sample disposal and status with SMR by providing a list of samples more than 90 days post-data delivery for which disposal is requested in the following month. The laboratory will also provide on a monthly basis a list of samples disposed of in the preceding month that includes disposal date and method or other relevant information. Signed chain-of-custody forms indicating sample disposal will be retained in laboratory case files pending return of case files to the contractor.

Pursuant to 40 CFR 300.440, “National Oil and Hazardous Substances Pollution Contingency Plan,” “Procedures for Planning and Implementing Off Site Response Actions,” approval from the DOE Project Manager is required before returning unused samples or waste from offsite laboratories.

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5 Health and Safety

The hazardous waste operations safety and health program was established to ensure the safety and health of workers involved in hazardous waste site activities. The program was developed to comply with the requirements of 29 CFR 1910.120, “Occupational Safety and Health Standards,” “Hazardous Waste Operations and Emergency Response,” and 10 CFR 835. The health and safety program defines the chemical, radiological, and physical hazards and specifies the controls and requirements for day-to-day work activities on the overall Hanford Site. Personal training, control of industrial safety and radiological hazards, personal protective equipment, site control, and general emergency response to spills, fire, accidents, injury, site visitors, and incident reporting are governed by the health and safety program.

Site-specific health and safety plans will be prepared to supplement the general health and safety program. Site access and sampling work activities will be controlled in accordance with the site-specific and general health and safety plans.

Project field staff will be required to comply with the health and safety program at all times. Unescorted site visitors must have completely read the health and safety plan and be escorted by project team personnel before entering the work area. Escorted visitors are briefed on health and safety concerns and must be escorted by the Project Manager (or designee) at all times when they are in the work area.

During operations, emergency response will be covered by the health and safety program. The health and safety program specifies primary emergency response actions for site personnel, area alarms, implementation of the emergency action plan and emergency equipment at the task site, emergency coordinators, emergency response, and spill containment.

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6 References

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