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JUN 30 2005

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Addressees:

TRANSMITTAL OF THE CENTRAL PLATEAU ECOLOGICAL SAMPLING AND ANALYSIS PLAN – PHASE I, DOE/RL-2004-42, REVISION 0

This letter transmits the Central Plateau Ecological Sampling and Analysis Plan – Phase I, DOE/RL-2004-42, Revision 0, for your review and approval.

The information contained in this sampling and analysis plan documents the culmination of the data quality objectives and sampling design development process for Phase I of the Central Plateau Ecological Risk Assessment that included participants from the U.S. Department of Energy, Richland Operations Office, the State of Washington Department of Ecology, the U.S. Environmental Protection Agency, the Hanford Natural Resource Trustee Council, and the Hanford Advisory Board and Tribal representatives in interviews, workshops, document reviews and site visits.

If you have any questions, please contact me, or you may contact Bryan Foley, of my staff on (509) 376-7087.

Sincerely,

Matthew S. McCormick, Assistant Manager
for the Central Plateau

AMCP:BLF

Attachment

cc: See page 2

JUN 30 2005

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DOE/RL-2004-42
Revision 0

Central Plateau Terrestrial Ecological Sampling and Analysis Plan - Phase I

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

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

DOE/RL-2004-42
Revision 0

Central Plateau Terrestrial Ecological Sampling and Analysis Plan - Phase I

Date Published
June 2005

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

United States Department of Energy
P.O. Box 550
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Release Approval _____ Date _____

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EXECUTIVE SUMMARY

This document is the Phase I terrestrial ecological sampling and analysis plan (SAP) for the Central Plateau on the Hanford Site. This SAP is the first in a series of three to assess ecological risks on the Central Plateau. The activities described in this document will result in soil and biota data needed for informed waste site decision-making and provide information to evaluate the health or condition of the ecosystem across the range of Central Plateau habitats. This plan is based on the ecological data quality objectives (EcoDQO) summary report for the Central Plateau on the Hanford Site, as documented in WMP-20570, *Central Plateau Terrestrial Ecological Risk Assessment Data Quality Objectives Summary Report-Phase I (pending)*. The culmination of the phased DQOs/SAPs and field characterization activities will be the development of a final Central Plateau Ecological Risk Assessment, planned for fiscal year 2007 as shown in Figure ES-1.

The *Hanford Federal Facility Agreement and Consent Order* (Tri-Party Agreement) (Ecology et al. 1989) established a framework to ensure that environmental impacts associated with past and present activities at Hanford are investigated and appropriate response actions are taken to protect human health and the environment. Within this framework, the *Comprehensive Environmental Response, Compensation and Liability Act of 1980* remedial investigation/feasibility study process is implemented to gather the information needed to arrive at records of decision that authorize remedial actions. The ecological risk assessment supported by this SAP is one of several being performed on the Hanford Site to ensure that ecological risks have been properly evaluated in support of remedial action decision making. This document only addresses potential terrestrial ecological impacts on the Central Plateau. It does not address Central Plateau human health or groundwater impacts, nor does it consider ecological impacts in other portions of the Hanford Site.

The SAP will be implemented using a phased and tiered approach to characterize ecological risks. Phases are based on the characteristics of study areas, whereas tiers are types of data collected within those study areas. This multifaceted approach has the advantage of resource effectively targeting data collection to those ecological receptors found to be at risk from Hanford Site processes and associated contaminants of potential ecological concern (COPEC).

Phasing allows the project to sequence the field work in a step-wise fashion that initially focuses on lower cost and less intrusive shallow-soil data gathering activities. These data will be evaluated to determine if deeper soil sampling and more extensive ecological studies are warranted. A phased approach enables the project to distribute work over multiple years in response to work scope, time, and budget constraints, while systematically establishing the ecosystem conceptual model. A phased approach also supports refinement of the sampling design with successive sampling campaigns.

Phase I activities are focused on the 200 East and 200 West Areas. Phase II will evaluate the need for ecological sampling in the US Ecology site, tank farms, the BC Controlled Area, and West Lake. Phase III is planned to evaluate the need for ecological sampling in habitat (non-operational) areas outside of the 200 East or 200 West Areas. Because of budgetary and schedule limitations that constrained the fiscal year 2004 activities, the spatial components of Phases I and II of the EcoDQO now will be characterized in fiscal year 2005. As Figure ES-1 shows, waste sites in the 200 East and 200 West Areas now will be sampled concurrently with an evaluation of the areas targeted for Phase II.

Several contaminated media were considered for the Central Plateau EcoDQO, including soil (shallow or <15 ft and deep or >15 ft), air, groundwater, and wetlands. For the terrestrial environment on the Central Plateau, groundwater and wetlands are typically not relevant media on the Central Plateau. However, West Lake represents a unique aquatic environment compared to the Central Plateau and its evaluation is based on revisions to an existing DQO (WMP-20570, Appendix E) with assessment of available studies in Phase III. And while ecological impacts associated with inhalation of contaminants are typically of minor concern (EPA 2003b), a diffuse carbon tetrachloride plume in the 200 West Area also was considered for possible ecological risks. Generally, the most important contaminated media for ecological risks are shallow-zone soils and associated food-web exposures; therefore, use of soil-screening values and terrestrial biota concentration guidelines based on these pathways are appropriate for identifying COPECs.

COPECs were identified based on shallow-zone data available from the *Hanford Environmental Information System*, a Hanford Site database and/or from DOE/RL-2001-54, *Central Plateau Ecological Evaluation*. Analytes were included as COPECs if the maximum detected

concentrations exceeded the soil-screening values or contributed to the sum of fractions for radiological dose to terrestrial receptors.

COPECs include eight radionuclides (Am-241, Cs-137, Co-60, Pu-239/240, Ra-226, Ra-228, Sr-90, and U-238), 21 metals (antimony, arsenic, barium, bismuth, boron, cadmium, chromium, hexavalent chromium, copper, cyanide, lead, mercury, molybdenum, nickel, selenium, silver, thallium, tin, uranium, vanadium, and zinc), and polychlorinated biphenyls (Aroclor-1254 and Aroclor-1260[1]). Carbon tetrachloride was identified as a COPEC in soil gas, based on available data on the soil-gas plume in the 200 West Area, and it will be evaluated in Phase III in conjunction with the potential deep-soil characterization. Additional analytes that share the specified analytical techniques also will be reported if detected. Additional analytes may include Cs-134, Eu-152, Eu-154, Eu-155, Np-237, and Sb-125 (gamma energy analysis), Pu-238 (isotopic plutonium), and U-234 and U-235 (isotopic uranium). Additional Aroclors will be measured and reported. Chlorinated pesticides are included as additional analytes, because they can be analyzed for little additional cost using the U.S. Environmental Protection Agency method for polychlorinated biphenyls.

Assessment endpoints were developed in the EcoDQO document (WMP-20570) that are representative of terrestrial ecological receptors potentially at risk from COPECs in soil. Plants and soil macroinvertebrates are valuable assessment endpoint entities because they potentially are more exposed indicators for evaluating the adverse effects of inorganic COPECs. Central Plateau-specific receptors are suggested as ecological and societal relevant assessment endpoints that also address management goals. Central Plateau-specific receptors are also suggested as surrogates for the *Washington Administrative Code* feeding guilds, because they are at greater risk from COPECs in the toxicity evaluation. These feeding guilds include producers, soil biota, soil macroinvertebrates, middle-trophic-level vertebrates, and carnivorous reptiles, birds, and mammals.

Risk questions were a logical outcome of COPEC refinement and consideration of assessment endpoint attributes, and they represent the conceptual model of how contaminant stressors are

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[1] Aroclor is an expired trademark.

most likely to impact the Central Plateau ecosystem. Risk questions are posed to identify measures of effect, exposure, and ecosystem/receptor characteristics. A full complement of risk questions were developed in the EcoDQO document (WMP-20570) for the possible measures considered in this phased and tiered approach to characterize ecological risks. The following risk questions are relevant to the data being collected in Phase I.

- For nonradionuclide COPECs: Are mean concentrations in soil greater than mean concentrations in the reference site soils (or mean of background concentrations) and, if so, are they greater than soil-screening values or literature no-adverse-effect levels or toxicity reference values for the receptor, based on effects of each individual COPEC or combined effects of COPECs where appropriate? Note that the toxicity values used for comparison are typically bounding cases such as no observed adverse effect levels.

- For radionuclide COPECs: Is the contribution to the sum of fractions based on mean concentrations greater than 1 and also greater than the sum of fractions based on mean concentrations for the reference site, or greater than the sum of fractions based on background mean concentrations?

- Do mean COPEC concentrations in the receptor increase compared to mean COPEC concentrations in the reference site receptors or along a gradient with increasing COPEC concentrations greater than published levels associated with toxicity?

- Do mean COPEC concentrations in the receptor diet increase from those of the reference site or along a gradient with increasing COPEC concentrations greater than toxicity reference value?

A synopsis of the Phase I study design is provided in Table ES-1; it shows how the various data types (measures) relate to risk questions, the key features of the study design, and the basis for the design element. All aspects of the study design are subject to field verification, which may require selecting alternate measures for an assessment endpoint or other modifications to the study design (e.g., plot size, trapping density). In some cases, assessment endpoints will be evaluated by collecting data on that endpoint; e.g., data on deer mice will be collected to evaluate potential impacts on middle trophic level omnivores. In other cases, surrogates will be used to

evaluate assessment endpoints because data collection for that endpoint would be impractical. For example, while grasshopper mice represent insect-eating mammals, they are not abundant. In this case, field measures on pocket mice or deer mice would be used to infer effects on growth or survival of insect-eating mammals.

The investigation area of 1 hectare was selected as an appropriate scale over which to evaluate the measures considered in this plan. The detailed rationale was provided in WMP-20570. The home range (most typically representing the foraging area) and the median dispersal distance were evaluated to identify 1 hectare as an appropriate spatial scale to evaluate ecological risk. The mean over this 1 hectare investigation area was the best estimate of the representative COPEC concentration in soil and the concentration of COPECs in biota.

One key aspect of the conceptual model is the list of COPECs, which are based on existing sample data and process knowledge. Sampling for contaminants of interest can help to verify this aspect of the conceptual model. Another important component of the conceptual model is the primary exposure medium, including the depth of biological activity. Data suggest that surface soil, in particular the first few inches, are important as an exposure medium for direct contact with wildlife, root uptake, and animal burrowing. For example, Cline (1981) and Cline and Cadwell (1984) showed that surface applied radionuclides (cesium-137 and strontium-90) remain in the top 6 inches of soil over several decades. Thus, surface soil samples (top 6 in.) can be collected along with biological tissues to test for COPEC uptake.

Collecting surface-soil samples for the initial data collection activities has important practical advantages. Methods for collecting surface-soil samples are less intrusive than those needed for deeper soil characterization (e.g., backhoe or truck-mounted drill rigs) and, therefore, minimize the impacts of data collection on the shrub-steppe ecosystem. The conceptual model of the possible upward mobility of buried waste through animal burrowing and plant uptake initially will be assessed using field radiological data. Soils sampled will be biased toward areas with high potential for mobilized subsurface waste, such as ant mounds and mammal burrow spoils.

The specific receptors targeted for initial sampling are mammals, lizards, and soil macroinvertebrates, because these organisms were viewed as having a high potential for accumulating site COPECs. Plant tissue initially will be assessed for radionuclide uptake by

collecting radiological field data on beta and gamma-emitting radionuclides. To help address Hanford Natural Resource Trustee information needs, any abnormalities on animals handled during data collection will be noted. Additional data collection is dependent on the results of the initial investigation phases and may include characterization of soils deeper than 6 in., plant tissue concentrations, population measures for mammals and lizards, field verification for middle trophic-level birds, litterbag studies, and toxicity tests for plants and invertebrates.

Phase I and Phase II data collection will be followed by a data quality assessment (DQA) early in Phase III, and the subsequent Phase III field investigations will be dependent on the results of the DQA. The DQA will emphasize the analysis of the Phase I and Phase II data, as well as relevant data from the literature (both from the Hanford Site and from other locations) using exploratory data analysis tools. Such tools include box plots that are used to compare results between data groups and scatter plots that are used to visually evaluate data for trends. These graphical tools will be supported by statistical tests, as appropriate and will be based on the underlying distributions of the data (e.g., normal or lognormal). Probability plots and histograms, coupled with statistical tests, can help to determine the underlying statistical distribution of the data. The exploratory data analysis is expected to lead to one of four possible outcomes:

1. COPECs are in soil and in biota.
2. COPECs are in soil only.
3. COPECs are in biota only (potentially triggering deep soil sampling in Phase III)
4. COPECs are not in soil and not in biota (indicating no additional data needed to characterize risk to biota for the spatial domains sampled for Tier 1).

For outcomes 1-3, exposure is compared to effect levels to determine if additional data should be collected. Thus, additional data collection is dependent on the results of the DQA and may include characterization of soils deeper than 6 in., plant tissue concentrations, population measures for mammals and lizards, field verification for middle trophic-level birds, litterbag studies, and toxicity tests for plants and invertebrates.

Figure ES-1. Phased Central Plateau Ecological Risk Assessment Emphasizing the Spatial Extent of the Investigations.

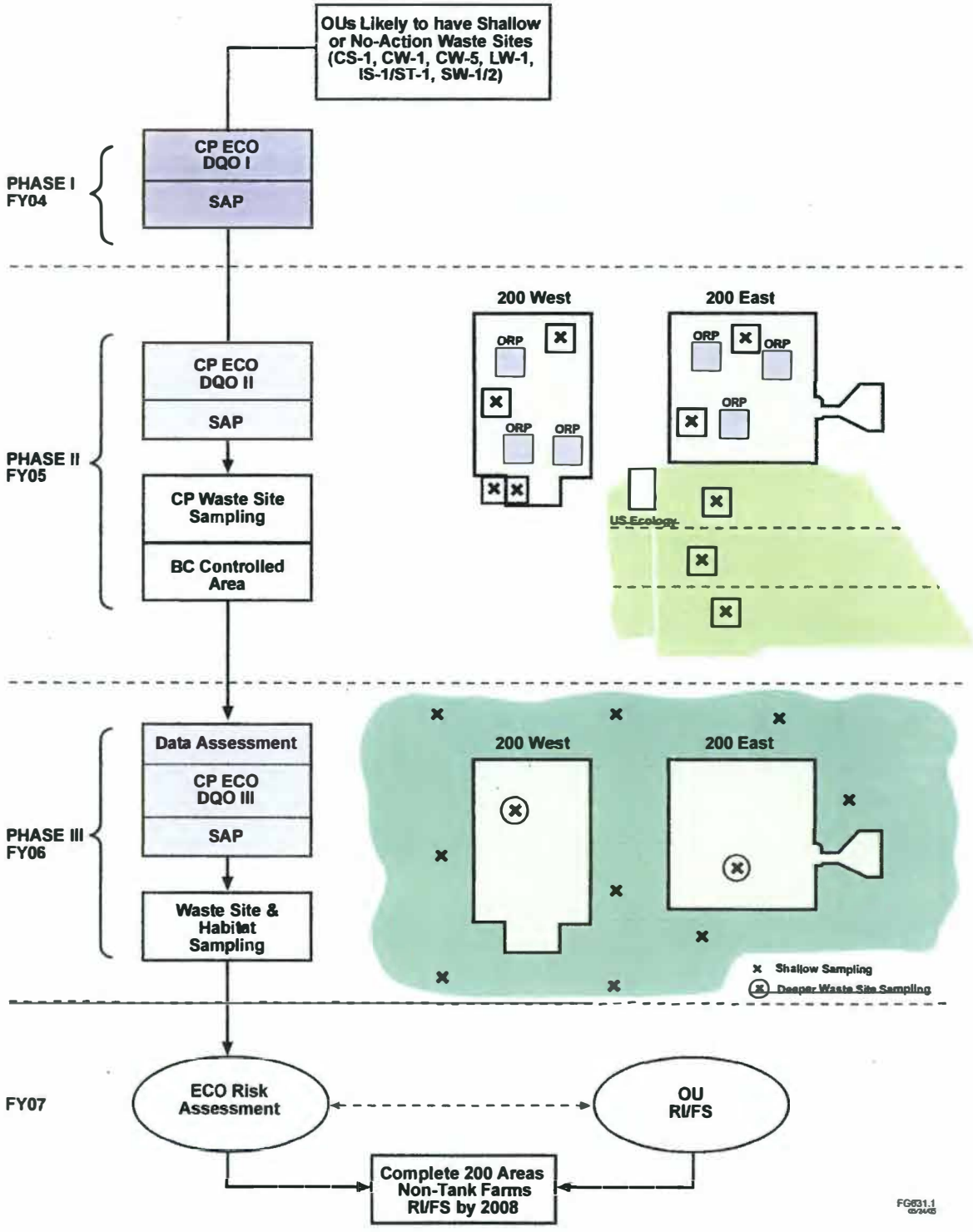

Table ES-1. Phase I Sampling Design Summary Table Linking Data to Risk Questions and Assessment Endpoints.

Data Type	Assessment Endpoint and Attribute	Measures	Population	Key Features of Design	Basis for Study Design
Reconnaissance and field verification	Herbivorous, insectivorous and omnivorous bird and mammal, insectivorous reptile, and carnivorous bird and mammal attributes based on field measures.	Basis for comparing all field-related measures in future phases of the SAP	Waste sites and reference sites	All sites will be classified according to vegetation and habitat status. Modified Daubenmire plots will be used to assess cover of dominant plants, bare ground, and cryptogams. Reconnaissance also helps to determine where and when to sample.	Field verification necessary to assess the comparability of habitat types among waste sites and reference areas
Field radiological data	Information used to guide sampling and test conceptual model of contaminant transport.	Radiological COPECs in soil and radiological COPECs in plant tissue	Waste site soils, plants, ant mounds, burrow spoil material	Used before sampling the soil	Supports testing of the conceptual model of biological transport
Surface soil sampling	Herbivorous, insectivorous and omnivorous bird and mammal, and carnivorous bird and mammal attributes of survival, growth, and reproduction.	COPECs in soil	Waste site and reference site soils	Multi-increment samples representing 0-0.5 ft (0-15 cm)	Multi-increment samples for estimate of average exposure over sampling area
Biota sampling	Insectivorous and omnivorous mammal, insectivorous reptile, and carnivorous mammal attributes of survival, growth and reproduction.	COPECs in macroinvertebrates, small mammals, and lizards	Invertebrates caught in pitfall traps, small mammals, lizards/reptiles	For invertebrates, composite of pitfall trap contents. For lizards/reptiles, individual animals, For mammals, individual animals	Samples of insects, reptiles, and small mammals provide information for comparison to literature information on toxic tissue concentrations and for contaminant loading in middle trophic levels, to be used in modeling upper trophic-level exposure
Literature reviews on COPEC concentrations or other information relevant to risk characterization	All assessment endpoints and attributes for which information can be gathered.	Compilation of existing site-specific or relevant data on COPEC concentrations or other information relevant to risk characterization	Relevant literature or unpublished but documented data sources	Consult with subject matter experts to identify relevant published or documented in-house information	Make use of existing Hanford Site or other relevant data on COPEC concentrations and other information relevant to risk characterization, which will support and aid in the interpretation of other data
Exposure modeling parameters	Herbivorous, insectivorous and omnivorous bird and mammal, and carnivorous bird and mammal attributes of survival, growth, and reproduction.	Uses data on COPECs in soil and in macro-invertebrates, small mammals, and lizards	Waste site and reference site soils and biotic tissues	Use of Hanford Site-specific uptake factors for soil to prey reduces uncertainty in use of non-site-specific literature values	Exposure modeling especially useful in assessing endpoints for which field measures would not be resource effective

Daubenmire, 1959, "A Canopy-Coverage Method of Vegetational Analysis."

COPEC = contaminant of potential ecological concern.

SAP = sampling and analysis plan.

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TERMS

AEA	alpha energy analysis
ALARA	as low as reasonably achievable
AMSCO	Allen Maintenance Supply Company, Inc.
CFR	*Code of Federal Regulations*
COPC	contaminant of potential concern
COPEC	contaminant of potential ecological concern
dpm	disintegrations per minute
DQA	data quality assessment
DQO	data quality objective
DR	decision rule
EPA	U.S. Environmental Protection Agency
ERAGS	*Ecological Risk Assessment Guidance for Superfund* (EPA/540/R-97/006)
ERSTI	Environmental Radiological Survey Task Instruction
FSP	field sampling plan
GEA	gamma energy analysis
GPC	gas proportional counter
HEIS	*Hanford Environmental Information System*
ICP	inductively coupled plasma
N/A	not applicable
PCB	polychlorinated biphenyl
PUREX	Plutonium-Uranium Extraction (Plant or process)
QAPjP	quality assurance project plan
QC	quality control
RECUPLEX	Recovery of Uranium and Plutonium by Extraction (Plant or process)
REDOX	Reduction-Oxidation (Plant or process)
RTD	remove/treat/dispose
SAF	Sampling Authorization Form
SAP	sampling and analysis plan
TAL	target analyte list
TBD	to be determined
Tri-Party Agreement	*Hanford Federal Facility Agreement and Consent Order*
URP	Uranium Recovery Process
WAC	*Washington Administrative Code*

METRIC CONVERSION CHART

Into Metric Units			Out of Metric Units		
If You Know	*Multiply By*	*To Get*	*If You Know*	*Multiply By*	*To Get*
Length			**Length**		
inches	25.4	millimeters	millimeters	0.039	inches
inches	2.54	centimeters	centimeters	0.394	inches
feet	0.305	meters	meters	3.281	feet
yards	0.914	meters	meters	1.094	yards
miles	1.609	kilometers	kilometers	0.621	miles
Area			**Area**		
sq. inches	6.452	sq. centimeters	sq. centimeters	0.155	sq. inches
sq. feet	0.093	sq. meters	sq. meters	10.76	sq. feet
sq. yards	0.836	sq. meters	sq. meters	1.196	sq. yards
sq. miles	2.6	sq. kilometers	sq. kilometers	0.4	sq. miles
acres	0.405	hectares	hectares	2.47	acres
Mass (weight)			**Mass (weight)**		
ounces	28.35	grams	grams	0.035	ounces
pounds	0.454	kilograms	kilograms	2.205	pounds
ton	0.907	metric ton	metric ton	1.102	ton
Volume			**Volume**		
teaspoons	5	milliliters	milliliters	0.033	fluid ounces
tablespoons	15	milliliters	liters	2.1	pints
fluid ounces	30	milliliters	liters	1.057	quarts
cups	0.24	liters	liters	0.264	gallons
pints	0.47	liters	cubic meters	35.315	cubic feet
quarts	0.95	liters	cubic meters	1.308	cubic yards
gallons	3.8	liters			
cubic feet	0.028	cubic meters			
cubic yards	0.765	cubic meters			
Temperature			**Temperature**		
Fahrenheit	subtract 32, then multiply by 5/9	Celsius	Celsius	multiply by 9/5, then add 32	Fahrenheit
Radioactivity			**Radioactivity**		
picocuries	37	millibecquerel	millibecquerels	0.027	picocuries

1.0 INTRODUCTION

This sampling and analysis plan (SAP) presents the rationale and strategy for the phased sampling and analysis activities that will be performed to characterize the ecological risks associated with the Central Plateau on the Hanford Site. The sampling and analysis described in this document will provide soil and biota data to support informed waste site decision-making and will provide information to evaluate the health or condition of the ecosystem across habitats. These data will supplement other characterization data for waste sites in the Central Plateau. Characterization activities described in this SAP are based on the implementation of the data quality objectives (DQO) process, as documented in WMP-20570, *Central Plateau Terrestrial Ecological Risk Assessment Data Quality Objectives Summary Report-Phase I (pending)*. This DQO used EPA/540/R-97/006, *Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments (Interim Final)*, Steps 3 and 4, as a basis for DQO Steps 1-7.

The SAP will be implemented using a phased and tiered approach to characterize ecological risks. Phases are based on study areas, whereas tiers are types of data collected within those study areas. This multifaceted approach has the advantage of cost effectively targeting data collection to those ecological receptors found to be at risk from Hanford Site processes and associated contaminants of potential ecological concern (COPEC). Phasing allows the project to sequence the field work in a step-wise fashion to initially collect less expensive and less intrusive shallow-soil data. These data are evaluated to determine if deeper soil sampling and more extensive ecological studies are warranted. A phased approach enables the project to distribute the work over three years in response to financial and schedule needs, while continually building the ecosystem conceptual model, so that the sampling design is refined with each successive sampling campaign.

As part of the Quality Assurance Project Plan (QAPjP), the activities described in this document meet the project quality assurance requirements. The Hanford Site internal laboratory quality assurance requirements implement the following governing documents:

- *Hanford Federal Facility Agreement and Consent Order* (Ecology et al. 1989) (Tri-Party Agreement) quality assurance requirements
- EPA/240/B-01/003, *EPA Requirements for Quality Assurance Project Plans for Environmental Data Operations*, March 2001 revision of EPA QA/R-5

1.1 PHASED APPROACH OVERVIEW

An overview of the phased sampling approach that shows the spatial extent of the investigation phases is shown in Figure 1-1. As indicated, Phase I activities are focused on the Central Plateau

Core Zone boundary[2]; Phase II expands consideration of spatial domains to the US Ecology site, tank farm areas in the Central Plateau, and the BC Controlled Area; while Phase III includes habitat outside the 200 East and 200 West Areas. The Phase I and II data collections will be followed by data quality assessment (DQA) in Phase III. The Phase III investigations will be dependent on the results of the DQA (see Section 2.9). The culmination of the phased DQOs/SAPs and field characterization will be the development of a final Central Plateau Ecological Risk Assessment, planned for FY07 as shown in Figure 1-1. The components of the characterization phases are described in the following text.

Phase I. Characterize exposure and ecological effects of COPECs from Central Plateau Core Zone waste sites (potentially impacted locations) and reference area (assumed unimpacted area, also referred to as "control" site), focusing on waste sites with existing soil COPEC concentration data by collecting Tier 1 soil and biota data:

- Collect surface soil samples to a depth of 6 in. (15 cm) for metals, radionuclides, and organics (polychlorinated biphenyls [PCB], pesticides) (note: 6-in. depth was selected for Phase I to evaluate the importance of near-surface contamination to biota)
- Collect radiological field data for beta and gamma-emitting radionuclides in soils (e.g., burrow spoils), ant nests, and plant material to test the conceptual site model of upward contaminant transport (the conceptual model suggests that the 0- to 6-in. soil interval is important for exposure, but deeper soil also may be important)
- Collect biological data including body analysis for metals, radionuclides, and organics (PCBs, pesticides) in small mammals, lizards, and insects (these animals are common and should have sufficient mass for analysis of all COPECs)
- Note any abnormalities for the vertebrate animals handled, in the field notes (these notes will provide qualitative information of the possible effects of COPECs on biota)
- Perform literature review of studies relevant to the Hanford Site, and collect exposure parameter data relevant to the Hanford Site terrestrial receptors and exposure pathways.

Phase II. The Phase II DQO/SAP will evaluate characterization needs for ecological effects of COPECs from the BC Controlled Area, tank farms, West Lake, and the US Ecology Site. Tier 1 soil and biota data may include:

- Collect surface soil samples to a depth of 6 in. (15 cm) for metals, radionuclides, and organics (PCBs and pesticides)

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[2] This application of the Core Zone boundary is defined in the Tri-Parties response to the HAB advice ("Consensus Advice #132: Exposure Scenarios Task Force on the 200 Area" [Klein et al. 2002]), and in the *Report of the Exposure Scenarios Task Force* (HAB 2002).

- Collect radiological field data for beta and gamma-emitting radionuclides in soils (e.g., burrow spoils), ant nests, and plants to test the conceptual site model of upward contaminant transport

- Collect biological data including body analysis for metals, radionuclides, and organics (PCBs and pesticides) in small mammals, lizards, and insects

- Note any abnormalities for the animals handled in the field notes

Phase III. Phase III begins with a DQA for Phase I and II data with the overall objective of testing the following aspects of the conceptual model and defining data needs for Phase III.

- Determine if mean concentrations of COPECs are detected in surface soil samples are greater than mean background values (DOE/RL-92-24, *Hanford Site Background: Part 1, Soil Background for Nonradioactive Analytes*; Ecology 94-115, *Natural Background Soil Metals Concentrations in Washington State*; and DOE/RL-96-12, *Hanford Site Background: Part 2, Soil Background for Radionuclides*) or mean concentrations at reference sites and also if these COPECs are those expected from process knowledge and previous site sampling. Determine if there is uptake of radionuclide in plants or biological transport through ants or burrowing mammals.

- Determine if COPECs are detected in biota samples (invertebrates, lizards, and small mammals) and if these COPECs are those expected from process knowledge and previous site sampling.

- Determine if biota and surface soil data correlate, suggesting that COPECs are present in surface soil and that the surface soil represents the primary exposure medium for ecological receptors.

- Evaluate the results of a literature review of studies relevant to the Hanford Site and the results of the collected exposure parameter data relevant to the Hanford Site to guide subsequent field data collection efforts.

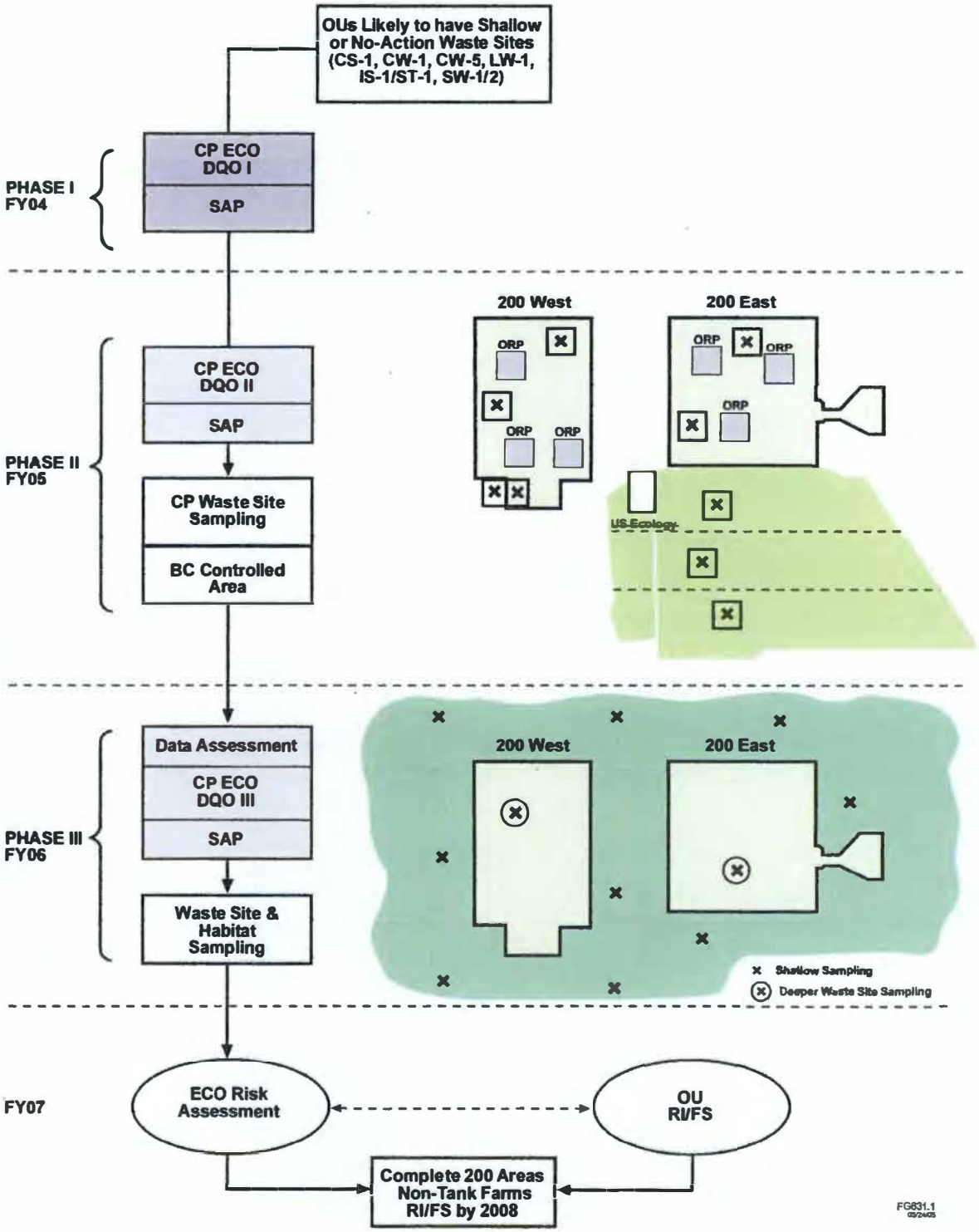
In Phase III, the DQOs may be revised based on the DQA findings, leading to the development of a Phase III SAP. The scope of this SAP is to characterize ecological effects of COPECs in Central Plateau habitat (outside of the 200 East and 200 West Areas) by collecting Tier 1 soil and biota data.

- Collect surface soil samples to a depth of 6 in. (15 cm) for metals, radionuclides, and organics (PCBs and pesticides) at selected sites.

- Collect biological data including body analysis for metals, radionuclides, and organics (PCBs and pesticides) in small mammals, birds, lizards, and insects.

- Note abnormalities for the animals handled in field notes.

Figure 1-1. Phased Central Plateau Ecological Risk Assessment Emphasizing the Spatial Extent of the Investigations.



Phase III characterization also may include the following Tier 2 data collection activities within the Core Zone, dependent on the findings of the DQA.

- Collect representative samples of soil below 6 in. (15 cm) to supplement existing waste site data, if needed, to address data gaps identified through the DQA.
- Collect plant tissue and soil grab samples along the rooting depth. These are conditional upon measuring COPEC concentrations greater than plant soil-screening values in Phase I and II soil samples.
- Collect data to evaluate population measures for mammals and lizards if the concentrations measured in biota and soil are greater than literature adverse-effect levels.
- Conduct toxicity tests, which are conditional on identifying COPECs for soil biota in Phase I and Phase II soil and biota samples.
- Evaluate the need for field verification of ground- and shrub-nesting bird measures.
- Determine if there is adequate density of ground- and shrub-nesting birds for use in evaluating measures of exposure and effect for middle trophic-level birds.
- Implement the nestbox (as an alternative) to obtain nest success and egg COPEC concentrations if field verification (Tier 2) shows that ground- and shrub-nesting birds are not at adequate density for field studies.
- Note any abnormalities for the animals handled.

Phase III also includes developing or revising DQOs for the following potential study design elements.

- Develop DQOs for Central Plateau habitat sampling. A focus of Phase III of the Central Plateau EcoDQO is to assess habitat in nonoperational areas to better understand the status and health of the Central Plateau ecosystem.
- Use the DQO process to evaluate the need for adding other reference sites.
- Develop the DQO to assess potential risks to fossorial mammals from the diffuse carbon tetrachloride plume in the 200 West Area. Carbon tetrachloride was identified as a COPEC based on data reviewed in Phase I. No sampling for carbon tetrachloride is planned for Phase I or Phase II, however, because data collection is focused on the 0- to 6-in. (0 to 15 cm) depth interval, measurement of volatile organics in this interval is meaningless because of barometric pumping and solar heating of the soil.
- Finalize the DQOs for West Lake. A DQO was developed for West Lake in the Phase I EcoDQO (WMP-20570) that will be completed based on an assessment of available and relevant West Lake studies.

A synopsis of the data collection efforts and geographic areas addressed in this SAP is presented in Table 1-1.

Table 1-1. Sampling Activities in the Three Proposed Investigation Phases, Structured by Study Area and Tier of Data Collection.

Phase	Study Area	Data Collection	
		Tier 1	Tier 2
I	Core Zone waste sites	X	-
	Reference site	X	-
II	Reference site(s)	TBD[a]	TBD
	Core Zone tank farm areas, the US Ecology site, the BC Controlled Area, and West Lake	TBD	TBD
III	Core Zone waste sites	-	If needed[b]
	Reference site(s)	-	If needed
	The US Ecology site, the BC Controlled Area, and West Lake	TBD	TBD
	Habitat surrounding 200 East and 200 West Areas (Non-waste site areas)	TBD	TBD

[a] "TBD" or to be determined based on ecological data quality objectives.
[b] "If needed" determination is based on data quality assessment results from the preceding phase.

1.2 BACKGROUND

The Hanford Site became a Federal facility in 1943 when the U.S. Government took possession of the land to produce nuclear materials for defense purposes. The Hanford Site's production mission continued until the late 1980s, when the mission changed from producing nuclear materials to cleaning up the radioactive and hazardous wastes that had been generated during the previous years.

1.3 SITE DESCRIPTION AND HISTORY

The Central Plateau consists of approximately 75 mi^2 (195 km^2) near the middle of the Hanford Site. It contains approximately 900 excess facilities formerly used in the plutonium production process. Five main processes for chemical separation and waste treatment operations were conducted on the Central Plateau at the Hanford Site.

Bismuth Phosphate Process. The bismuth phosphate process was an inorganic, step-wise precipitation process that separated plutonium from uranium and fission products.

Uranium Recovery Process, U/UO_3 Plant and Scavenging Operations, and the Plutonium-Reduction Extraction (PUREX) Process. The Uranium Recovery Process was implemented at the U Plant to recover the spent uranium from the metal waste and first-cycle waste streams generated in the T Plant and B Plant for reuse in weapons-grade plutonium production. In 1953, tests to further treat Uranium Recovery Process aqueous waste streams generated at the T, U, and B Plants during the bismuth/phosphate campaign proved successful. The "scavenging" process separated the long-lived fission products (including Sr-90 and Cs-137) from the waste solutions

by precipitation. The PUREX process was an advanced solvent extraction process that replaced the Reduction-Oxidation (REDOX) process. PUREX used a recyclable salting agent, nitric acid (which greatly lessened costs and amount of waste generated), and tributyl phosphate in a normal paraffin hydrocarbon diluent such as AMSCO (trade name of a kerosene-based solvent [Allen Maintenance Supply Company, Inc.]) or kerosene solution as a solvent, just like the Uranium Recovery Process. The main purpose of the PUREX facility (202-A Canyon Building or A Plant) was to extract, purify, and concentrate plutonium, uranium, and neptunium contained in irradiated uranium fuel rods discharged from Hanford Site reactors.

REDOX. The (REDOX) process, used until 1967, was a solvent-extraction process that extracted plutonium and uranium from dissolved fuel rods into a methyl isobutyl ketone (or hexone) solvent.

Waste Recovery/Fractionation/Waste Encapsulation and Storage Facility. From 1961 (Hot Semiworks) and 1963 to 1966 (B Plant), strontium, cerium, and rare earths were recovered using an acidic oxalate-precipitation process.

The Z Plant Complex (231-Z Plutonium Isolation Plant and 234-5Z Recovery of Uranium and Plutonium by Extraction or RECUPLEX Plant / Plutonium Finishing Plant). At the Z Plant Complex, the recovered, purified plutonium was refined to one of several forms, depending on the era and available process.

The management of wastes from these five processes resulted in six major categories of waste sites:

1. Pipelines that were used to transport liquid wastes to disposal sites. Both the pipe matrix and the surrounding soil may be contaminated

2. Liquid effluent disposal sites including subsurface disposal structures (e.g., cribs) and surface disposal ponds, used for disposal of steam condensate and cooling water. Also, open ditches were used to carry water to ponds, and concrete basins were used to route the effluent

3. Nonradioactive surface dumps and burial grounds, used to store or dispose of solid wastes and waste containers

4. Radioactive burial grounds, used to dispose of both Hanford Site and offsite wastes

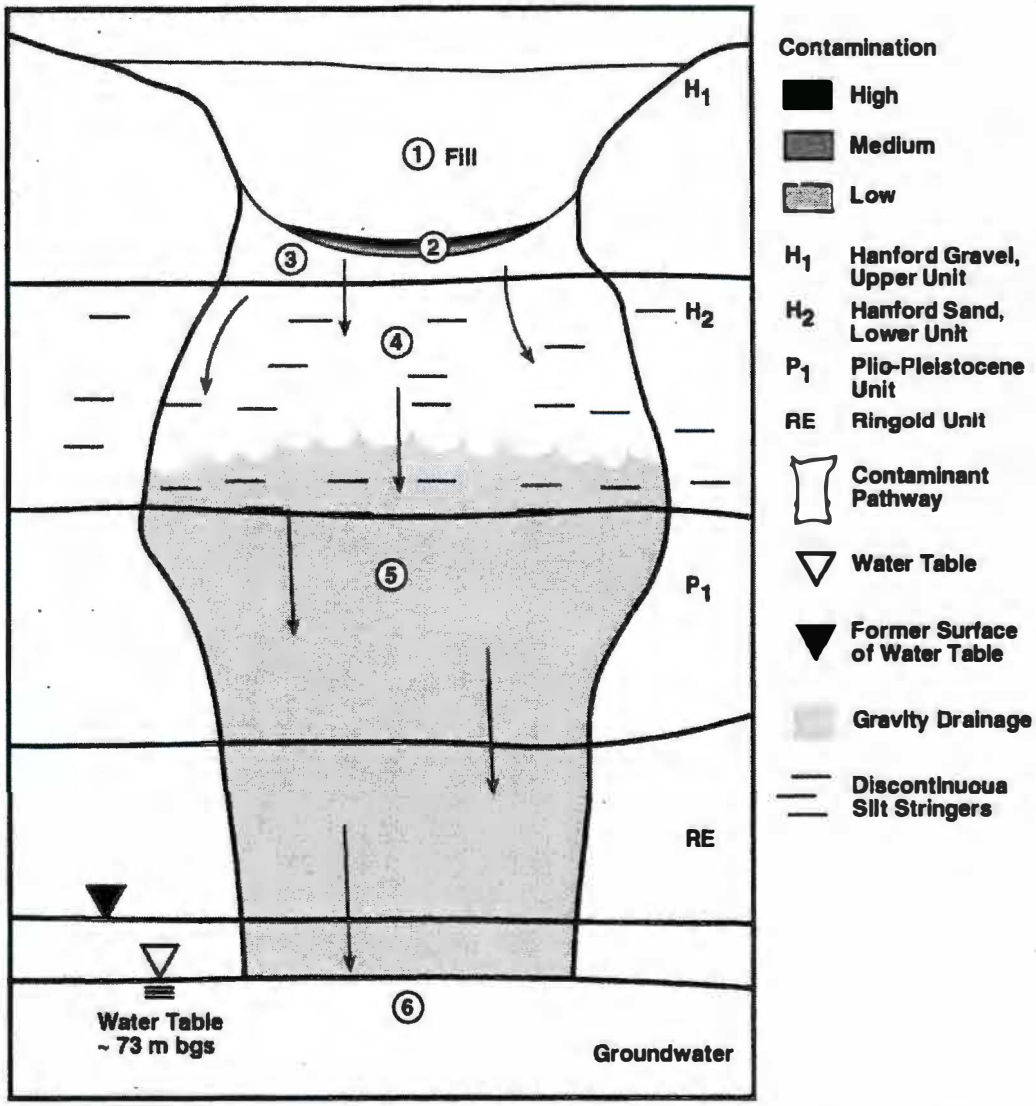
5. Unplanned releases: areas of contamination resulting from spills, leaks, and wind-blow dispersal of contamination from the previous four categories of waste disposal sites

6. The BC Controlled Area, the largest (12 mi^2) of the unplanned release sites. Animals, plants, and wind-dispersed contaminated material excavated by animals intruding into a radioactive crib.

A general understanding of the construction and operation of these categories of Central Plateau waste sites is relevant for developing conceptual models and therefore understanding the

potential for ecological risks from these sites. Pipelines and ditches were used to transport liquid waste from operational areas to the liquid effluent waste sites. Liquid effluent waste sites in the Central Plateau were primarily engineered structures including ditches, cribs, trenches, and ponds. A schematic of a typical ditch waste site is provided as Figure 1-2. A typical pond site is shown in Figure 1-3, and a schematic for a typical liquid effluent waste site is provided as Figure 1-4. Typical construction of dumps and burial grounds is provided as Figure 1-5. Originally, most of these engineered features were subsurface, and now that these sites are inactive they have been covered with clean fill. Unplanned releases represent another waste site category that typically was surface contamination, and they also have been covered. The depth of fill varies between a thin cover and more than 10 ft. Typically, the sites with the greatest concentrations have more cover. The design of the waste sites explains why concentrations of COPECs generally are low in shallow zone soils (0 to 15 ft depth interval).

Figure 1-2. Example Schematic of a Ditch Waste Site.



① Site has been backfilled/stabilized with approximately 2 m of clean soil. Upward migration of contaminants has been noted in the clean fill on the Hanford site.

② Some particulates in the effluent (e.g., Pu-239/240, Am-241) settled out in the bottom of ditch. Most of the dissolved contaminants in solution sorbed to sediments within 2 m of the ditch bottom; concentrations decrease rapidly with depth.

③ Contaminant concentrations are very low compared to the bottom of the ditch.

④ Lateral spreading within the lower unit of the Hanford formation and at the top of the Plio-Pleistocene unit.

⑤ High moisture zone. Moisture flux in this zone is decreasing over time. Wetting front moves vertically down into Ringold Unit E with gravity drainage. Residual concentrations of the more mobile contaminants may remain in the vadose zone after gravity drainage.

⑥ No contaminants have been attributed to the groundwater from the ditch.

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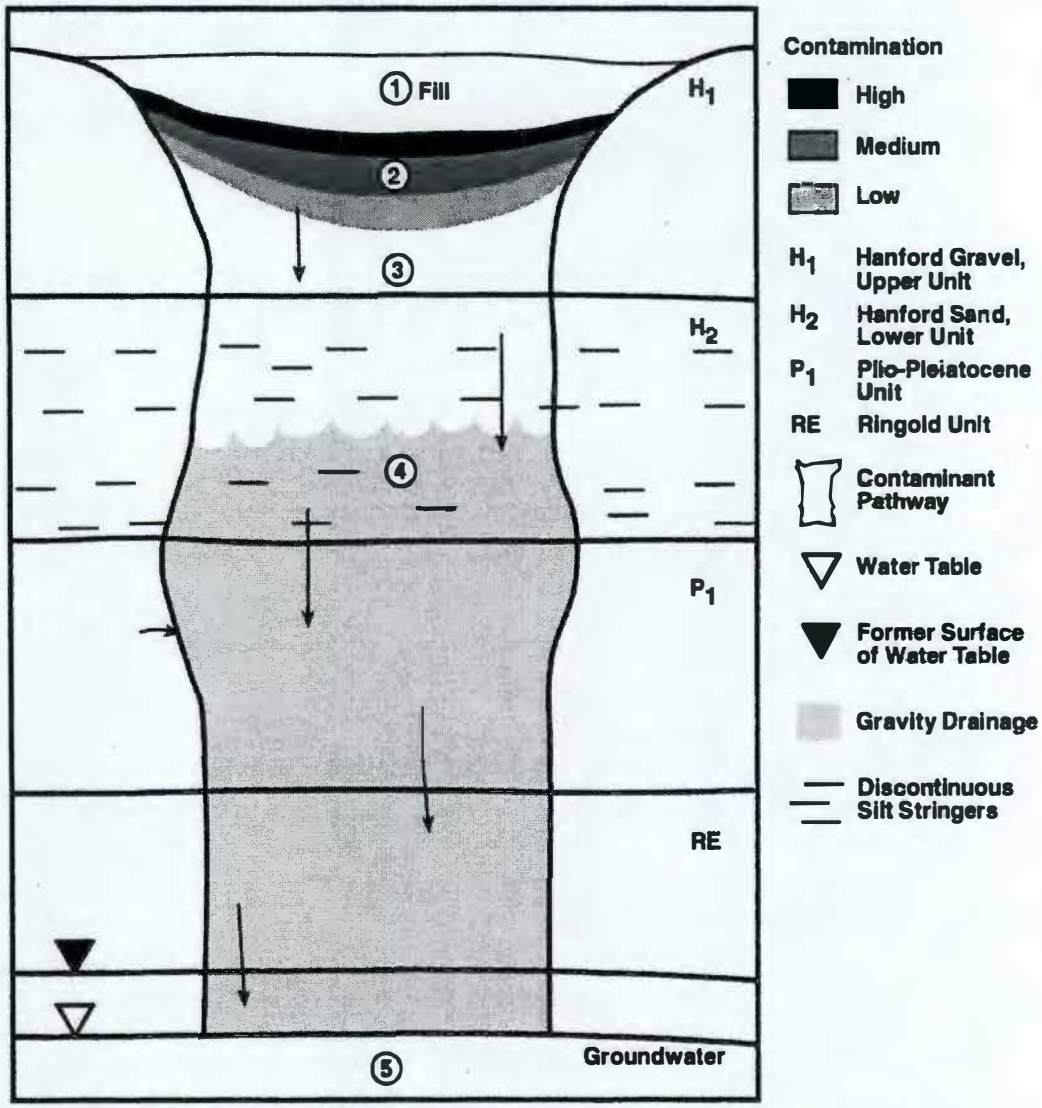
Figure 1-3. Example Schematic of a Pond Waste Site.



① Site has been backfilled/stabilized with clean soil. Upward migration of contaminants has been noted in the clean fill on the Hanford site.

② Some particulates in solution (e.g.,Cs-137, Pu-239/240, uranium, Sr-90, metals, and PCB'a) settled out in the bottom of the pond and sorbed to sediments. The highest concentrations are within 2 m of the pond bottom and decrease rapidly with depth. Some uranium complexed with carbonates in the soil and moved with the wetting front.

③ Contaminant concentrations are very low compared to the bottom of the pond. Uranium and Sr-90 may be detected in this zone.

④ High moisture zone. Lateral spreading within the lower unit of the Hanford formation and at the top of the Plio-Pleistocene unit. Moisture flux in this zone is decreasing over time. Wetting front moves vertically down into Ringold Unit E with gravity drainage. Residual contamination may remain in vadose zone after gravity drainage.

⑤ High volumes of liquid exceeded soil pore volumes and clastic dikes may have been mechanisms to allow low levels of contaminants to reach groundwater. Evidence suggests that uranium has impacted the groundwater.

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Figure 1-4. Example Schematic of a Liquid Disposal Waste Site Construction.

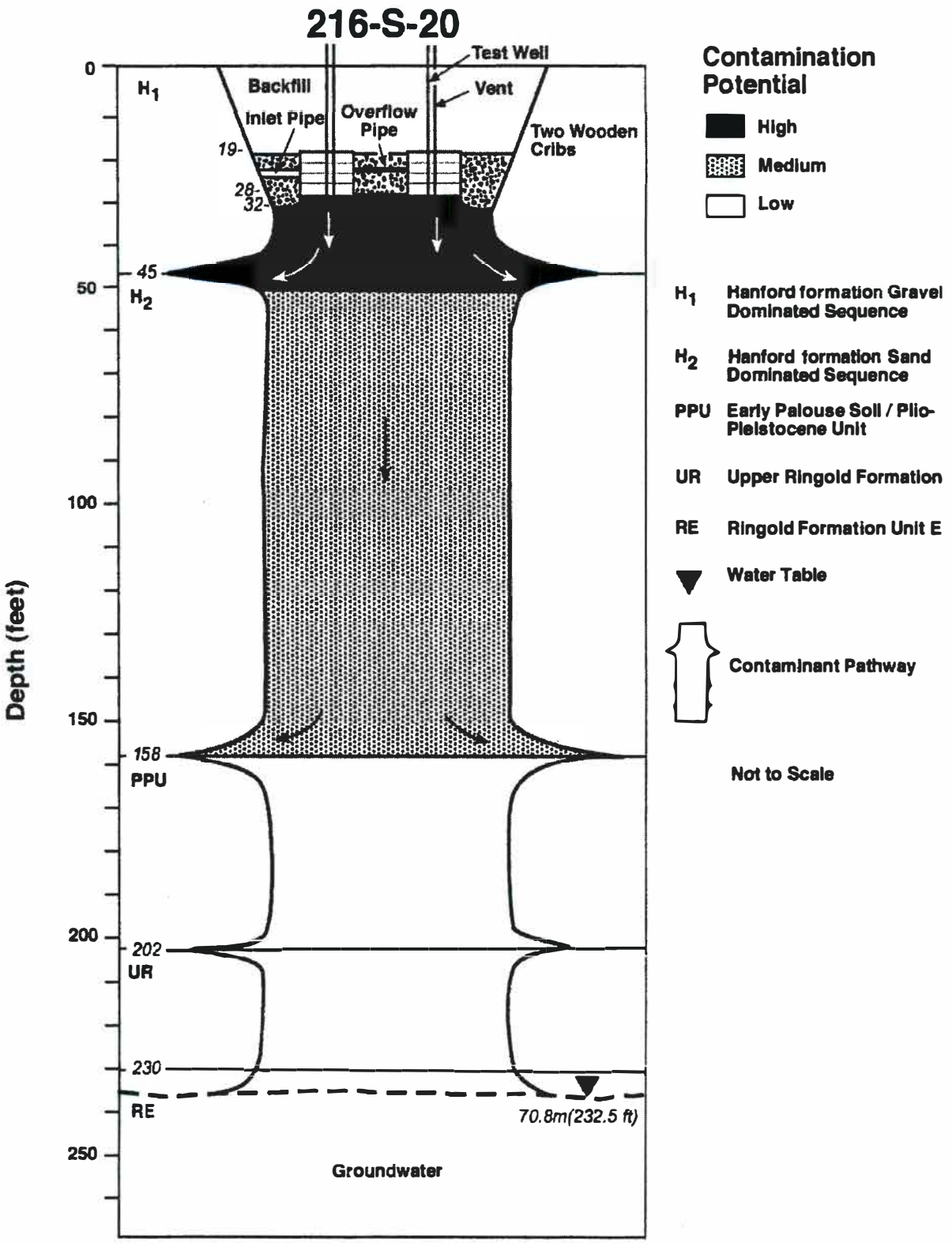
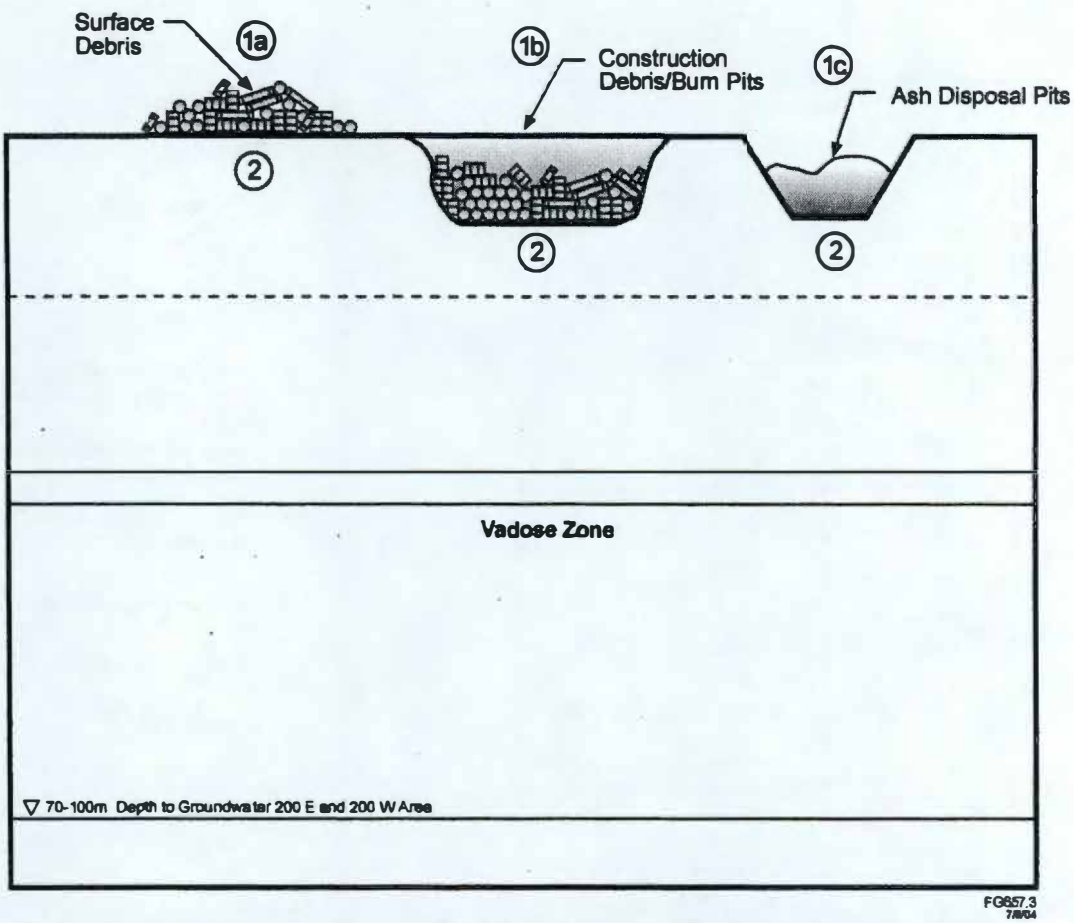


Figure 1-5. Example Schematic of a Burial Ground Waste Site.



① Burial ground waste sites are primarily shallow (<4.6 m deep), of limited area, and contain waste that was either uncontaminated or contained contaminants that have volatilized or decayed to innocuous levels. The sites include:

a. Surface debris sites that may include building rubble, asbestos, equipment and miscellaneous trash
b. Shallow excavations filled with debris similar to above and/or used for burning combustibles.
c. Shallow pits excavated for disposal of fly ash

② Potential contaminants may include hazardous chemicals and/or radionuclides. Contaminants are anticipated to be present at or near ground surface (<1 m below bottom of waste site).

③ Groundwater is not impacted by disposal practices

1.4 CONTAMINANTS OF POTENTIAL ECOLOGICAL CONCERN

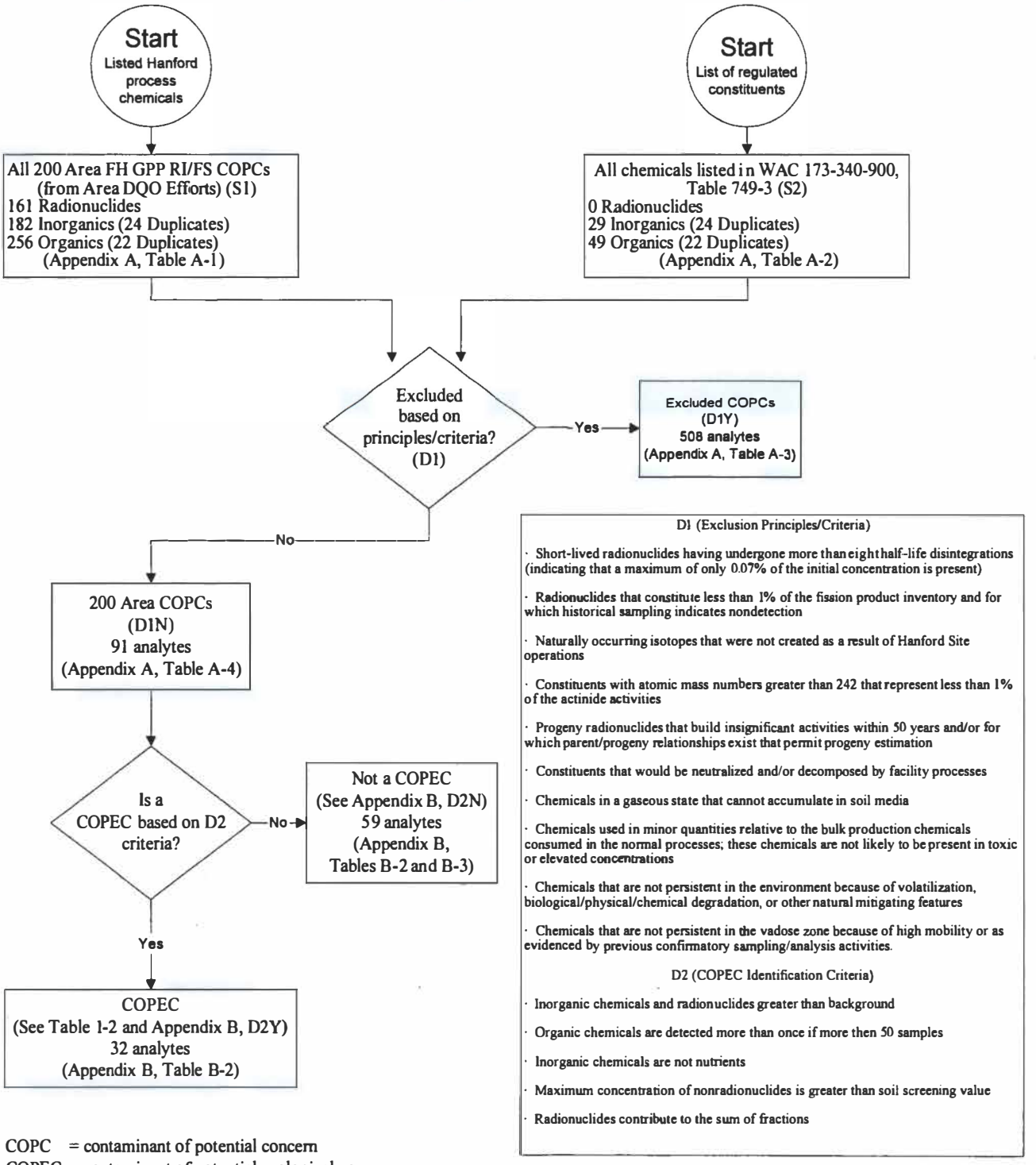
The COPECs were refined using ecological risk assessment guidance for superfund (ERAGS) Step 3 (EPA/540/R-97/006). COPEC refinement is an essential step toward refining the conceptual site model. Development of the COPEC list is described in WMP-20570, and this process is summarized below. Two major decision points were used to identify COPECs and this process is illustrated by Figure 1-6. The first decision point involved reviewing process knowledge and the list of regulated constituents. From an initial list of 599 contaminants that potentially could have been discharged to waste sites, 91 contaminants of potential concern (COPC) were identified (see Appendix A).

As shown in the second decision point in Figure 1-6, an analyte is a COPEC if it is greater than background (or detected more than once for organic chemicals) and greater than the soil screening value (radionuclides must contribute to the sum of fractions to be a COPEC). For the purposes of identifying COPECs for further investigation, the maximum detected concentration is compared to soil-screening values. The methods and criteria in WAC 173-340-7490, "Terrestrial Ecological Evaluation Procedures," are pertinent to the risk assessment in that they provide useful evaluation systems and numerical values. The screening values not provided in WAC 173-340-900, "Tables," Table 749-3, were calculated using *Washington Administrative Code* (WAC) methodology (WAC 173 340 900, Table 749-4) as described in WMP-20570. Radionuclide-specific screening concentrations (e.g., picocuries per gram) for a defined exposure scenario are based on DOE/EH-0676, *RESRAD-BIOTA: A Tool for Implementing A Graded Approach to Biota Dose Evaluation*, and DOE-STD-1153-2002, *A Graded Approach For Evaluating Radiation Doses To Aquatic And Terrestrial Biota.* This methodology is used because it is pertinent to the risk assessment by providing useful evaluation systems and numerical values.

The results of the COPEC screen are provided in Appendix B, and the list of COPECs is provided in Table 1-2. Chlorinated pesticides did not meet the criteria to be identified as COPECs, but they were identified as additional analytes, because they can be analyzed for little additional cost using EPA Method 8082/8081A for PCBs (SW-846, *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, as amended*, (Table 1-2).

Carbon tetrachloride is included as a COPEC in Table 1-2; no sampling for carbon tetrachloride is planned for Phase I, because Phase I sampling is focused on the 0- to 6-in. depth interval. Measurement of volatile organics in this interval is meaningless because of barometric pumping and solar heating of the soil. Therefore, soil samples from the 0- to 6-in. depth will not be analyzed for carbon tetrachloride. However, carbon tetrachloride will be evaluated in Phase III.

Figure 1-6. Contaminant of Potential Concern/Contaminant of Potential Ecological Concern Identification Process.



COPC = contaminant of potential concern
COPEC = contaminant of potential ecological concern
DQO = data quality objective
FH = Fluor Hanford, Inc.
GPP = Groundwater Protection Program
RI/FS = remedial investigation/feasibility study

Table 1-2. Contaminants of Potential Ecological Concern and Additional Analytes for the Central Plateau.

Radioactive Constituents		
Americium-241	Plutonium-239/240	Strontium-90
Cesium-137	Radium-226	Uranium-238
Cobalt-60	Radium-228	
Chemical Constituents – Metals		
Antimony	Hexavalent chromium	Selenium
Arsenic	Copper	Silver
Barium	Cyanide	Thallium
Bismuth	Lead	Tin
Boron	Mercury	Uranium
Cadmium	Molybdenum	Vanadium
Chromium	Nickel	Zinc
Chemical Constituents - Organics		
Aroclor-1254[a]	Aroclor-1260	Carbon tetrachloride
Pesticides[b]		

[a] Aroclor is an expired trademark.

[b] Pesticides are included in the study design as additional analytes, because they can be analyzed by EPA Method 8082/8081A (SW-846, *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, as amended,* for little additional cost.

If an analyte that was not identified as a COPEC is detected during laboratory analysis, the data will be evaluated against acute and chronic regulatory standards, or risk-based levels if exposure data are available, and existing process knowledge in support of remedial action and waste designation decision making.

1.5 WASTE SITE SELECTION PROCESS

The Central Plateau waste sites are located in southeastern Washington State on the Hanford Site. A process was used to select sites for ecological sampling; this process is documented in WMP-20570, Appendix B. To summarize, waste site selection started with a master list of sites that included all of the Central Plateau waste sites listed in the Tri-Party Agreement, Appendix C, as amended to September 1, 2003. A query of a Hanford Site database (e.g., *Waste Information Data System*) was used for waste site selection. Waste sites classified or reclassified as rejected, proposed rejected, consolidated rejected, or closed out are excluded from the sites considered for ecological sampling. If the Tri-Parties (U.S. Department of Energy, Washington State Department of Ecology, and the EPA) determine that a proposed rejected site should not be rejected, then it can be considered for ecological characterization in Phases II or III. Waste sites also were excluded if the contamination is not accessible to ecological receptors, based on

contamination being deeper than 15 ft[3] (4.6 m) below the ground surface (bgs) or on the fact that the potential contaminant pathways to ecological receptors has been broken by man-made structural features. Waste sites then were grouped into categories for which remedial actions are presumed, based on human health risk drivers, because these categories generally correlate to waste site contaminant levels. Categories included high, moderate, and low radiological/chemical concentration grouping categories and the presumed no-action groupings. In addition, ecological risk is more likely to be a decision driver for sites in the presumed no-action or low-contaminant categories.

Because the data identified in this plan supplements other characterization efforts and will be used for many waste sites in the Central Plateau, a representative site approach was implemented. Within each of these categories, worst-case representative waste sites were selected based on the following:

- Sites with large inventories or volumes of waste
- Sites that received waste from the most contaminated or highly concentrated waste streams for each operation and each grouping
- Sites with potential ecological receptors
- Sites with a minimum of surface stabilization
- Sites that had accurate coordinates and could be located in the field
- Sites with data or where data will be collected that potentially could be applicable to this ecological risk assessment activity.

This process identified 89 candidate waste sites (Figure 1-7). These sites were evaluated by experts knowledgeable about the Central Plateau ecosystem. Selected sites included those with greater potential for complete exposure pathways to ecological receptors were identified (Mitchell and Roos, 2004a, *Ecological Evaluations of Selected Central Plateau Waste Sites*). Because of the potential importance of ecological risk for the presumed no-action sites, these sites were the subject of an additional scoping evaluation that led to identifying some candidate waste sites in this category (Mitchell and Roos, 2004b, *Ecological Evaluations of Selected Central Plateau Waste Sites - Addendum*). Other candidate sites were recommended by the Tri-Parties or by public workshop participants. These sites were considered, and included, if contaminants were present and ecological pathways were likely to be complete. Soil contaminant data associated with the candidate waste sites also were reviewed, and association of the waste sites with key processes was reviewed to select the list of waste sites considered for investigation in this Phase I SAP (Table 1-3). Chapter 3.0 provides the list of sites selected for investigation based on current site conditions. Figure 1-8 shows the locations of the Central Plateau waste sites considered for Phase I characterization.

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[3] WAC 173-340-7490 [4] defines the soil cleanup depth (the standard point of compliance) as extending from the ground surface to 15 ft bgs, "Terrestrial Ecological Evaluation Procedures," "Point of Compliance").

Figure 1-7. Waste Site Selection Process.

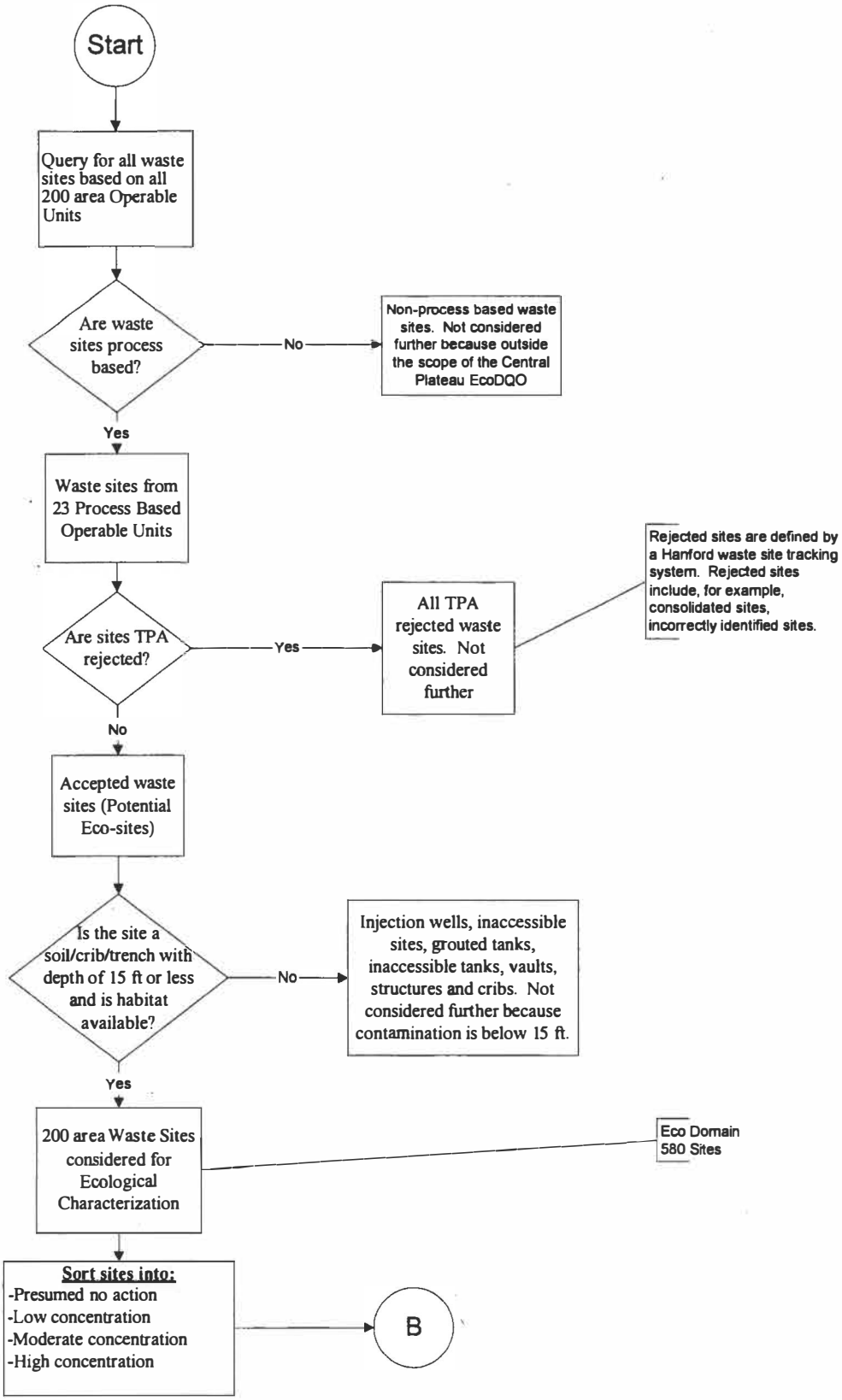
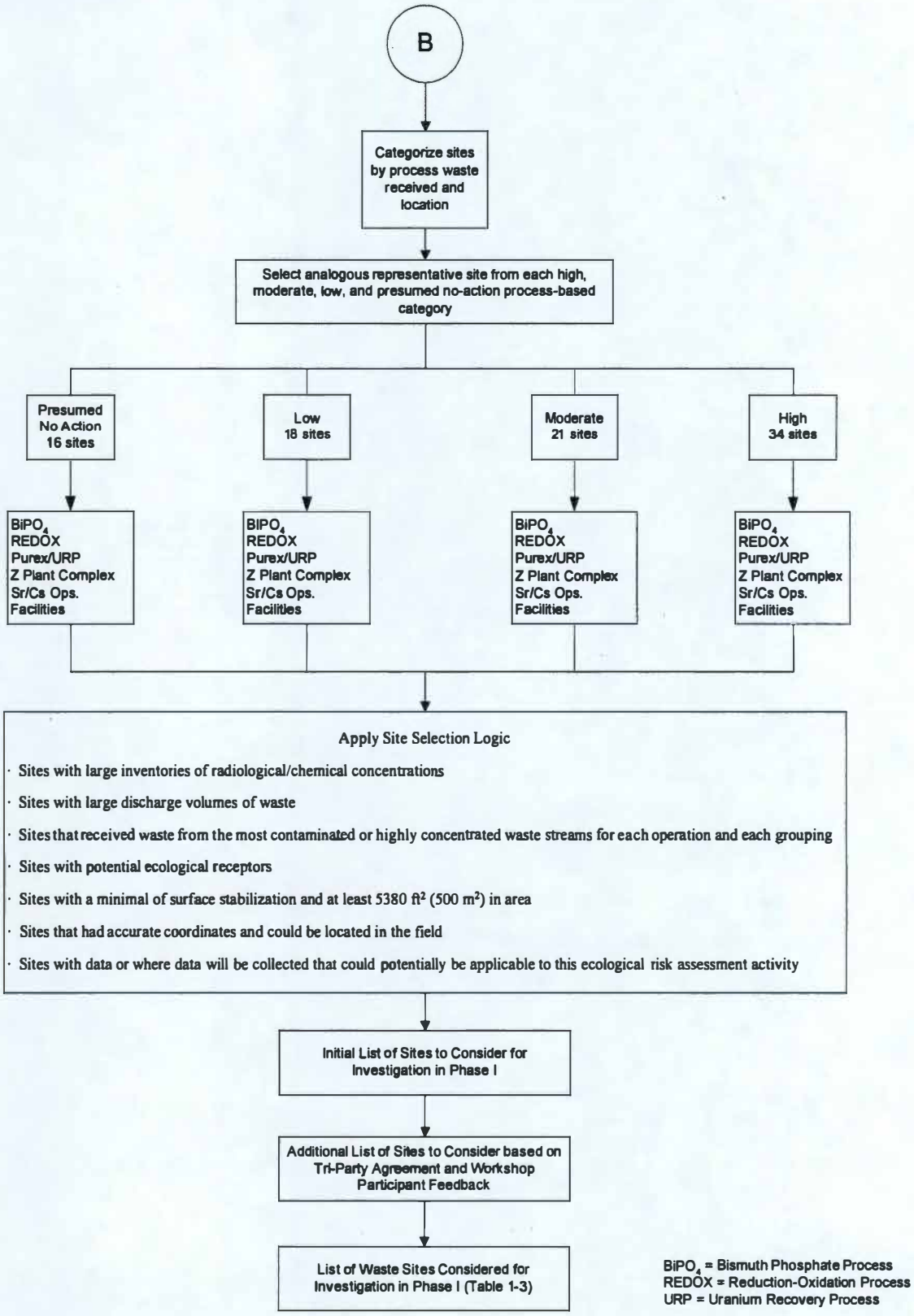


Figure 1-7. Waste Site Selection Process (cont).



Gable Mountain Pond has been sampled for various biota. These existing Gable Mountain Pond data will be assessed with the other data collected in this Phase I SAP. Thus, there are nine remaining waste sites considered for Phase I sampling (Table 1-3).

The investigation of candidate reference sites for the Phase I sampling included those waste sites that have been impacted, disturbed, and revegetated with wheatgrass. The reference site should be ecologically similar to the contaminated sites except for the COPEC concentrations. The reference site COPEC concentrations should reflect Hanford Site background levels. Because airborne deposition of COPECs is possible, it is advantageous to locate the reference site upstream of the prevailing (northwest) winds and existing waste management facilities. Other factors to consider in selecting reference sites include dominant plant species and cover, soil type and texture, burn history and elevation. The reference site should provide a good overall match to these characteristics while meeting the primary requirement of COPEC concentrations at background levels.

Two candidate locations were evaluated for use that previously had been revegetated with crested wheatgrass. One site met the vegetation, cover, and soil requirements and was upwind of most of the Central Plateau waste management sites. However, it was not selected because of its proximity to the T Plant. A second candidate site is a revegetated site located west-northwest of the 218-W-5 Burial Ground. Because it meets the vegetation, cover, and soil requirements and is located upwind of all other Central Plateau waste management sites, it was selected as the reference site for the Phase I field characterization.

1.6 DATA QUALITY OBJECTIVES

The Central Plateau terrestrial ecological DQO (WMP-20570) builds on the screening assessment (DOE/RL-2001-54, *Central Plateau Ecological Evaluation*) and is focused on ERAGS Steps 3 and 4 (EPA/540/R-97/006). In Step 3, problem formulation establishes the goals, scope, and focus of the baseline ecological risk assessment, and it also establishes the conceptual model and specific ecological values to be protected for the Central Plateau. Step 4 establishes the measures used to complete the conceptual model initiated in Step 3 and structures the assessment in the remedial investigation. Steps 3 and 4, respectively, provide the foundation of the ecological risk assessment and the ecological risk assessment's study design; in effect, Steps 3 and 4 are the DQO process for the baseline ecological risk assessment.

As part of the DQO process, the SAP is the basis for establishing the quantity and quality of data needed to support ecological risk management decisions. EPA/600/R-96/055, *Guidance for the Data Quality Objectives Process*, EPA QA/G-4, was used to support the development of this SAP. The DQO process is a strategic planning approach that provides a systematic process for defining the criteria that a data collection design should satisfy. Using the DQO process ensures that the type, quantity, and quality of environmental data used in decision making will be appropriate for the intended application.

This section summarizes the key outputs resulting from ERAGS, which was used to implement the seven-step DQO process. Additional details are provided in WMP-20570.

Table 1-3. List of Waste Sites Considered for Investigation in Phase I.

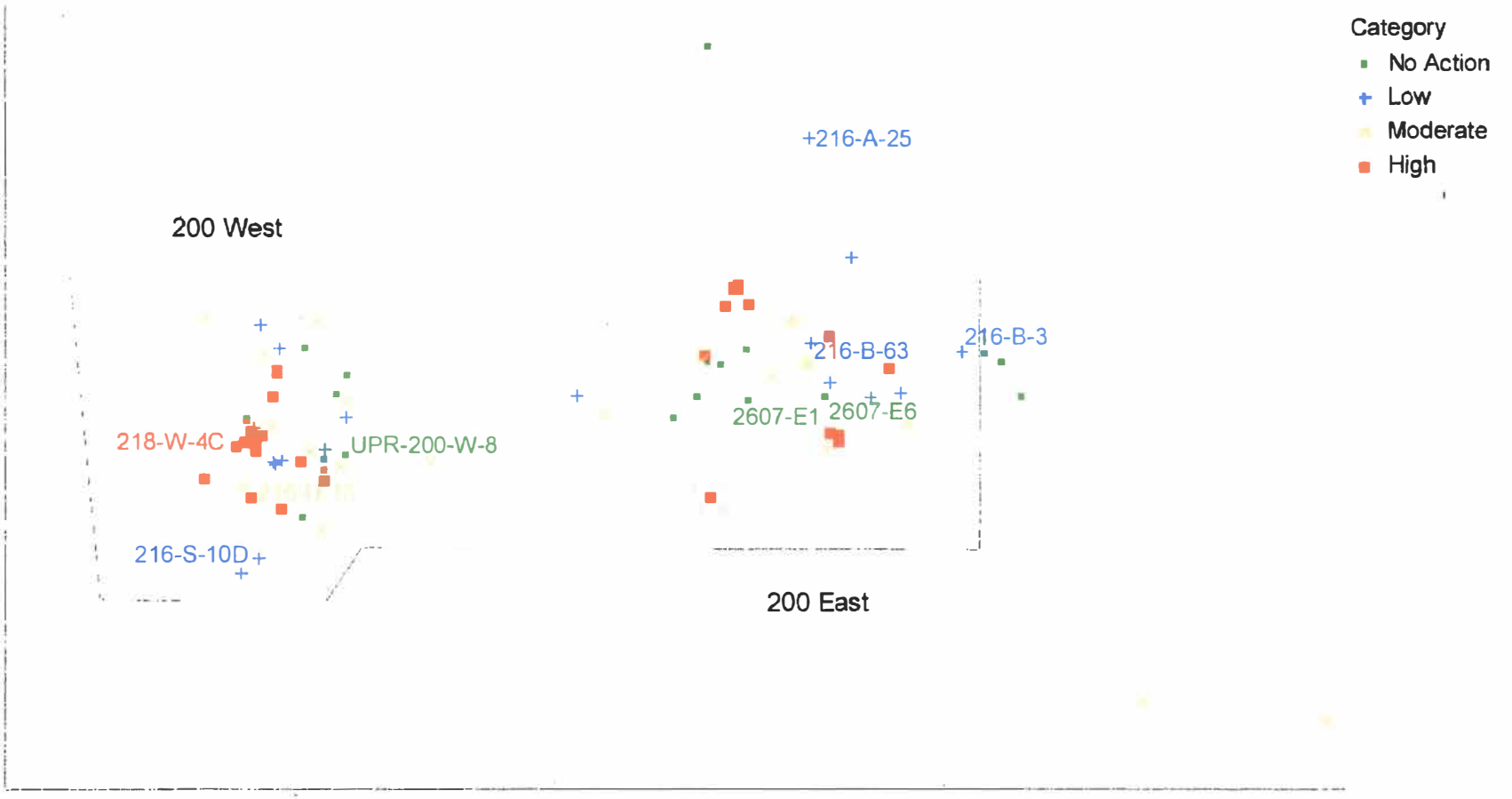
Remedial Action Category[a]	Names	Type	Process/ Operations	Operable Unit	Site Code	Site Area (ft^2)	Site Stabilization Depth	Remediation Type
Presumed No-Action	200-W-5, Burial ground/burn pit U Plant burn pit, UPR-200-W-8	Burn pit	U Plant	200-SW-2	UPR-200-W-8	42,500 ft^2 (3,900 m^2)	10 ft (3 m)	Presumed No-Action
Presumed No-Action	2607-El	Septic tank (active 1970-1997)	Not available from Hanford Site databases	200-ST-1	2607-El	Not available from Hanford Site databases	Not available from Hanford Site databases	Presumed No-Action
Presumed No-Action	2607-E6	Septic tank (active 1953-1997)	Not available from Hanford Site databases	200-ST-1	2607-E6	Not available from Hanford Site databases	Not available from Hanford Site databases	Presumed No-Action
Low	216-A-25, Gable Mountain Swamp, 216-A-25 Swamp, Gable Mountain Pond	Pond (active 1958-1987)	PUREX/ URP	200-CW-1	216-A-25	3,732,900 (347,160 m^2)	3-9 ft (0.9-2.7 m)	RTD
Low	216-B-3, B Pond, B-3 Pond, 216-B-3 Main Pond, B Swamp, 216-B-3 Swamp, B Plant Swamp	Pond (active: 1945-1994)	PUREX/ URP	200-CW-1	216-B-3	174,0581 (161,874 m^2)	2-7 ft (edges to center) (0.6 – 2.1 m)	RTD
Low	216-S-10D, 216-S-10D Ditch, 202 Chemical Sump #1 and Ditch, Chemical Sewer Trench, Open Ditch to the Chemical Sewer Trench, 216-S-10 Ditch	Ditch (active: 1951-1991)	REDOX	200-CS-1	216-S-10D connected to the 216-S-10P Pond	13,495 (1,255 m^2)	6-10 ft/ 0 ft (1.8 – 3 m)	RTD
Low	216-B-63, B Plant Chemical Sewer, 216-B-63 Trench, 216-B-63 Ditch	Ditch (active 1970- 1992)	Sr/Cs	200-CS-1	216-B-63	5,591 (520 m^2)	9-12 ft (2.7 – 3.7 m)	Barrier (Cap)
Moderate	216-U-10, U Swamp, 216-U-1, 216-U-10 Pond, 231 Swamp	Pond (active: 1944-1985)	PUREX/ URP	200-CW-5	216-U-10	1,305,441 (121,406 m^2)	2-7 ft (0.6-2.1 m)	Barrier (Cap)
High	Dry Waste No. 004C	Burial Ground (1978-present)	Multiple 100 and 200 Area and offsite processes	200-SW-2	218-W-4C	2,500,000 (232,000 m^2)	Active TSD has not been stabilized	Barrier (Cap)

[a]Presumed remediation category based on human health risk, and presumed no-action sites will be reviewed and if appropriate selected for characterization.

PUREX = Plutonium-Uranium Extraction (Plant or process). RTD = remove/treat/dispose. URP = Uranium Recovery Process.

REDOX = Reduction-Oxidation (Plant or process). TSD = treatment, storage, and disposal (unit).

Figure 1-8. Locations of Phase I Candidate Waste Sites (numbered sites are listed in Table 1-3).



1.6.1 Statement of the Problem

The purpose of the DQO document (WMP-20570) was to define the scope and data needs to support a baseline ecological risk assessment of waste sites in the Central Plateau. This SAP describes the general approach and data to be collected in Phase I of the phased and tiered approach to characterize ecological risks.

1.6.2 Risk Characterization Questions

A full complement of risk questions was developed in the DQO document (WMP-20570) for all the possible measures considered in this phased and tiered approach to characterize ecological risks. The following risk questions are relevant to the data being collected in Phase I.

- For nonradionuclide COPECs: Are mean concentrations in soil greater than mean concentrations in the reference site soils (or background mean concentrations) and, if so, are they greater than soil-screening values or literature no-adverse-effect levels or toxicity reference values for the receptor, based on effects of each individual COPEC or combined effects of COPECs where appropriate? Note that the toxicity values used for comparison are typically bounding cases such as no observed adverse effect levels.

- For radionuclide COPECs: Is the contribution to the sum of fractions based on mean concentrations greater than 1 and also greater than the sum of fractions based on mean concentrations for the reference site, or greater than the sum of fractions based on background mean concentrations?

- Do mean COPEC concentrations in the receptor increase compared to mean COPEC concentrations in the reference site receptors or along a gradient with increasing COPEC concentrations greater than published levels associated with toxicity?

- Do mean COPEC concentrations in the receptor diet increase from those of the reference site or along a gradient with increasing COPEC concentrations greater than toxicity reference value?

The investigation area of 1 hectare was selected as an appropriate scale over which to evaluate the measures considered in this plan. The detailed rationale was provided in WMP-20570, but the home range (most typically representing the foraging area) and the median dispersal distance were evaluated to identify 1 hectare as an appropriate spatial scale to evaluate ecological risk, particularly for middle trophic-level receptors. The mean over this 1 hectare investigation area was the best estimate of the representative COPEC concentration in soil and the concentration of COPECs in biota.

These questions will be evaluated using various exploratory data analysis tools, including box plots that are used to compare concentrations between data groups and scatter plots that are used to visually evaluate data for trends. These graphical tools will be supported by statistical tests, as appropriate, and will be based on the underlying distributions of the data (e.g., normal or

lognormal). Probability plots and histograms coupled with statistical tests can help to determine the underlying statistical distribution of the data.

1.6.3 Limits of Decision Error

A fundamental aspect of this assessment, and of ecological risk assessments in general (Fairbrother 2003), is to find evidence of exposure and effects. Multiple lines of evidence are being evaluated using a weight- (or strength-) of-evidence approach (Menzie et al. 1996) and this is particularly true for the middle trophic-level birds and mammals; e.g., one set of lines of evidence involve tissue COPEC concentrations for three different middle trophic level taxa (invertebrates, lizards and small mammals) for dozens of COPECs at all investigation and reference areas. The middle trophic-level species are the focus of this assessment because they have the potential to bioaccumulate contaminants, and their spatial scales (e.g., home range) match the scale of investigation areas better than the higher trophic-level species.

It is important to note that evaluation of uncertainty in ecological risk assessments requires more than simply calculating confidence limits on means used in exposure concentrations. Given the complexity of interpreting ecological data, professional judgment was used to structure the study design for this ecological risk assessment. A judgmental design is based on the reliability of the experts who are knowledgeable about the Central Plateau ecosystem. While limits on decision errors will be qualitative, some aspects of the study design will benefit from randomization (e.g., selection of some sample locations, randomization of test organisms to treatments). The design also will use data generated to make more quantitative assessments of the sample coverage needed to characterize the 0- to 6-in. surface soil interval. Subsequent phases may be more amenable to statistical sampling design options as relevant data on which to develop a quantitative design are available.

1.6.4 Study Design Summary

A synopsis of the proposed study design is provided in Table 1-4 and shows how the various data types relate to assessment endpoints, the population, the key features of the study design, and the basis for the design element. For example, field verification and reconnaissance are performed to assess vegetation and habitat on waste sites and reference sites for applicability of the sites and future comparability of the proposed wildlife field measures. All aspects of the study design are subject to field verification, which may require selecting alternate measures for an assessment endpoint or other modifications to the study design (e.g., plot size, trapping density). The complete study design is in WMP-20570.

An important component of the study design is field reconnaissance and verification. This activity will support all of the field measures proposed in the study design and will provide a basis for documenting inclusion/exclusion of waste sites selected as ecological study plots and appropriate reference sites. Radiological field data also will be acquired and used to assist with investigation area location selection and to test the conceptual model of upward contaminant mobility driven by biological uptake and transport. Also, a literature review of information related to the Hanford Site will be used to augment the results of data collection activities in the assessment. For example, toxicity reference values for upper trophic-level mammals and birds

will be obtained from literature for representative carnivorous mammals and birds of the Central Plateau. These toxicity reference values will be used in exposure modeling along with site-specific estimates of contaminant levels in the prey of Central Plateau upper trophic levels. The literature also will be searched for additional information on the home range and dispersal distance of representative ecological receptors.

The design uses multi-increment soil samples to characterize concentrations of COPECs in surface soil. This methodology emphasizes obtaining a representative sample of the particle size fraction of interest. In this case, 2 mm was selected because this is the typical definition of soil-sized particles. Another specification for the multi-increment sampling design is the fundamental error term. A value of 10% was selected, which corresponds to a standard error of 10% on the mean concentration. This value was selected such that the fundamental error would be low relative to other sources of error (i.e. analytical measurement error is typically 30%).

The number of biota samples is based on the availability of these organisms for sampling, and the minimum number of animals or replicates needed for making statistical inferences. Six lizards or mammals are targeted because it is believed this is a reasonable number to collect from a 1 hectare investigation area while providing enough information to construct a box plot. Six values also provide some statistical power for detecting differences between sites. Three replicate invertebrate measurements per investigation area provide the minimum number to determine differences in concentrations between investigation areas. The number of biota samples is sufficient for calculating the mean and standard deviation. For evaluating bioaccumulation, these tissue concentration data can be used to develop bioaccumulation models based on the soil concentrations measured in the 11 Phase I and II investigation areas.

Phasing also allows for testing aspects of the conceptual model that were used to develop the overall design. One key aspect of the conceptual model is the list of COPECs, which are based on existing sample data and process knowledge. COPECs were identified based on their potential for impact on ecological receptors. Inorganic COPECs were screened based on soil-screening values in WAC 173-340-900, as augmented with literature toxicity data.

Nutrients were evaluated on an *ad hoc* basis because of a lack of sufficient information otherwise. Radionuclide toxicity data are expressed as dose limits (0.1 rad/day), which were translated to radionuclide-specific concentrations (picocuries per gram) using DOE/EH-0676 and DOE-STD-1153-2002. Radionuclide analytes were identified as COPECs if they significantly contributed to the sum of fractions. Organic chemicals were identified as COPECs if they were detected more than once (out of at least 50 samples or more inclusive than the more typically employed minimum 5 percent detection frequency) and the maximum concentrations were greater than their soil-screening value. Organochlorine pesticides will be analyzed as additional analytes at little additional cost from the same extract as used for PCB analysis.

Table 1-4. Phase I Sampling Design Summary Table Linking Data to Risk Questions and Assessment Endpoints. (2 Pages)

Data Type	Assessment Endpoint and Attribute	Measures	Population	Key Features of Design	Basis for Study Design
Reconnaissance and field verification	Herbivorous, insectivorous and omnivorous bird and mammal, insectivorous reptile, and carnivorous bird and mammal attributes based on field measures.	Basis for comparing all field-related measures in future phases of the SAP	Waste sites and reference sites	All sites will be classified according to vegetation and habitat status. Modified Daubenmire plots will be used to assess cover of dominant plants, bare ground, and cryptogams. Reconnaissance also helps to determine where and when to sample.	Field verification necessary to assess the comparability of habitat types among waste sites and reference areas
Radiological field data	Information used to guide sampling and test conceptual model of contaminant transport.	Rad COPECs in soil and rad COPECs in plant tissue	Waste site soils, plants, ant mounds, burrow spoil material	Used before sampling the soil	Supports testing of the conceptual model of biological transport
Surface soil sampling	Herbivorous, insectivorous and omnivorous bird and mammal, and carnivorous bird and mammal attributes of survival, growth, and reproduction.	COPECs in soil	Waste site and reference site soils	Multi-increment samples representing 0-0.5 ft (0-15 cm)	Multi-increment samples for estimate of average exposure over sampling area
Biota sampling	Insectivorous and omnivorous mammal, insectivorous reptile, and carnivorous mammal attributes of survival, growth and reproduction.	COPECs in macroinvertebrates, small mammals, and lizards	Invertebrates caught in pitfall traps, small mammals, lizards/reptiles	For invertebrates, composite of pitfall trap contents. For lizards/reptiles, individual animals. For mammals, individual animals	Samples of insects, reptiles, and small mammals provide information for comparison to literature information on toxic tissue concentrations and for contaminant loading in middle trophic levels, to be used in modeling upper trophic-level exposure
Literature reviews on COPEC concentrations or other information relevant to risk characterization	All assessment endpoints and attributes for which information can be gathered.	Compilation of existing site-specific or relevant data on COPEC concentrations or other information relevant to risk characterization	Relevant literature or unpublished but documented data sources	Consult with subject matter experts to identify relevant published or documented in-house information	Make use of existing Hanford Site or other relevant data on COPEC concentrations and other information relevant to risk characterization, which will support and aid in the interpretation of other data

Table 1-4. Phase I Sampling Design Summary Table Linking Data to Risk Questions and Assessment Endpoints. (2 Pages)

Data Type	Assessment Endpoint and Attribute	Measures	Population	Key Features of Design	Basis for Study Design
Exposure modeling parameters	Herbivorous, insectivorous and omnivorous bird and mammal, and carnivorous bird and mammal attributes of survival, growth, and reproduction.	Uses data on COPECs in soil and in macro-invertebrates, small mammals, and lizards	Waste site and reference site soils and biotic tissues	Use of Hanford-specific uptake factors for soil to prey reduces uncertainty in use of non-site-specific literature values	Exposure modeling especially useful in assessing endpoints for which field measures would not be resource effective

Daubenmire, 1959, "A Canopy-Coverage Method of Vegetational Analysis."

COPEC = contaminant of potential ecological concern.

SAP = sampling and analysis plan.

Another important component of the conceptual model is the primary exposure medium, including the depth of biological activity. Air, groundwater, deep soil, shallow soil, and biota were media considered for sampling, based on the general conceptual exposure model (WMP-20570). Inhalation of surface air is not typically a risk driver in ecological assessments. However, COPECs associated with the diffuse carbon tetrachloride plume in the 200 West Area subsurface air will be evaluated in Phase III when deeper subsurface sampling is planned to occur. Groundwater is approximately 200 ft (61 m) below ground surface and thus is an unlikely exposure medium under current conditions. Hypothetical future groundwater-use scenarios cannot be evaluated by ecological data collected in this plan. Data suggest that surface soil, in particular the first foot, is important as an exposure medium for direct contact with wildlife, root uptake, and animal burrowing.

Thus, surface samples (of the first 6 in.) can be collected along with specific biological samples to test for COPEC uptake. Collecting surface soil samples for the initial data collection activities has important practical advantages. Methods for collecting surface soil samples are less intrusive than those needed for deeper soil characterization (e.g., truck-mounted drill rigs) and, therefore, minimize the impacts of data collection on the shrub-steppe ecosystem. The conceptual model of the possible upward mobility of buried waste through animal burrowing and plant uptake also will be initially assessed, using radiological field data.

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2.0 QUALITY ASSURANCE PROJECT PLAN

The quality assurance project plan (QAPjP) establishes the quality requirements for environmental data collection, including sampling, field measurements, and laboratory analysis. This QAPjP complies with the requirements of the following:

- DOE O 414.1A, *Quality Assurance*
- 10 CFR 830 Subpart A, "Quality Assurance Requirements"
- EPA/240/B-01/003, *EPA Requirements for Quality Assurance Project Plans for Environmental Data Operations*, March 2001, as revised, EPA QA/R-5

The following sections describe the quality requirements and controls applicable to this investigation. Correlation between EPA/240/B-01/003 (QA/R-5) requirements and information in this chapter is provided in Table 2-1.

Table 2-1. Quality Assurance Crosswalk. (2 Pages)

EPA QA/R-5 Criteria	EPA QA/R-5 Title	Reference Section
Project Management	Project/Task Organization	2.1 and 2.1.1
	Problem Definition and Background	1.1, 1.2, 1.6.1
	Project Task Description	1.0, 1.1, 2.0
	Quality Objectives and Criteria	1.6, 2.2, 2.3
	Special Training/Certification	2.1.2
	Documents and Records	2.1.1.2, 2.7, 2.9
Data Generation and Acquisition	Sample Process Design	3.0 and 3.2
	Sampling Methods	2.10, 3.3, 3.4, Tables 3-1, 3-2
	Sample Handling and Custody	2.4, 2.10.4, 2.10.5, Tables 2-3 through 2-6, Section 3.5
	Analytical Methods	2.3, Table 2-2, 2.7.1
	Quality Control	2.2 and 2.3
	Instrument/Equipment Testing, Inspection and Maintenance	2.3.1 and 2.10.7
	Instrument/Equipment Calibration and Frequency	2.3.1, 2.5, 2.8
	Inspection and Acceptance of supplies and consumables	2.3.1
	Non Direct Measurement	1.1, Table 1-4
	Data Management	2.7

Table 2-1. Quality Assurance Crosswalk. (2 Pages)

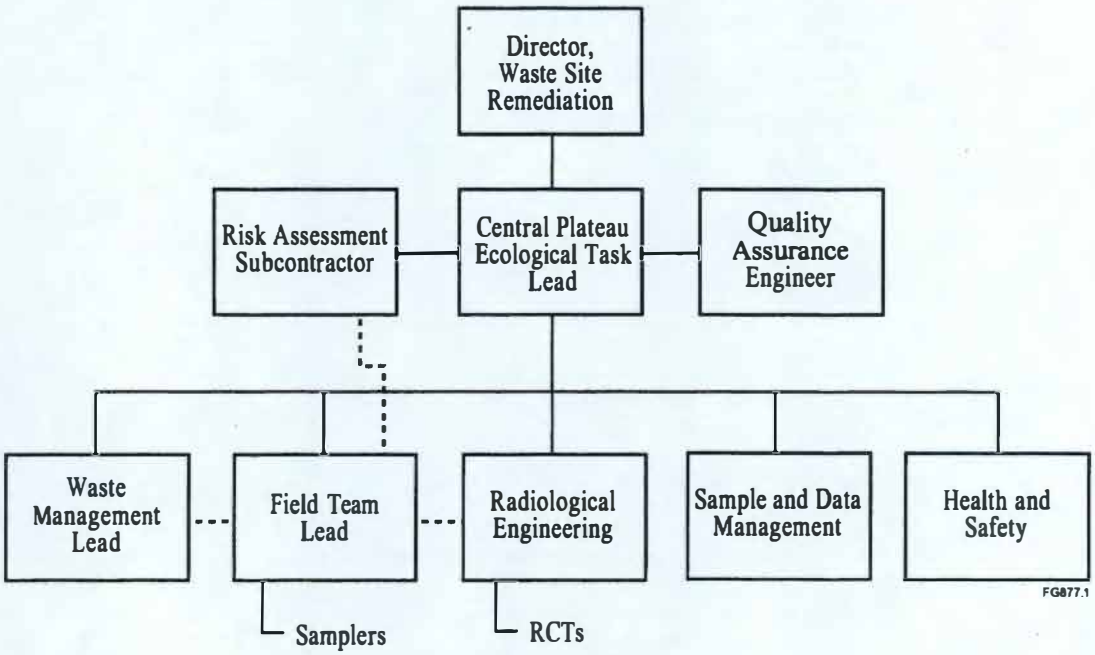
EPA QA/R-5 Criteria	EPA QA/R-5 Title	Reference Section
Assessment and Oversight	Assessment and Response Actions	2.1.1 and 2.6
	Reports to Management	2.6
Data Validation and Usability	Data Review, Verification and Validation	2.8
	Verification and Validation Methods	2.8
	Reconciliation with User Requirements	2.7 and 2.9

2.1 PROJECT MANAGEMENT

This section addresses the basic areas of project management and will ensure that the project has a defined goal, that the participants understand the goal and approach to be used, and that the planned outputs have been appropriately documented.

2.1.1 Project/Task Organization

Fluor Hanford Inc., or its approved subcontractor, is responsible for collecting, packaging, and shipping soil and biota samples to the laboratory. The project organization is described in the subsections that follow and is shown graphically below.



2.1.1.1 Director, Waste Site Remediation

The Director of Waste Site Remediation provides oversight for all activities, coordinates with RL, regulators, and FH management in support of ecological sampling activities. In addition, support is provided to the Ecological Task Lead to ensure that the work is performed safely and cost-effectively.

2.1.1.2 Central Plateau Ecological Task Lead

The Central Plateau Ecological Task Lead is responsible for direct management of sampling documents and requirements, field activities, and subcontracted tasks. The Ecological Task Lead ensures that the Field Team Lead, Samplers, and others responsible for implementation of this SAP and QAPjP are provided with current copies of this document and any revisions thereto. The Ecological Task Lead also works closely with Quality Assurance and Health and Safety organizations and the Field Team Lead to integrate these and the other lead disciplines in the planning and implementing the workscope. The Ecological Task Lead also coordinates with, and reports to RL, regulators, and FH management on all ecological sampling activities.

2.1.1.3 Risk Assessment Subcontractor

The Ecological Risk Assessment subcontractor is responsible for the performance of EPA's 8-Step Ecological Risk Assessment Guidance for Superfund process, which for this project, results in the development of the ecological sampling design. Responsibilities include development and documentation of the ecological sampling DQOs and sampling design, and associated presentations, resolution of technical issues.

2.1.1.4 QA Engineering

The QA Engineer is matrixed to the Ecological Task Lead and is responsible for Quality Assurance issues on the project. Responsibilities include oversight of implementation of the project QA requirements, review of project documents, including DQO summary reports, SAPs (and QAPjP) and participation in quality assurance assessments on sample collection and analysis activities, as appropriate.

2.1.1.5 Waste Management

The Waste Management Lead communicates policies and procedures and ensures project compliance for storage, transportation, disposal and waste tracking in a safe and cost effective manner. Other responsibilities include identifying waste management sampling/characterization requirements to ensure regulatory compliance, interpretation of the characterization data to generate waste designations, profiles, and other documents that confirm compliance with waste acceptance criteria.

2.1.1.6 Field Team Lead

The Field Team Lead has the overall responsibility for the planning, coordination, and execution of the field characterization activities. Specific responsibilities include converting the sampling design requirements into field task instructions that provide specific direction for field activities.

Responsibilities also include directing training, mock-up's, and practice sessions with field personnel to ensure that the sampling design is understood and can be performed as specified. The Field Team Lead communicates with the Task Lead and Risk Assessment Subcontractor to identify field constraints that could affect the sampling design. In addition, the Field Team Lead directs the procurement and installation of materials and equipment needed to support the field work.

2.1.1.7 Radiological Engineering

Radiological Engineering is responsible for the radiological engineering and health physics support within the project. Specific responsibilities include conducting ALARA reviews, exposure and release modeling, and radiological controls optimization for all work planning. In addition, radiological hazards are identified and appropriate controls are implemented to maintain worker exposures to the hazards ALARA. Radiological Engineering interfaces with the project safety and health representative and plans and directs radiological control technician support for all activities.

2.1.1.8 Sample and Data Management

The Sample and Data Management organization selects the laboratories that perform the analyses. This organization also ensures that the laboratories conform to Hanford Site internal laboratory quality assurance requirements, or their equivalent, as approved by the U.S. Department of Energy, Richland Operations Office; the EPA, and the Washington State Department of Ecology. Sample and Data Management receives the analytical data from the laboratories, performs the data entry into HEIS, and arranges for data validation.

2.1.1.9 Health and Safety

Responsibilities include coordination of industrial safety and health support within the project carried out through safety and health plans, job hazard analyses, and other pertinent safety documents required by federal regulation or by internal FH work requirements. In addition, assistance is provided to project personnel in complying with applicable health and safety standards and requirements. Personnel protective clothing requirements are coordinated with Radiological Engineering.

2.1.2 Special Training Requirements/Certification

Typical training or certification requirements have been instituted by the Fluor management team within Fluor Hanford to meet training requirements imposed by the Fluor Contract, regulations, DOE Orders, Contractor Requirements Documents, American National Standards Institute/American Society of Mechanical Engineers, Washington Administrative Codes, etc. For example:

- Training or certification requirements needed by sampling personnel will be in accordance with Site analytical requirements.

The environmental safety and health training program provides workers with the knowledge and skills necessary to safely execute assigned duties. Field personnel typically will have completed the following training before starting work:

- Occupational Safety and Health Administration 40-hour hazardous waste worker training and supervised 24-hour hazardous waste site experience;
- 8-hour hazardous waste worker refresher training (as required);
- Hanford general employee radiation training;
- Radiological worker training.

A graded approach is used to ensure that workers receive a level of training commensurate with their responsibilities which complies with applicable DOE Orders and government regulations. Specialized employee training includes pre-job briefings, on-the-job training, emergency preparedness, plan of the day, and facility/work site orientations.

2.2 FIELD QUALITY CONTROL

Field quality control (QC) samples will be collected to evaluate the potential for cross-contamination and laboratory performance. Field QC for sampling in the Central Plateau will require the collection of field replicates and equipment blanks. The QC samples and the required frequency for collection are described in this section.

2.2.1 Field Replicates

Field replicate samples are used to evaluate laboratory consistency and the precision of field sampling methods. Field replicate samples are applicable to soil, but are not applicable to biota samples because the latter are independent units. Because all soil samples will be multi-increment samples, the field replicates will be collected as two additional multi-increment samples in one investigation area; i.e., a total of three multi-increment samples will be collected from the site targeted for field QC. The field replicate samples shall be retrieved from the same depth interval as the primary multi-increment sample but at additional randomly-selected locations.

2.2.2 Equipment Blanks

Equipment blanks are collected for any soil sampling device that is reused. Biota will be rinsed of external soil before chemical or radiological analysis, and thus any bias associated with the trap or other collection device is not relevant. Equipment blanks shall be collected from a minimum of 5 percent of the total collected soil samples, or one equipment blank for every 20 samples (whichever is greater), and will be used to verify the adequacy of sampling equipment decontamination. The field team leader may request that additional equipment blanks be taken. Equipment blanks shall consist of silica sand poured over the decontaminated

sampling equipment and placed in containers, as identified on the project Sampling Authorization Form (SAF).

Equipment blanks shall be analyzed for the following, as appropriate:

- Cs-137
- Sr-90
- Target analyte list (TAL) metals[4]
- Gross alpha and beta/gamma contamination levels

These analytes are considered to be the best indicators of decontamination effectiveness.

2.2.3 Prevention of Cross-Contamination

Special care should be taken to prevent cross-contamination of soil samples 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.

2.3 QUALITY OBJECTIVES AND CRITERIA FOR MEASUREMENT DATA

Quality objectives and criteria for soil and biota measurement data are presented in Table 2-2 for chemical and radiological analytes. The detection limits are based on calculations presented in WMP-20570. The ability to meet PQLs is dependant on the amount of sample obtained (e.g., especially biota) and matrix interferences.

2.3.1 Measurement and Testing Equipment

Measurement and testing equipment used in the field or in the laboratory that directly affects the quality of analytical data will be subject to preventative maintenance measures to ensure minimization of measurement system downtime. Laboratories and on-site measurement organizations must maintain and calibrate their equipment. Maintenance requirements (such as parts lists and documentation of routine maintenance) will be included in the individual laboratory and the on-site organization QA plan or operating procedures (as appropriate).

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[4] see SW-846, *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, as amended*, for the target analyte list.

Calibration of laboratory instruments will be performed in a manner consistent with SW-846 or with auditable U.S. Department of Energy Hanford Site-wide and contractual requirements. Calibration of radiological field instruments is discussed in Section 2.8.

Consumables, supplies, and reagents will be reviewed per SW-846 requirements and will be appropriate for their use. Note that contamination is monitored by the QC samples discussed in Section 2.3.3.

2.3.2 Laboratory Sample Custody

Sample custody during laboratory analysis will be addressed in the applicable laboratory Standard Operating Procedures (SOPs). Laboratory custody procedures will ensure the maintenance of sample integrity and identification throughout the analytical process.

2.3.3 Quality Assurance Objective

The QA objective of this plan is to develop implementation guidance that will provide data of known and appropriate quality. Data quality is assessed by representativeness, comparability, accuracy, precision, and completeness. The applicable QC guidelines, quantitative target limits, and levels of effort for assessing data quality are dictated by the intended use of the data and the nature of the analytical method. Each of these is addressed below.

2.3.3.1 Representativeness

Representativeness is a measure of how closely the results reflect the actual concentration and distribution of the chemical and radiological constituents in the matrix sampled. Sampling plan design, sampling techniques, and sample handling protocols (e.g., storage, preservation, and transportation) have been developed and are discussed in subsequent sections of this document. The documentation will establish that protocols have been followed and sample identification and integrity ensured.

2.3.3.2 Comparability

Comparability expresses the confidence with which one data set can be compared to another. Data comparability will be maintained using standard procedures, consistent methods, and units. Table 2-2 lists applicable fixed laboratory methods for analytes and target detection limits. Actual detection limits will depend on the sample matrix, and the sample quantity available. Data will be reported as defined for specific samples.

2.3.3.3 Accuracy

Accuracy is an assessment of the closeness of the measured value to the true value. Accuracy of chemical test results is assessed by spiking samples with known standards and establishing the average recovery. A matrix spike is the addition to a sample of a known amount of a standard compound similar to the compounds being measured. Radionuclide measurements that require chemical separations use this technique to measure method performance. For radionuclide

measurements that are analyzed by gamma spectroscopy, laboratories typically compare results of blind audit samples against known standards to establish accuracy. Validity of calibrations are evaluated by comparing results from the measurement of a standard to known values and/or by generation of in-house statistical limits based on three standard deviations (+/- 3s). Table 2-2 lists the accuracy provided for fixed laboratory analyses for the project.

2.3.3.4 Precision

Precision is a measure of the data spread when more than one measurement has been taken on the same sample. Precision can be expressed as the relative percent difference for duplicate measurements or relative standard deviation for triplicates. Analytical precision for fixed laboratory analyses are listed in Table 2-2.

2.3.3.5 Completeness

Completeness is a measure of the amount of valid data obtained from the analytical measurement process and the complete implementation of defined field procedures.

2.3.3.6 Detection Limits

Detection limits are functions of the analytical method utilized to provide the data and the quantity of the sample available for analyses.

2.3.4 Laboratory Quality Control

Instead of laboratory duplicates, triplicate samples will be analyzed. Two additional laboratory QC samples will be analyzed from the primary sample from the investigation area selected for field QC (field replicates are discussed in Section 2.2.1). This will result in triplicate laboratory analyses for one sample.

The laboratory method blanks, laboratory control sample/blank spike, and matrix spike are defined in Chapter 1 of SW-846 and will be run at the frequency specified in Chapter 1 of SW-846. Instead of laboratory duplicates, triplicates will be analyzed as previously discussed.

Table 2-2. Analytical Performance Requirements. (3 pages)

Contaminant of Potential Ecological Concern or Additional Analytes	Chemical Abstracts Service #	Name/ Analytical Technology[a]	Units	Practical Quantitation Limit (PQL)[b]	Matrix Specific Target Required Quantitation Limits for Ecological Receptors			Precision Soil and Biota	Accuracy Soil and Biota
					Soil[c]	Vertebrate tissues (fresh wt)[d]	Invertebrate tissues (fresh wt)[d]		
Americium-241	14596-10-2	GEA	pCi/g	1	3890	15.6	15.6	±30%	70-13%0[e]
Cobalt-60	10198-40-0	GEA	pCi/g	0.5	692	55.4	55.4	±30%	70-130%[e]
Cesium-137	10045-97-3	GEA	pCi/g	0.1	20.8	2290	2290	±30%	70-130%[e]
Plutonium-239/240	Pu-239/240	Plutonium isotopic – AEA	pCi/g	1	6110	18.3	18.3	±30%	70-130%[e]
Radium-226	Ra-226	GEA	pCi/g	0.1	50.6	3.0	3.0	±30%	70-130%[e]
Radium-228	Ra-228	GEA	pCi/g	0.2	43.9	2.6	2.6	±30%	70-130%[e]
Strontium-90	Rad-Sr	Total radioactive strontium – GPC	pCi/g	1	22.5	1710	1710	±30%	70-130%[e]
Uranium-238	U-238	Uranium isotopic – AEA (pCi)	pCi/g	1	1580	5.9	5.9	±30%	70-130%[e]
Aroclor-1254	53469-21-9	PCBs – Method 8082/8081 A[f]	mg/kg	0.0165	0.65	0.65	0.2	±30%	70-130%[g]
Aroclor-1260	11096-82-5	PCBs – Method 8082/8081 A[f]	mg/kg	0.0165	0.65	19.5	10.2	±30%	70-130%[g]
Antimony	7440-36-0	Metals[h]	mg/kg	6/0.6[i]	0.058	1.27	0.39	±30%	70-130%[g]
Arsenic	7440-38-2	Metals[h]	mg/kg	10/1[i]	7	2.67	0.83	±30%	70-130%[g]
Barium	7440-39-3	Metals[h]	mg/kg	2/0.5[i]	132	668	289	±30%	70-130%[g]
Bismuth	7440-69-9	Metals[h]	mg/kg	1	j	j	j	±30%	70-130%[g]
Boron	7440-42-8	Metals[h]	mg/kg	2[i]	0.5	26.5	13.8	±30%	70-130%[g]
Cadmium	7440-43-9	Metals[h]	mg/kg	0.5/0.2[i]	4	181	95	±30%	70-130%[g]
Chromium (III)	7440-47-3	Metals[h]	mg/kg	10/0.2	42	45.4	23.7	±30%	70-130%[g]
Copper	7440-50-8	Metals[h]	mg/kg	1	50	560	293	±30%	70-130%[g]
Cyanide	57-12-5	Method 9010B, 9012A, 9013, or 9014	mg/kg	0.5	0.31	0.36	0.19	±30%	70-130%[g]
Hexavalent chromium	18540-29-9	Method 7196A	mg/kg	0.5	0.2	N/A	N/A	±30%	70-130%[g]

Table 2-2. Analytical Performance Requirements. (3 pages)

Contaminant of Potential Ecological Concern or Additional Analytes	Chemical Abstracts Service #	Name/ Analytical Technology[a]	Units	Practical Quantitation Limit (PQL)[b]	Matrix Specific Target Required Quantitation Limits for Ecological Receptors			Precision Soil and Biota	Accuracy Soil and Biota
					Soil[c]	Vertebrate tissues (fresh wt)[d]	Invertebrate tissues (fresh wt)[d]		
Lead	7439-92-1	Metals[h]	mg/kg	5/0.5[i]	50	102	53.6	±30%	70-130%[g]
Mercury	7439-97-6	Metals[h]	mg/kg	0.2	0.33	8.18	4.27	±30%	70-130%[g]
Molybdenum	7439-98-7	Metals[h]	mg/kg	2	2	65.4	20.5	±30%	70-130%[g]
Nickel	7440-02-0	Metals[h]	mg/kg	4	30	972	508	±30%	70-130%[g]
Selenium	7782-49-2	Metals[h]	mg/kg	10/1[i]	0.3	9.09	4.75	±30%	70-130%[g]
Silver	7440-22-4	Metals[h]	mg/kg	10/0.2[i]	2	49.4	25.8	±30%	70-130%[g]
Thallium	7440-28-0	Metals[h]	mg/kg	5/0.5[i]	0.007	0.15	0.047	±30%	70-130%[g]
Tin	7440-31-5	Metals[h]	mg/kg	10	13.16	61.8	32.3	±30%	70-130%[g]
Uranium	7440-61-1	Metals[h]	mg/kg	1	5	129	40.6	±30%	70-130%[g]
Vanadium	7440-62-2	Metals[h]	mg/kg	2.5	85.1	10	5.22	±30%	70-130%[g]
Zinc	7440-66-6	Metals[h]	mg/kg	1	86	1190	622	±30%	70-130%[g]
Pesticides	N/A	PCBs – Method 8082/8081A	mg/kg	[k]	[k]	[k]	[k]	±30%	70-130%[g]

Table 2-2. Analytical Performance Requirements. (3 pages)

Contaminant of Potential Ecological Concern or Additional Analytes	Chemical Abstracts Service #	Name/ Analytical Technology[a]	Units	Practical Quantitation Limit (PQL)[b]	Matrix Specific Target Required Quantitation Limits for Ecological Receptors			Precision Soil and Biota	Accuracy Soil and Biota
					Soil[c]	Vertebrate tissues (fresh wt)[d]	Invertebrate tissues (fresh wt)[d]		

REFERENCES:

WAC 173-340-745, "Soil Cleanup Standards for Industrial Properties."

WAC 173-340-747, "Deriving Soil Concentrations for Ground Water Protection."

[a] For 4-digit EPA method numbers, see SW-846, *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, as amended.*

[b] The ability to meet PQLs is dependant on the amount of sample obtained (e.g., especially biota) and matrix interferences. Where two PQLs are listed, the one lower than the soil quantitation limit will be applied. Note that for the metals and anions for which the achievable PQL is above or at the desired quantitation limit, methods have been evaluated and no commonly used methods are available that will achieve the desired quantitation limit. For this situation, the PQL may become the limiting evaluation factor. This evaluation applies to antimony, arsenic, boron, Cr+6, cyanide, mercury, molybdenum, selenium, and thallium.

[c] Detection limits for soil are based on available Washington State ecological indicator concentrations (WAC 173-340-7493, Table 749-3), the no effect levels (LANL 2003, Los Alamos National Laboratory, ECORISK Database), or Site-Wide Background values as appropriate.

[d] Detection limits for biotic tissues are derived by calculating the dose to wildlife that is associated with consuming contaminated vertebrates or invertebrates. The dose is based on COPEC-specific toxicity reference values (see Ch. 9, WMP-20570) and the lowest resulting detection limit is used for invertebrate-eating and vertebrate-eating wildlife.

[e] Accuracy criteria for associated batch laboratory control sample percent recoveries. Except for GEA, additional analysis-specific evaluations also are performed for matrix spikes, tracers, and carriers as appropriate to the method. Precision criteria for batch laboratory replicate sample analyses.

[f] Method also includes Aroclor-1016, Aroclor-1221, Aroclor-1232, Aroclor-1242, Aroclor-1248, Aroclor-1262, Aroclor-1268. Aroclor is an expired trademark.

[g] Accuracy criteria is the minimum for associated batch matrix spike percent recoveries. Laboratories must meet statistically based control if more stringent. Evaluation criteria based on laboratory statistical limits or fixed limits as defined in the referenced methods. Precision criteria for batch laboratory replicate matrix spike analyses or replicate sample analysis.

[h] SW-846 Method 6010 or 6020 or EPA Method 200.8 (EPA/600/R-94/111, *Methods for the Determination of Metals in Environmental Samples, Supplement 1*) and extraction Method 3050B (SW-846).

[i] First value shown is via routine inductively coupled plasma; second value via "trace" inductively coupled plasma.

[j] No toxicity data on which to base a detection limit.

[k] Compound specific.

[l] The value shown is for PCB mixtures (total). Therefore the analytical results of Aroclor 1254 and 1260 must be combined and compared to this value.

AEA = alpha energy analysis.
EPA = U.S. Environmental Protection Agency.
GEA = gamma energy analysis.
GPC = gas proportional counter.
N/A = not applicable.
PCB = polychlorinated biphenyl.
PQL = practical quantitation limit.
TBD = To be determined.

2.4 SAMPLE PRESERVATION, CONTAINERS, AND HOLDING TIMES

Soil sample preservation, containers, and holding times for chemical and radiological analytes of interest and physical property tests are presented in Table 2-3. Requirements for biological samples are provided in Tables 2-4 through 2-6. Final sample collection requirements will be identified on the SAF.

Table 2-3. Sample Preservation, Container, and Holding Times for Soil Samples.

Priority	Analytes[a]	Container		Volume[b]	Preservation	Packing Requirements	Holding Time
		Number	Type				
1	Gamma spectroscopy	1	Plastic	500 g	None	None	NA
2	Radiogenic strontium	1	Plastic	[c]	None	None	NA
3	Isotopic plutonium	1	Plastic	[c]	None	None	NA
4	Isotopic uranium	1	Plastic	[c]	None	None	NA
5	PCBs/pesticides – Method 8082/8081A	1	Amber glass	120 g	None	Cool 4 °C	14 days to extraction; 40 days to analysis[d]
6	Metals (TAL plus Bi, Mo, Sn)	1	Plastic	125 g	None	None	6 months
7	Mercury	1	Plastic	25 g	None	Cool 4 °C	28 days
8	Hexavalent chromium – Methods 7196 and 3060	1	Plastic	60 g	None	Cool 4 °C	30 days
9	Cyanide	1	Plastic	75 g	None	Cool 4 °C	NA

[a] For 4-digit methods, see SW-846, *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, as amended.*
[b] Optimal volumes, which may be adjusted downward to accommodate the possibility of small sample recoveries. Minimum sample size will be defined in the Sampling Authorization Form.
[c] Analysis of all radionuclide suites will be accommodated in 500 g.
[d] Depending on the radioactivity of the samples, laboratories with radiological licenses may be required. Should this occur holding times may not be met as radiological screening and shipping may cause holding time exceedance.
NA = not applicable. PCB = polychlorinated biphenyl. TAL = target analyte list.

Table 2-4. .Sample Preservation, Container, and Holding Times for Invertebrate Samples.

Priority	Analytes[a]	Container		Volume[b]	Preservation	Packing Requirements	Holding Time
		Number	Type				
1	Gamma spectroscopy	1	Plastic	TBD	None	None	NA
2	Radiogenic strontium	1	Plastic	TBD	None	None	NA
3	PCBs/pesticides – Method 8082/8081A	1	Amber glass	TBD	None	Cool 4 °C	NA
4	ICP metals – Method 6010A (TAL plus Bi, Mo, Sn)	1	Plastic	TBD	None	None	NA
5	Isotopic plutonium	1	Plastic	TBD	None	None	NA
6	Isotopic uranium	1	Plastic	TBD	None	None	NA
7	Mercury	1	Plastic	TBD	None	Cool 4 °C	NA
8	Cyanide	1	Plastic	TBD	None	Cool 4 °C	NA

[a] For 4-digit methods, see SW-846, *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, as amended.*
[b] Optimal volumes, which may be adjusted downward to accommodate the possibility of small sample recoveries. Minimum sample size will be defined in the Sampling Authorization Form.
ICP = inductively coupled plasma. PCB = polychlorinated biphenyl. TBD = to be determined.
NA = not applicable. TAL = target analyte list.

Table 2-5. Sample Preservation, Container, and Holding Times for Small Mammal Samples.

Priority	Analytes[a]	Container		Volume[b]	Preservation	Packing Requirements	Holding Time
		Number	Type				
1	Gamma spectroscopy	1	Plastic	TBD	None	None	NA
2	Radiogenic strontium	1	Plastic	TBD	None	None	NA
3	PCBs/pesticides – Method 8082/8081A	1	Amber glass	TBD	None	Cool 4 °C	NA
4	ICP metals – Method 6010A (TAL plus Bi, Mo, Sn)	1	Plastic	TBD	None	None	NA
5	Isotopic plutonium	1	Plastic	TBD	None	None	NA
6	Isotopic uranium	1	Plastic	TBD	None	None	NA
7	Mercury	1	Plastic	TBD	None	Cool 4 °C	NA
8	Cyanide	1	Plastic	TBD	None	Cool 4 °C	NA

[a] For 4-digit methods, see SW-846, *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, as amended.*
[b] Optimal volumes, which may be adjusted downward to accommodate the possibility of small sample recoveries. Minimum sample size will be defined in the Sampling Authorization Form.
ICP = inductively coupled plasma. PCB = polychlorinated biphenyl. TBD = to be determined.
NA = not applicable. TAL = target analyte list.

Table 2-6. Sample Preservation, Container, and Holding Times for Lizard Samples.

Priority	Analytes[a]	Container		Volume[b]	Preservation	Packing Requirements	Holding Time
		Number	Type				
1	Gamma spectroscopy	1	Plastic	TBD	None	None	NA
2	Radiogenic strontium	1	Plastic	TBD	None	None	NA
3	PCBs/pesticides – Method 8082/8081A	1	Amber glass	TBD	None	Cool 4 °C	NA
4	ICP metals – Method 6010A (TAL plus Bi, Mo, Sn)	1	Plastic	TBD	None	None	NA
5	Isotopic plutonium	1	Plastic	TBD	None	None	NA
6	Isotopic uranium	1	Plastic	TBD	None	None	NA
7	Mercury	1	Plastic	TBD	None	Cool 4 °C	NA
8	Cyanide	1	Plastic	TBD	None	Cool 4 °C	NA

[a] For 4-digit methods, see SW-846, *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, as amended.*
[b] Optimal volumes, which may be adjusted downward to accommodate the possibility of small sample recoveries. Minimum sample size will be defined in the Sampling Authorization Form.
ICP = inductively coupled plasma. PCB = polychlorinated biphenyl. TBD = to be determined.
NA = not applicable. TAL = target analyte list.

2.5 ONSITE MEASUREMENTS QUALITY CONTROL

The collection of QC samples for onsite measurements QC is not applicable to the field screening techniques described in this SAP. Field screening instrumentation will be calibrated and controlled according to Sections 2.7 and 2.8, as applicable.

2.6 ASSESSMENT/OVERSIGHT

Routine evaluation of data quality described for this project will be documented and filed along with the data in the project file.

2.6.1 Assessments and Response Action

The Fluor Hanford Regulatory Compliance group may conduct random surveillance and assessments to verify compliance with the requirements outlined in this SAP, project work packages, the QAPjP, procedures, and regulatory requirements.

Deficiencies identified by these assessments shall be reported in accordance with existing programmatic requirements. The Plateau Projects Quality Assurance group coordinates the corrective actions/deficiencies in accordance with the Fluor Hanford QA Program. When appropriate, corrective actions will be taken by the Ecological Task Lead.

2.6.2 Reports to Management

Management will be made aware of all deficiencies identified by self-assessments. Identified deficiencies will also be reported to the Fluor Hanford Director of Waste Site Remediation, as appropriate.

2.7 DATA MANAGEMENT

Ecological and analytical data resulting from the implementation of this QAPjP shall be managed and stored in accordance with applicable programmatic requirements governing data management procedures. At the direction of the task lead, all analytical data packages will be subject to final technical review by qualified personnel before their submittal to the regulatory agencies or inclusion in reports. Electronic data access, when appropriate, will be via a database (e.g., *Hanford Environmental Information System* [HEIS] or a project-specific database). Where electronic data are not available, hard copies shall be provided in accordance with Section 9.6 of the Tri-Party Agreement (Ecology et al. 1989).

Planning for sample collection and analysis shall be in accordance with the programmatic requirements governing fixed laboratory sample collection activities as discussed in the sample teams procedures. In the event that specific procedures do not exist for a particular work evolution, or it is determined that additional guidance to complete certain tasks is needed, a work package will be developed to adequately control the activities, as appropriate. Examples of the sample teams requirements include the activities associated with the following:

- Chain of custody/sample analysis requests
- Project and sample identification for sampling services
- Control of certificates of analysis
- Logbooks, checklists
- Sample packaging and shipping.

Approved work control packages and procedures will be utilized to document radiological measurements when implementing this SAP. Examples of the types of documentation for field radiological data include the following:

- Instructions regarding the minimum requirements for documenting radiological controls information as per 10 CFR 835

- Instructions for managing the identification, creation, review, approval, storage, transfer, and retrieval of Hanford radiological records

- The minimum standards and practices necessary for preparing, performing, and retaining radiological related records

- The indoctrination of personnel on the development and implementation of survey/sample plans

- The requirements associated with preparing and transporting regulated material.

Ecological data will be cross referenced to the analytical data and radiation measurements to facilitate interpreting the investigation results. Units for analytical sample results for biological tissues will be explicit in terms of fresh weight and dry weight measures.

2.7.1 Resolution of Analytical System Errors

Errors reported by the laboratories are reported to the Sample Management Project Coordinator who initiates a Sample Disposition Record in accordance with FH procedures. This process is used to document analytical errors and to establish the resolution with the Project Task Lead. In addition, the FH QA Engineer receives quarterly reports that provide summaries and summary statistics of the analytical errors.

2.8 VALIDATION AND VERIFICATION REQUIREMENT

Completed data packages will be validated by qualified Fluor Hanford Sample and Data Management personnel or by a qualified independent contractor. Validation will consist of verifying required deliverables, requested versus reported analyses, and transcription errors. Validation also will include evaluating and qualifying results based on holding times, method blanks, matrix spikes, laboratory control samples, laboratory duplicates, and chemical and tracer recoveries, as appropriate. No other validation or calculation checks will be performed. At least 5 percent of all data types (i.e., metals, cyanide, PCBs, etc.) will be validated. All data, except "R" qualified or rejected data, will be used.

A data validation package will be generated for at least one of the waste sites identified for sampling in this SAP. Validation requirements identified in this section are consistent with Level C validation, as defined in data validation procedures. No validation for physical property data will be performed.

Formal data validation will not be performed on field-screening analytical results. Field QA/QC will be reviewed to ensure that the data are useable. Field instrumentation, calibration, and QA checks will be performed in accordance with the following.

- Calibration of radiological field instruments on the Hanford Site is performed under contract by Pacific Northwest National Laboratory (PNNL) as specified in PNNL program documentation.

- Daily calibration checks will be performed and documented for each instrument used to characterize samples that are under investigation. These checks will be made on standard materials sufficiently like the matrix under consideration that direct comparison of data can be made. Analysis times will be sufficient to establish detection efficiency and resolution.

The approval of radiological survey reports by the Radiological Engineering Manager represents the data validation and usability review for handheld field radiological measurements.

2.9 DATA QUALITY ASSESSMENT

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 data evaluation is to determine if quantitative data are of the correct type and are of adequate quality and quantity to meet the project DQOs. The EPA DQA process, EPA/600/R-96/084, 2000, *Guidance for Data Quality Assessment*, identifies five steps for evaluating data generated from this project, as summarized below:

Step 1. Review DQOs and Sampling Design. This step requires a comprehensive review of the sampling and analytical requirements outlined in the project-specific DQO summary report and SAP.

Step 2. Conduct a Preliminary Data Review. In this step, a comparison is made between the actual QA/QC achieved (e.g., detection limits, precision, accuracy, completeness) and the requirements determined during the DQO. Any significant deviations will be documented. Basic statistics will be calculated from the analytical data at this point, including an evaluation of the distribution of the data.

Step 3. Select the Data Analyses. Using the data evaluated in Step 2, select appropriate statistical hypothesis tests or graphical data analyses and justify this selection.

Step 4. Verify the Assumptions. Assess the validity of the data analyses by determining if the data support the underlying assumptions necessary for the analyses or if the data set must be modified (e.g., transposed, augmented with additional data) before further analysis. If one or more assumptions are questioned, return to Step 3.

Step 5. Draw Conclusions from the Data. The analyses are applied in this step and the results will be used to select among four possible outcomes for each COPEC (Figure 2-1).

Implementing the DQA process will require a set of plots and associated data analysis tools that are outlined below. These tools are used to assist in determining the presence of outliers or other anomalous data that might affect statistical results and interpretations. These tools also provide methods for determining differences between potentially impacted and reference areas, and for determining if COPECs are bioaccumulating in tissues.

2.9.1 General Plot Descriptions

Exploratory data analysis plots allow visual inspection and summary of the data (Chambers et al., 1983, *Graphical Methods for Data Analysis*). Each plot described below provides a different visual presentation of the distributions of COPECs. The choice of plotting procedure(s) depends on the hypothesis being tested and may include and/or depend on one of the following:

- The type of difference that is to be displayed, such as an overall shift in results (shift of central location) or

- When the centers are nearly equal, a difference between the upper tails of the two distributions (elevated results in a small fraction of one distribution).

The plotting method chosen will accommodate characteristics of the data sets (e.g., the rate of detection or censoring) or the amount of overlap or multiplicity of results reported at a few values. When there are both detects and nondetects in a data set, the convention used for plotting the nondetects is given. It is typical to use different plotting characters for detects and nondetects and to include nondetects at their reported detection limits or half the detection limit or estimated quantitation limit. Additional details are provided below on the types of plots that may be used.

2.9.1.1 Histograms

Histograms split the full range of results for an analyte into equal-width data classes (intervals). Each interval is represented by a vertical bar, and the height of each bar may depict the number of samples that fall into that data class. The horizontal axis indicates the observed results in the appropriate units provided with each histogram. The total number of observations included ("n") is presented in text below the histogram. When separate histograms are presented for different data sets (e.g., site data and background data), the same scale often is used for the axes of both plots to aid comparison.

2.9.1.2 Estimated (Probability) Density Functions

In density functions, the horizontal axis indicates the analyte results in the appropriate units. The curve, or density estimate, is merely a smoothed histogram. As an estimate of a density function, the area under the curve is approximately equal to one. The area under the curve between two possible observed values gives an estimate of the relative frequency for which observations of those magnitudes occur as compared to the other observations within the data set. These density estimates are nonparametric (i.e., they have no shape restriction).

2.9.1.3 Box plots

Box plots summarize information about the shape and spread of the distribution of results from a data set. Box plots consist of a box, a (median) line across the box, whiskers (lines extended beyond the box and terminated with a perpendicular line segment), and points outside the whiskers. The y-axis displays the data in the appropriate units. The area enclosed by the box shows the range containing the middle half of the data; that is, the lower box edge is at the first or lower quartile of the data (Q1, also called the 25th percentile; 25 percent of the data fall below Q1), and the upper box edge is at the third or upper quartile of the data (Q3, the 75th percentile; 25 percent of the concentrations fall above Q3). The height of the box (the interquartile range, Q3-Q1) is a measure of the spread of the data. The horizontal line across the box represents the median (50th percentile or second quartile) of the data, a measure of the center of the data distribution. If the median line divides the box into two approximately equal parts, this indicates that the shape of the distribution is symmetric; if not, it indicates that the distribution is skewed or nonsymmetric. Frequently, the full set of results are plotted as points overlaying the box plot. When a data set contains results for both detects (detected chemical concentrations) and nondetects (nondetected chemicals reported as less than a sample-specific detection limit), it is standard to use different plotting symbols for the detects and nondetects.

The format for large data sets, or data sets with much redundancy, results in an amount of overlap or multiplicity of results reported at a few values. Within each group (site or background), the points that represent individual observations are spread out laterally to reduce overlap. The random horizontal "jitter" has no significance; it is used strictly to improve the readability of the plot. Differences between data groups depicted in box plots can be evaluated with parametric (t-test or analysis of variance based on an alpha of 5 percent) methods or with nonparametric methods (Wilcoxon rank sum test or Gehan test). Such tests will be selected based on the underlying statistical distribution of the data.

2.9.1.4 Outlier Box Plots

The purpose of this type of format is to display or draw attention to extreme values (Iglewicz and Hoaglin, 1993, *How to Detect and Handle Outliers*). The upper and lower "fences" enclose a range that extends beyond the box. The length of each fence is a multiple of the interquartile range, K*(Q3-Q1), K=1.5 is a standard choice. The fences are not plotted, per se, in the figure, but are implied by the whiskers. The whiskers (dashed line) extend beyond the box and terminate at "adjacent values". The upper adjacent value is the largest observed result within the upper fence. The lower adjacent value is the smallest observed result within the lower fence. The data range enclosed by the fences is the equivalent of a nonparametric confidence interval around the median. Points beyond the whiskers, "outside points" (all points beyond the whiskers are outside the fences), represent data that may be evaluated for their potential to be outliers (extreme or unusual values).

2.9.1.5 Quantile Plots

Quantile plots provide a comparison of different data sets by plotting the analyte results of each group in increasing order and evenly spread out. The y-axis displays the data scale, and the x-axis displays the quantiles (or percentiles) of the data. Each position along the x-axis displays the fraction or percent of the data that falls below the corresponding value. If the x-axis and the y-axis were reversed, the resulting plot would be called a cumulative probability distribution function.

2.9.1.6 Normal Quantile-Quantile (Q-Q) Plots (Normal Probability Plot)

The normal q-q plot is a particular type of quantile plot. The data set is plotted in increasing order and spread out in a manner that allows comparison of their distribution to that of a theoretical distribution, the standard normal distribution. The quantiles of the data set (y-axis) are plotted against the quantiles for a standard normal (x-axis). The quantiles of a standard normal (i.e., normal with mean=0 and standard deviation=1) are those for the theoretical distribution and can be found in tables of the cumulative normal distribution. For example, the 50th quantile is 0, the 90th quantile is approximately 1.282, and the 95th quantile is about 1.645. In the normal q-q plot below, 0 corresponds to the 50th percentile (median), 1 corresponds to (approximately) the 84th quantile, 2 corresponds to (approximately) the 98th quantile, and 3 would correspond to (approximately) the 99.9th quantile. If the data set closely follows that of a normal distribution, the points in the plot will lie close to the diagonal straight line (q-q line) overlaying the plot. The subsets of the data set that differ the most from those expected from a normal distribution are seen as points straying from the q-q line. Often, the difference is seen in

the extreme values of the data set (the largest or smallest data values at one or both ends of the plot), even for data sets that produce histograms that look rather "normal." Often, too, these plots are used to determine whether a data set looks more "normal" (all points fall closer to the q-q line) after a data transformation. Two different data sets (site and background) can be compared to each other, and to a normal distribution, by plotting a separate line for each data set in the same display. The viewer can see where, if anywhere, the two q-q plots follow the same line, overlap, or intersect, indicating that they have equal results at that (those) associated quantile(s).

2.9.1.7 Bivariate Plots

Scatter plots are an example of a bivariate display used to look for a mutual relationship or correlation between two variables of interest in the same sample. Data relating to one variable (y-axis) are plotted against data from a second variable (x-axis). Each point represents the values of the two variables from the same sample. Two variables have a positive correlation if they have a tendency to increase together, and a negative correlation if an increase in one tends to produce a decrease in the other. The strength of the correlation between the two variables may be interpreted by the scatter of points around a sloped least squares fit line. The scatter of points typically follows the general pattern and is described as an ellipse. The shape of the ellipse reflects the strength of the correlation (i.e., the magnitude of r, the correlation coefficient). The shape of the ellipse ranges from circular when there is no correlation ($r=0$) to a thin ellipse that collapses into straight line (a degenerate ellipse) when the variables are perfectly correlated ($r=1$, or $r=-1$). The slope of the line or ellipse of points (positive or negative slope) indicates whether there is a positive or negative correlation. Both parametric and nonparametric methods are available to assess data for correlations; and a statistical model may be developed using tools like simple linear regression.

A series of scatter plots for pairs of analytes from a set of samples often are used to explore potential (or expected) relationships among the analytes. Scatter plots of related isotopes provide a visual display of isotopic ratios to evaluate secular equilibrium or (for uranium isotopes) to evaluate evidence of depleted or enriched uranium.

2.9.1.8 Spatial Plots

Spatial plots present data in a given area or volume using a variety of techniques. The plots described here are bivariate plots, bubble plots, grayscale images, and contour lines suited for two-dimensional presentations.

2.9.1.9 Circle Plots

Circle plots provide simple graphical representations of the magnitude of results at each sample location. Each concentration of a particular analyte is represented as a circle with an area proportional to the value. The circles are centered at the locations from which the samples were collected, typically the lateral surface locations throughout an area.

2.9.1.10 Multivariate Analyses

When taking multiple environmental and ecological measurements in an attempt to avoid overlooking any that may have relevance, the subsequent analyses of individual responses may become unmanageable and difficult to study. The solution is to condense the data information, or reduce the dimensionality of the data, by using multivariate analysis. Data reduction is summarization, and summarization can result in categories or quantitative variables. Multivariate analysis is designed in such a way that a small number of variables has discriminating power similar to that of the full set of original variables. The multivariate approaches most useful to an ecological community setting include: discriminate analysis, principal components analysis and canonical correlation analysis. Discriminate analysis produces the best linear combination of the original variables that will classify a sample location into one of k groups; e.g., control area, minimally contaminated site, highly contaminated site. Canonical correlation analysis determines the linear combination(s) of predictor variables (e.g., sediment contaminant concentrations) and associated linear combination(s) of outcome measures (e.g., species abundance) that produce the strongest relationship (correlation) between the predictor set and the outcome set. Principal components analysis determines the linear combination(s) of the set of original variables that explain the maximum amount of variability or differences between the samples taken. The results of multivariate analyses can be displayed graphically using bivariate plots.

2.9.2 Data Analysis/Risk Characterization

Figure 2-1 shows the decision logic associated with the DQA activities for Phase I. The DQA will make use of existing literature information relevant to the Hanford Site. The DQA process is initiated after Phases I and II are completed. For example, the Tier 1 data collected in Phases I will be evaluated through the DQA to assess whether collecting Tier 2 data for Core Zone waste sites is warranted in Phase III. Similarly, sampling of soils below 0.5 ft (15 cm) will occur in Phase III if warranted by the DQA (Table 1-1).

Data analysis of the Phase I ecological data starts with various exploratory data analysis approaches as described in Section 2.9.1. Data analysis will evaluate results from the six Phase I waste sites areas and the bunchgrass reference site. The data from the investigation areas will be assessed for outliers and for differences in concentration between the potentially impacted areas and the reference areas. While many statistical approaches will be used, not all data are equally valid for all analyses[5]. Among the relationships explored with these analyses are differences in the relative density of invertebrates, lizards, and mammals based on variation in plant cover. Data also will be evaluated for statistically increased tissue concentrations versus soil concentrations: i.e., transfer factors or more complex bioaccumulation models. Contaminant transfer or bioaccumulation factors are an empirical ratio of contaminants in soil to contaminants in biota, which are used in exposure modeling. Adverse effects are inferred by the ratio of exposure to effects levels (toxicity reference values or TRVs). It is assumed that the dose

[5] Analysis of the abundance of specific waste-site plant species in multivariate analyses is inappropriate because these sites are highly managed systems, seeded with a finite number of targeted plants – the flora present is consequently more reflective of a management decisions than of a subtle interplay among environmental variables.

received orally for terrestrial wildlife can be described mathematically as one of the two following equations.

$$E_{oral} = [C_{soil} \cdot I_{food} \cdot fs + C_{food}] \cdot AUF$$

where

E_{oral} is the estimated oral daily dose for a COPEC (mg-COPEC/kg-body weight/day)

C_{soil} is the concentration of chemical constituent x in soil (mg/kg dry weight)

I_{food} is the normalized daily dietary ingestion rate (kg-dry weight/kg-body weight/day)

fs is the fraction of soil ingested, expressed as a fraction of the dietary intake

C_{food} is the concentration of COPEC in food (mg/kg-dry weight)

AUF is the area use factor for the receptor (ratio of the investigation area to the home range, but no larger than 1.0).

$$E_{oral} = C_{soil} \cdot I_{food} \cdot [fs + TF_{food}] \cdot AUF$$

where

E_{oral} is the estimated oral daily dose for a COPEC (mg-COPEC/kg-body weight/day)

C_{soil} is the concentration of COPEC in soil (mg/kg dry weight)

I_{food} is the normalized daily dietary ingestion rate (kg-dry weight/kg-body weight/day)

fs is the fraction of soil ingested, expressed as a fraction of the dietary intake

TF_{food} is a transfer factor from soil to food (mg/kg food dry weight per mg/kg soil dry weight)

AUF is the area use factor for the receptor (ratio of the investigation area to the home range, but no larger than 1.0).

The above equations assumes that a single food type is ingested and that exposure modeling must be specific for herbivores, omnivores, insectivores, and carnivores. This model is the same as the one used in WAC 173-340-900, "Tables," Table 749-4, "Wildlife Exposure Model for Site-Specific Evaluations," for evaluation of ecological effects of contaminants on terrestrial wildlife (WAC 173-340-7492, "Simple Terrestrial Ecological Evaluation Procedures").

Exposure modeling will be based on site-specific soil COPEC data and on COPECs detected in the three taxonomic representatives of middle trophic level species (invertebrates, lizards and small mammals) sampled for tissue analyses (Figure 2-1). Food ingestion rates and home ranges for Central Plateau receptors are provided in the Phase I EcoDQO (WMP-20570). Avian and mammalian toxicity reference values for the COPECs being evaluating in this plan are also provided in the Phase I EcoDQO (WMP-20570). Soil ingestion values will be obtained from the

literature for the receptors considered in the Central Plateau or from appropriate surrogate receptors (Beyer et al. 1994, "Estimates of Soil Ingestion by Wildlife"). A framework for considering uncertainties in exposure-related (e.g., ingestion rate) and toxicity-related parameters is described in LA-UR-04-8246, *Screening-Level Ecological Risk Assessment Method,* as well and will be adopted for evaluating uncertainty in this SAP.

Analysis of the Phase I ecological data starts with various exploratory data analysis approaches as described in Section 2.9.1. Data analysis will evaluate results from all investigation areas and the reference sites. Among the relationships explored with these analyses are differences in the relative density of invertebrates, lizards, and mammals based variation in plant cover. These data also will be evaluated for statistically increased tissue concentrations vs soil concentrations.

The DQA will provide the basis for selecting from among four possible outcomes for each COPEC (Figure 2-1).

As illustrated in Figure 2-1, for each COPEC there are four possible outcomes following Tier 1 data collection.

1. COPECs are in soil and in biota.

2. COPECs are in soil only.

3. COPECs are in biota only (potentially triggering deep soil sampling or additional lateral sampling in Phase III and an evaluation of the need for receptor-specific Tier 2 data).

4. COPECs are not in soil and not in biota (indicating no additional data needed to characterize risk to biota for the geographic areas sampled for Tier 1).

For outcomes 1-3, exposure is compared to effect levels to determine if additional data should be collected. Figure 2-2 is used to identify the types of data needed for Tier 2. The last outcome is the clearest case for not proceeding to Tier 2 sampling. The second outcome of detecting COPECs in soil and not biota would likely suggest that Tier 2 data collection is unnecessary. Thus, outcome #2 indicates that no further data are needed to determine if COPECs are affecting biota.

The assumption is that animals collected from the investigation areas obtained exposure from that area and do not represent transient biota. The design has been structured to collect animals with small home ranges and dispersal distance compared to other species and to focus biological collections on the central part of the investigation areas. These steps minimize the chance that transient invertebrates, lizards, and small mammals are collected.

Figure 2-2 shows the DQA activities associated with data collected for specific ecological receptors in Phase I and how these data assist with the development of DQOs and the Phase II SAP. The five decision logic components in Figure 2-2 represent the receptors considered for Tier 2 characterization.

1. Plants: The radiological field data and analytical data are used to evaluate the potential for bioaccumulation of COPECs into plants. The results will be reviewed to determine the characteristics of contaminants that may be present to establish surrogate ratios with other COPEC (i.e., cesium to strontium and/or cesium to metals). Modified Daubenmire (1959, "A Canopy-Coverage Method of Vegetational Analysis") plots will be used to assess cover of dominant plants, bare ground, and cryptogams. This information will be used to evaluate the comparability of the investigation areas in terms of plant cover and therefore the expected abundance and types of other receptors.

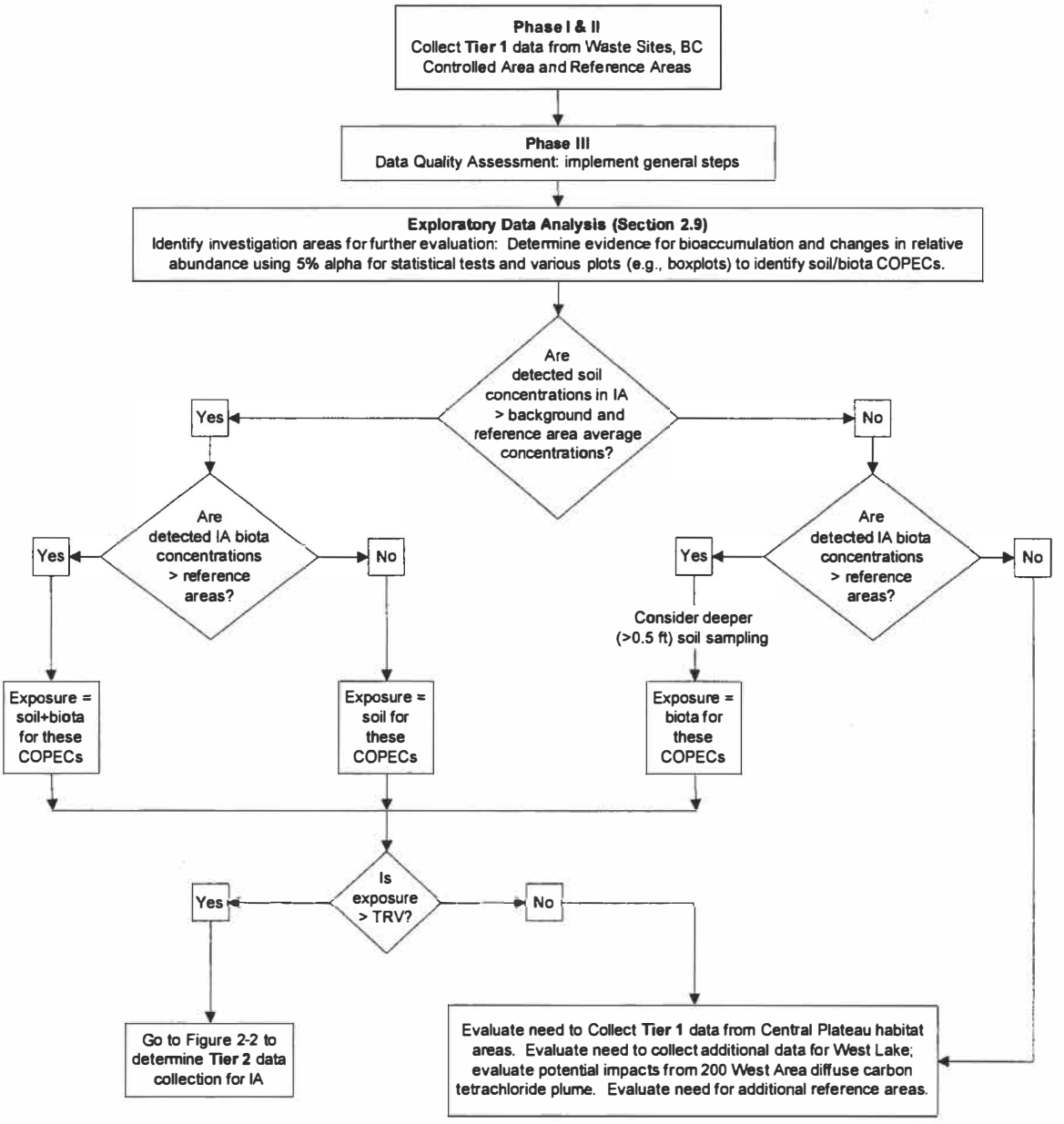
2. Invertebrates: Toxicity tests and litterbag assessments are planned if COPECs are measured in soil at greater than invertebrate soil screening values, and these COPECs also are measured in soil macroinvertebrates. This evaluation will include exploratory data analysis of the macroinvertebrate and soil COPEC concentrations to look for bioaccumulation trends. These results also will be compared to relationships documented in the literature or from other relevant sites. The DQA also will evaluate the diversity and relative abundance of invertebrates by measuring the biomass of invertebrates in major taxonomic groups (predominantly beetles and crickets; biomass of lesser fractions will be noted as "other"). A measure of relative abundance is obtained by tabulating the trap-days of capture effort at each investigation area.

3. Birds: Further evaluation of the avian receptors will be based on measuring COPEC concentrations in soil at levels greater than avian soil screening values and based on exposure modeling with Hanford-specific dietary data (see the detection limit calculations in the Phase I EcoDQO [WMP-20570] for the form and parameters of the exposure model) and also by detecting COPECs in mammals and/or lizards. Mammal and lizard data are relevant in that these species are in the same middle trophic level as the bird species under consideration for Tier 2 data collection.

4. Mammals: Small mammal population studies are planned if COPECs are measured in soil at greater than mammalian soil screening values and are based on exposure modeling with Hanford-specific dietary data (see the detection limit calculations in the Phase I EcoDQO [WMP-20570] for the form and parameters in the exposure model). These COPECs also are measured in small mammals. This evaluation will include exploratory data analysis of the mammal and soil COPEC concentrations to look for bioaccumulation trends. These results also will be compared to relationships documented in the literature or from other relevant sites. The relative abundance of small mammals will also be evaluated by measuring the biomass of each animal captured. A measure of relative abundance is obtained by tabulating the trap-days of capture effort at each investigation area.

5. Lizards: Lizard population studies are planned if COPECs are measured in lizards. This evaluation will include exploratory data analysis of the lizard and soil COPEC concentrations to look for bioaccumulation trends. These results also will be compared to relationships documented in the literature or from other relevant sites.

Figure 2-1. Decision Logic for Phase II Data Quality Assessment to Support the Phased Sampling Approach and Tiered Data Collection for the Ecological Data Quality Objective Sampling and Analysis Plan.



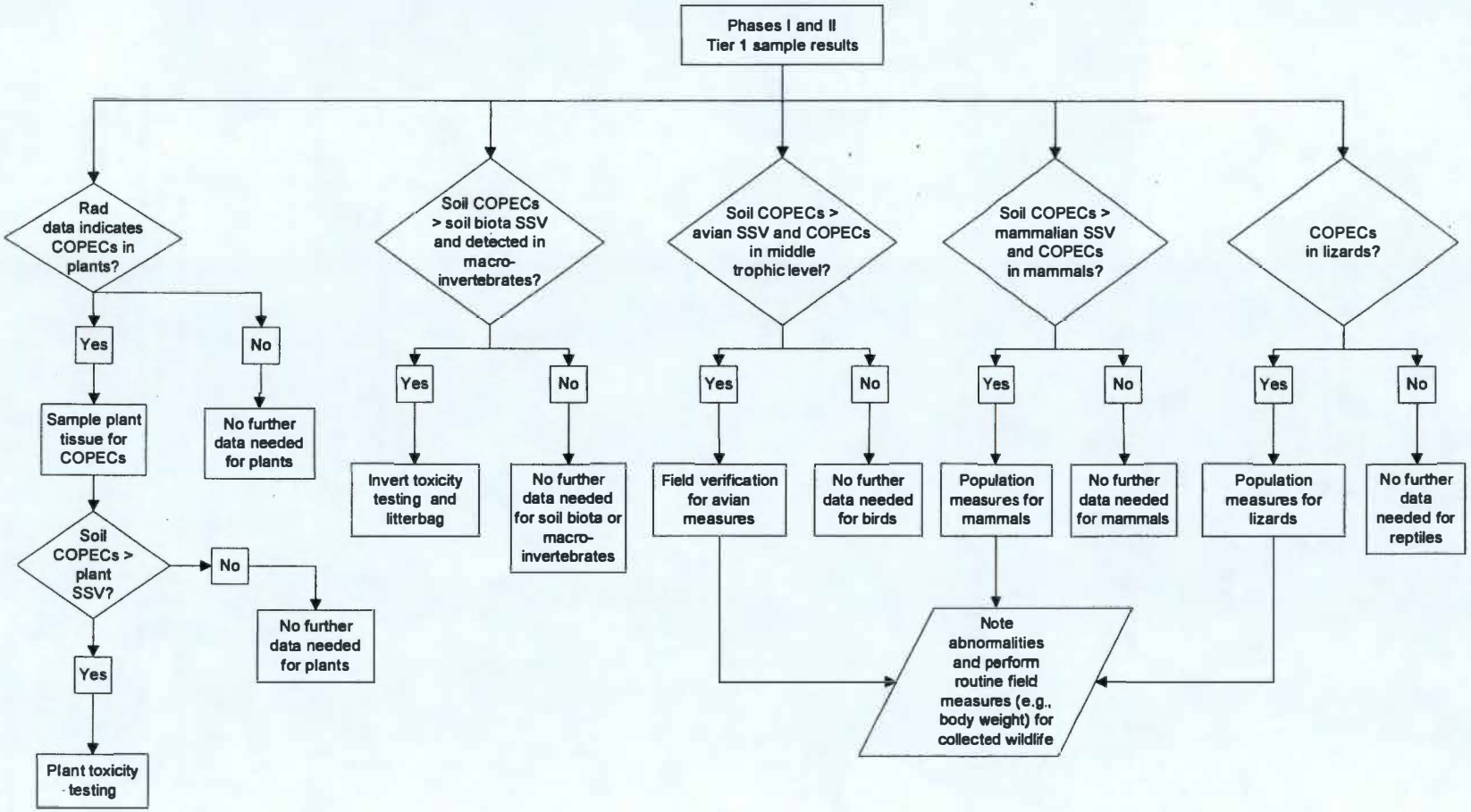
NOTE:

Tier 1 data include:
- Field radiological data on soil, ant mounds, burrows
- 0-0.5 ft soil samples for metals, rads, and organics
- Biota (insect, lizard, mammal) samples
- Note abnormalities in collected wildlife
- Relative animal abundance
- Plant cover

Tier 2 data may include:
- Deeper soil sampling (>0.5 ft)
- Plant tissue analytical samples
- Population measures for mammals and lizards
- Field verification for middle trophic-level birds
- Litterbag studies and toxicity tests for plants/inverts
- Note abnormalities in collected wildlife

COPEC = contaminant of potential ecological concern
IA = investigation area
TRV = Toxicity Reference Value

Figure 2-2. Data Quality Assessment Logic for Determining Data Requirements for Specific Ecological Receptors.



COPEC = Contaminant of potential ecological concern
SSV = Soil screening value

The DQA also will evaluate the data to determine if an indicator model for ecological risk or ecological effects can be developed. Data analysis will determine if exposure levels are comparable between any of the waste sites and, therefore, will be able to use results from sites with comparable exposure levels as something similar to field duplicates of analytical results.

2.10 FIELD SPECIFIC COLLECTION

Additional details regarding field specific collection requirements are provided below:

2.10.1 Sample Location

Sample locations will be staked and labeled before starting the activity. After the locations have been staked, minor adjustments to the location may be made to mitigate unsafe conditions, avoid structural interferences, or bypass utilities. Locations will be identified as part of the work planning process for the collection of samples. Changes in sample locations that do not affect the DQOs will require approval of the project manager. However, changes to sample locations that result in impacts to the DQOs will require EPA concurrence.

2.10.2 Sample Identification

The Hanford Sample and Data Tracking database will be used to track the samples through the collection and laboratory analysis process. The HEIS database is the repository for the laboratory analytical results. The HEIS sample numbers will be issued to the sampling organization for this project. The chemical/radiological and physical properties of each sample will be identified and labeled with a unique HEIS sample number. The sample location, depth, and corresponding HEIS numbers will be documented in the sampler's field logbook.

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

- SAF number
- HEIS number
- Sample collection date and time
- Name of person collecting the sample
- Analysis required
- Preservation method (if applicable).

2.10.3 Field Sampling Log

All information pertinent to field sampling and analysis will be recorded in field checklists and bound logbooks in accordance with existing sample collection protocols. The sampling team will be responsible for recording all relevant sampling information. Entries made in the logbook will be dated and signed by the individual who made the entry. Program requirements for managing the generation, identification, transfer, protection, storage, retention, retrieval, and disposition of records will also be followed.

2.10.4 Sample Custody

Sample custody will be maintained in accordance with existing Hanford Site protocols. The custody of samples will be maintained from the time the samples are collected until the ultimate disposal of the samples, as appropriate. A chain-of-custody record will be initiated in the field at the time of sampling and will accompany each set of samples shipped (cooler) shipped to any laboratory. Wire or laminated water proof tape will be used to seal the coolers. The analyses requested for each sample will be indicated on the accompanying chain-of-custody form. Chain-of-custody procedures will be followed throughout sample collection, transfer, analysis, and disposal to ensure that sample integrity is maintained. Each time the responsibility for the custody of the sample changes, 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 transmit the copy to Fluor Hanford Sample and Data Management within 48 hours of shipping.

A custody seal (i.e., evidence tape) shall be affixed to the lid of each sample jar. The container seal will be inscribed with the sampler's initials and the date.

2.10.5 Sample Containers and Preservatives

Level I EPA precleaned sample containers will be used for soil samples collected for chemical and radiological analysis. Container sizes may vary depending on the laboratory-specific volumes needed to meet analytical detection limits. If, however, the dose rate on the outside of a sample jar or the curie content within the sample exceeds levels acceptable to an offsite laboratory, the sampling lead can send smaller volumes to the laboratory after consultation with Fluor Hanford Sample and Data Management to determine acceptable volumes. Preliminary container types and volumes are identified in Tables 2-3 through 2-6. The final container type and volumes will be provided in the SAF. Tables 2-3 through 2-6 also lists the priority for the analyses, with gamma spectroscopy being the highest analytical priority because it is a nondestructive analysis. The order for the remaining analyses is based on their importance for potential ecological risks, based on U.S. Department of Energy-Headquarters analysis documented in WMP-20570.

2.10.6 Sample Shipping

The radiological control technician (RCT) will measure both the contamination levels on the outside of each sample jar and the dose rates on each sample jar. The RCT also will measure the radiological activity on the outside of the sample container (through the container) and will document the highest contact radiological reading in millirem per hour. This information, along with other data, will be used to select proper packaging, marking, labeling, and shipping paperwork in accordance with U.S. Department of Transportation regulations (49 CFR, "Transportation"), and to verify that the sample can be received by the analytical laboratory in accordance with the laboratory's acceptance criteria. The sampler will send copies of the shipping documentation to Fluor Hanford Sample and Data Management within 48 hours of shipping.

As a general rule, samples with activities of <1 mR/h will be shipped to an offsite laboratory. Samples with activities between 1 mR/h and 10 mR/h may be shipped to an offsite laboratory although samples with dose rates within this range will be evaluated on a case-by-case basis by the Fluor Hanford Sample and Data Management. Samples with activities of >10 mR/h will be sent to an onsite laboratory arranged for by Sample and Data Management.

2.10.7 Radiological Field Data

Alpha and beta/gamma field data will be used to support the characterization as described in this SAP, as appropriate. The following information will be disseminated to personnel performing work in support of this SAP, as appropriate.

- Instructions to the RCTs on methods required to measure sample activity and media for gamma, alpha, and/or beta emissions, as appropriate. This will include direction to allow RCTs to calculate a number of quantities supporting sample analysis.

- Information regarding the Geiger-Mueller (GM) portable instrument, to include a physical description of the GM, radiation and energy response characteristics, calibration/maintenance and performance testing descriptions, and the application/operation of the instrument. This is a commonly used beta/gamma instrument on the Hanford Site for removable surface contamination measurements and direct measurements of the total surface contamination.

- Information regarding the Portable Alpha Meter (PAM), to include a physical description of the PAM, radiation and energy response characteristics, calibration/maintenance and performance testing descriptions, and the application/operation of the instrument. This is a commonly used alpha instrument on the Hanford Site for removable surface contamination measurements and direct measurements of the total surface contamination.

- Information regarding the Sodium Iodide (NaI), to include a physical description of the NaI, radiation and energy response characteristics, calibration/maintenance and performance testing descriptions, and the application/operation of the instrument. The NaI instrument is a commonly used gamma detector on the Hanford Site utilized when performing direct measurements.

- Information on the characteristics associated with the hand held probes to be utilized in the performance of direct radiological measurements to include a physical description of the probe, radiation and energy response characteristics, calibration/maintenance and performance testing descriptions, and the application/operation of the instrument. Probes appropriate for the type and energy range of radioactivity present in the soils are commonly used alpha instrument on the Hanford Site utilized when performing removable surface contamination measurements and direct measurements of the total surface contamination.

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3.0 FIELD SAMPLING PLAN

The Field Sampling Plan (FSP) addresses the study scope defined through the DQO process and implements an iterative approach to characterizing ecological risks for the Central Plateau waste sites. This sampling design uses a tiered sample-collection framework. A screening-level approach is used to match COPECs with the medium that has the greatest potential of occurrence. In some sampling zones, the occurrence of a COPEC in an abiotic exposure medium may trigger future sampling in biota. For example, some COPECs are not very mobile in the abiotic environment and hence may not be easily transported to the biota. In such cases, decisions were made to sample only in the medium where they likely would be found (e.g., PCBs in animals as opposed to plants). Tables presented in the FSP contain a complete suite of analyses for easy comparison between media and sampling zones.

The FSP defines sampling objectives (Section 3.1), sampling design (Section 3.2), and descriptions of the different sampling media: soil (Section 3.3) and biota (Section 3.4). Administrative matters include sample handling (Section 3.5), environmental measurements (Section 3.6), sample management (Section 3.7), and management of investigation-derived waste (Section 3.8).

3.1 SAMPLING OBJECTIVES

The objective of the FSP is to provide information that will be used to support Central Plateau waste site remedial decision-making and to provide information to evaluate ecosystem health across habitats. A secondary benefit is that the collected data also may help the Hanford Natural Resources Trustees in understanding the condition of the ecosystem.

3.2 SAMPLING DESIGN

The approach for Phase I is to classify sites within the Central Plateau based on waste disposal processes and COPECs, the cover depth, and the habitat. To accomplish these goals, sample locations will be selected that represent a potential gradient of COPEC concentrations. As discussed in Section 1.5, reference locations will be selected that are distant from the waste sites. The top 6 in (15cm) of soil will be sampled and compared to tissue concentrations to determine if the biota are taking up COPECs from this interval. The study area for ecological risk investigations will be a 1 hectare area or 100 x 100 m. Surface radiation data will be collected over the selected waste sites and reference areas on a 32.8 x 32.8 ft (10 x 10 m) grid. The surface radiation data collection will be conducted by a qualified radiological control technician (RCT) in accordance with task instruction and other applicable approved procedures that will specifically provide direction to the RCTs on how the areas under consideration are to be surveyed to meet the requirements as stated in this SAP.

A variety of sampling methods are required to ensure that the proper characterization data are collected from these diverse areas and media. The sampling methods considered for the Central Plateau waste sites include the following.

- **Reconnaissance Surveys** – Reconnaissance surveys (visual observations, radioactivity measurements, and mapping) will be conducted to determine locations, abundance, and availability of soil and biotic sampling populations. These surveys are to be conducted by ecologists experienced in the Central Plateau ecology. Obvious ecological effects (e.g., distressed vegetation) will be noted during reconnaissance or during other field collection activities; these notes will be communicated to the project team for evaluation and to solicit recommendations on changes in sampling or analytical activities. The reconnaissance surveys will provide information for the selection of six waste sites for Phase I investigation out of the list of candidate waste sites (Table 1-2). Criteria for selecting reference sites were discussed in Section 1.5; one reference site will be identified for detailed complementary sampling and evaluations of ecological health. To the extent possible, all media sampled in the investigation areas will be sampled in the reference site. Modified Daubenmire (1959) plots will be used to assess cover of dominant plants, bare ground, and cryptogams. This information will be used to evaluate the comparability of the investigation areas in terms of plant cover and therefore the expected abundance and types of other receptors.

- **Systematic Grid Surveys** – Systematic grid surveys are based on a specified pattern, with samples taken at regular intervals along that defined pattern. The radiological field data will be performed following a grid. Surveys may be designed for one, two, or three dimensions if the population characteristic of interest has a spatial component as follows:

  - Surveys along a line or transect represent sampling in one dimension

  - Surveys at every node on a grid laid over an area of interest is sampling in two dimensions

  - Surveys representative of a depth profile at a node represents three-dimensional sampling.

  To make the systematic surveys a probability-based design, the initial unit for the first survey point of size n is chosen at random, and then the remaining (n-1) units are chosen so that all n are located according to the pattern.

- **Random Sampling** – This method is used for soil sampling and is intended to ensure that the investigation area soils are fully and uniformly represented in the multi-increment samples. The random assignment of start locations to the systematic sampling grid provides assurance that the sample truly represents the overall characteristics of the target population, which leads to an unbiased estimate of the mean.

- **Opportunistic Collections** – In some cases biological samples can be collected opportunistically at locations within the investigation area. In such cases the animal will be collected and the notes will be recorded on the specific location by referencing a grid node. An example is collecting a lizard in a pitfall trap intended for collecting invertebrates. Another example is hand-collecting invertebrates observed on the investigation area.

The sample design objectives, methods, features, and basis presented in Table 1-4 are discussed in the following subsections additional detail is provided in Table 3-1.

Table 3-1. Methods for Radiological Field Data and Sample Collection.

Targeted Field Data	Description
Soils	Direct-reading radiological detectors for beta/gamma detection measured on a systematic survey grid. Collect multi-increment samples with a soil corer or hand shovels using a random start location in the systematic sampling grid.
Ant nests	Characterize selected ant mounds at locations marked within the investigation area using direct-reading radiological detectors for beta/gamma detection.
Burrow spoils	Characterize selected burrow spoils at locations marked within the investigation area using direct-reading radiological detectors for beta/gamma detection.
Plants	Direct-reading radiological detectors for beta/gamma detection measured on a systematic survey grid. Modified Daubenmire plots will be used to assess cover of dominant plants, bare ground, and cryptogams.
Invertebrates	Pitfall traps along transects within the investigation area and opportunistic collections.
Small mammals	Live traps systematically placed along transects within the investigation area.
Lizards	Collect lizards, make measurements, and submit whole animal.

Daubenmire, 1959, "A Canopy-Coverage Method of Vegetational Analysis."

3.3 SOIL SAMPLING PROCEDURES

One of the primary objectives of the soil sampling in the Central Plateau is to locate and sample a gradient or range of COPEC concentrations between waste sites. These waste sites also represent different habitat types. The waste sites chosen are greater than 5,380 ft^2 (500 m^2) in area and have a maximum cover depth of 6 ft (1.8 m). Sampling locations will be distributed along transects within the 1 hectare plot in an effort to locate the radiological contamination level ranges.

As discussed in WMP-20570, the sampling design was based on the scale that the of middle-trophic level biota use the environment. The species used as measures of exposure (e.g., small mammals) reflect relevant scales for waste site impacts. The investigation area of 1 hectare reflects the home range and dispersal distance of these species. Employing smaller investigation areas for smaller sites would represent an artificial distinction, because biota would forage and move over an area of approximately 1 hectare.

If the waste site is larger than 1 hectare, then radiological field data will be used to locate the investigation in the area with potential for the highest COPEC concentrations. A 1 hectare grid based on 32.8 x 32.8-ft (10 x 10 m) nodes will be placed over the waste site and surveyed

utilized radiological instrumentation (i.e., NAF, CAMs, etc.). Figure 3-1 shows two possibilities, first that the waste site is smaller than the 32.8 x 32.8-ft (100 x 100 m) area, and the second that the waste site is larger than the grid.

The use of the characterization techniques identified in this SAP is expected to yield meaningful radiological and chemical characterization data. Additionally, reference areas will be sampled in the same manner that the waste sites are sampled. Figure 3-1 shows an example of how waste sites and reference sites will be sampled. Surface soils (the top 6 in.) will be characterized by collecting multi-increment samples that are representative of the entire 1 hectare investigation area. The multi-increment samples will be a mixture of 50 samples taken at 0 to 6 in. (0-15 cm). The samples will be collected from a systematic sampling grid, using a random starting location.

3.3.1 Field Sampling Implementation Process Examples

3.3.1.1 Soil Surfaces

- Identify the investigation area based on existing radiological field data.
- Identify the grid pattern.
- Develop Environmental Radiological Survey Task Instructions (ERSTI) for the RCTs – these are specialized surveys that will be performed by RCTs based on specific guidance to the RCTs. The task instruction will instruct the RCTs what to survey, how to survey a particular area, and with what instrumentation/equipment. For example, this may include information on both NaI instrumentation (to perform an evaluation for 137-Cs contamination levels) and GM's (to perform an evaluation for gross beta/gamma contamination levels), as needed, for the area under consideration.
- Collect radiological field data over the surface of the site by implementing the ERSTI and produce a record that documents its implementation.
- Identify the soil samples that are needed within the grid boundary (i.e. a work instruction that says where to collect the soil samples).
- Biologists will identify areas of interest such as plants, ant nests, animal burrows, areas where soil has been disturbed and/or removed, etc. for radiological field data to be collected (gross beta/gamma measurements with handheld instrumentation).
- Samplers collect the individual soil samples and mix the samples ("containerize and label" the soil samples) –RCTs will use standard radiological field instrumentation for these samples to measure the gross contamination levels directly within the soil samples under consideration for both radiological safety/job control purposes and to measure the contamination levels associated with each sample.
- Perform sample preparation activities for transfer to the lab.

- The samples will be stored in chain-of–custody conditions until submitted to the lab for COPEC analyses.

3.3.1.2 Animals (Lizards, Small Mammals and Insects)

- Identify the site.
- Identify the grid pattern.
- Place the traps and collect insects, lizards, and mammals – the work instruction for this process will follow existing programs and procedures that will be implemented via existing processes.
- Collect the animals via the traps (this process will use existing radiological controls for health and safety purposes).
- Following collection, the RCTs will use field instrumentation to measure the contamination levels on the exterior of the animals for both H&S purposes and for documenting measured contamination levels on the exterior of the animals (e.g. standard GM handheld field instrumentation and/or NaI measurements per the survey task instructions).
- Record species-specific information, weight, and other information.
- Containerize and label the samples.
- The samples will be stored in a freezer prior to submittal to a lab.
- The lab will prepare the samples for analysis to include a de-ionized water rinse to be analyzed for the COPEC's.
- The results that are provided from the lab will be analytical data for the animals.

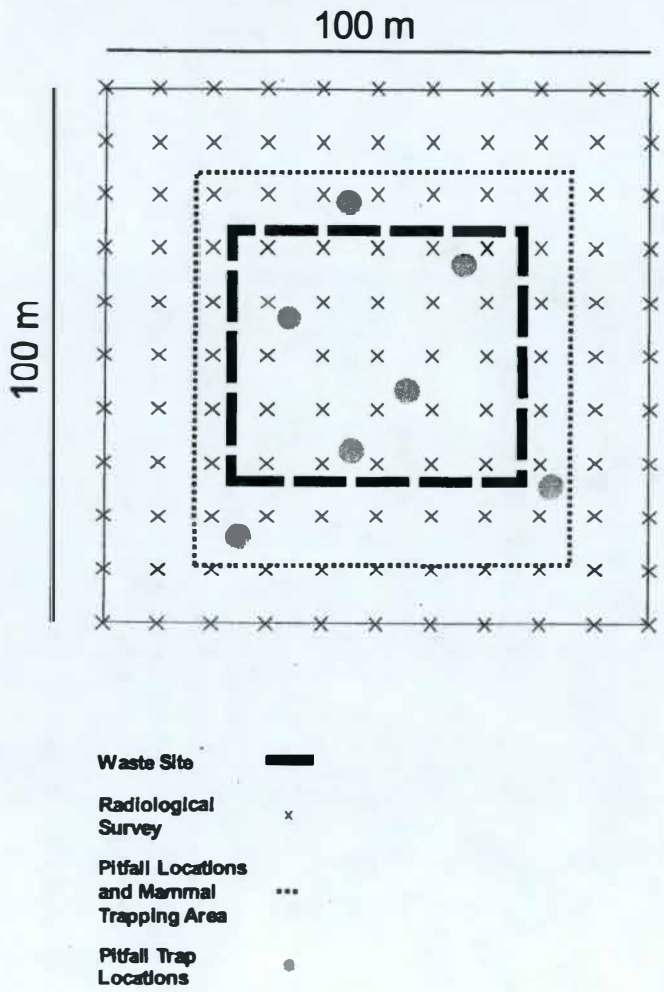
3.3.1.3 Plants

- Identify the site.
- Identify the grid pattern.
- Within each grid identify plants based on the characteristic of the species within the grid for evaluation. Collect and analyze the radiological information associated with the species under consideration per the work package instructions and the survey requirements as described in the task instructions.

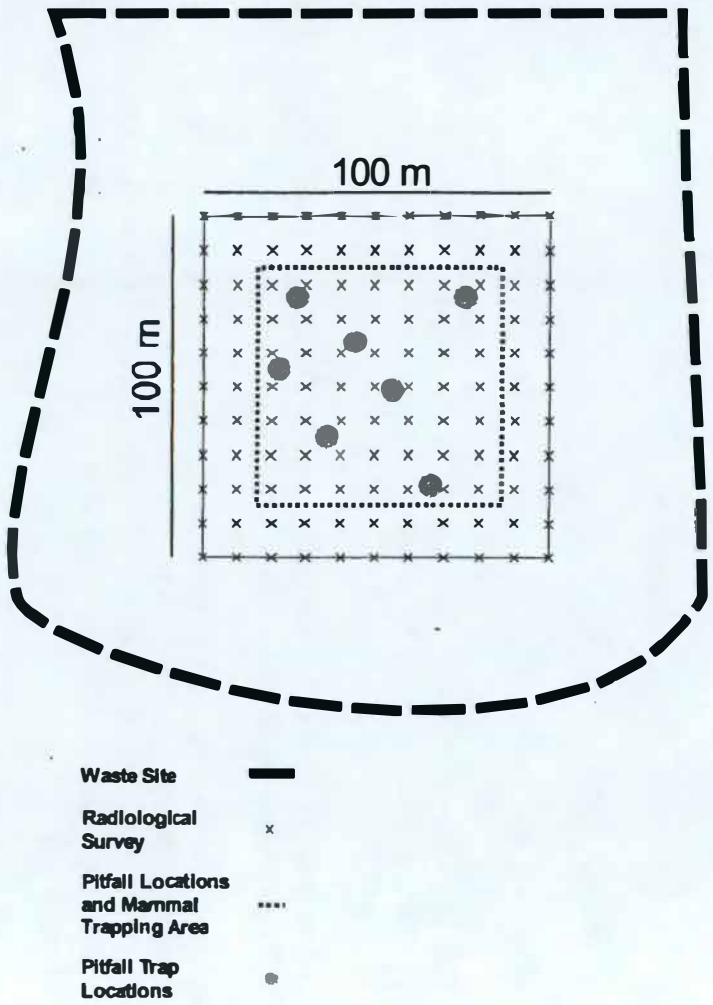
Detailed sampling techniques are described further in the following subsections.

Figure 3-1. Schematic Used to Illustrate Phase I Radiological Surveys and Biota Sampling.

a. Waste Site Smaller than 1 Hectare (2.47 Acres).



b. Waste Site Larger then 1 Hectare (2.47 Acres).



3.3.2 Radiological Field Data Collection

A grid of 1 hectare (100 x 100 m) will be set up over the waste site. If the waste site size is less than 10,000 m^2, then it will be placed in the center of the grid as shown in Figure 3-1. Figure 3-1 also shows an example placement of the hectare grid over a large waste site.

Radiological instrumentation that may be utilized is shown in Table 3-2.

Table 3-2. Field Screening Methods.

Measurement Type	Emission Type	Method/Instrument or Equivalent[a]	Detection Limit
Contamination level	Alpha/beta-gamma	SHP380-A/B scintillation probe or equivalent	100 dpm α 1,921 dpm[b] β–γ
NaI field instrument (must be used for site surveys for assessment of variance)	Gamma isotopic emissions	NaI	~3 pCi/g for Cs-137

[a] RO-20, RO-03, and SHP380-A/B scintillation probe are trademarks of Eberline Instruments, a subsidiary of Thermo Electron Corporation, Waltham Massachusetts.
[b] Detection limit rating is for 100 cm^2 at a scan rate of 2 in./s.

If the waste area is larger than 1 hectare, then the investigation area will be placed in the area of the anticipated greatest COPEC concentrations, based on previously conducted Rad Rover radiological field data results from NaI measurements.

Once the hectare investigation area is located, radiological field data will be collected in the areas between grid nodes that are staked with flags or wood posts that contain the location numbers. A total of 121 nodes are located in each hectare plot.

Surface soil and plant radiological readings will be measured in a 1 m^2 area surrounding each flag and located within the 1-hectare study site. The results from implementing the ERSTI will be documented on a radiological survey record, as per the survey task instructions. The plant nearest to the field radiological data location will be selected. If more than one plant is equidistant from the location, the tallest specimen will be selected for the plant radiological field data collection. The species and dimensions (height and width) of the plant will be noted, as well as the radiological measurement used. Both beta and gamma measurements will be taken on the surface soil as well as on the plant material.

The investigation area will be surveyed for burrowing animal activity and ant mounds, with the objective of marking and making surface radiological measurements at these locations. From 30 to 50 burrow spoils should be surveyed, and 15 to 20 ant mounds should be surveyed, subject to availability. One-quarter of the investigation plot initially should be inspected, and large ant mounds and burrow spoils marked. If more than enough of each type are located in the first 0.25 hectare, then the radiation measurements will be made in this 0.25 hectare, and the locations will be marked. The ambient radiological background levels, the radiation measurements for both ant mounds and burrow spoils will be recorded as per the ERSTI, and the locations will be recorded using the node ID number. In addition, the location will be flagged for future reference.

If additional measurements are needed for ant mounds or for burrows, then the next 0.25 hectare section of the investigation plot will be surveyed, and ant mounds and/or burrows will be marked until the desired minimum numbers are obtained. The field team leader may select additional areas for radiological measurements that are outside the study site, either to meet the desired minimum field radiological data collection locations or to obtain a more representative survey of the waste site (with consultation of the radiological controls supervisor). If sufficient numbers cannot be obtained, this deviation will be documented in the radiological field data recorded documentation.

3.3.3 Soil Screening

An assessment population of small mammals will be exposed to contamination within a spatial area of approximately 1 hectare (Ryti et al. 2004). Animals range freely over the hectare and thus integrate exposure from multiple locations as a result. The parameter of interest is therefore the average soil concentration for the hectare. As such, the samples will be field screened for evidence of radioactive contamination by the radiological control technician. These materials will be measured with field instruments for both beta and gamma radiation. Potential screening methods and instruments are listed in Table 3-2 with their respective detection limits.

Before sampling begins, a local area background reading will be taken with the field screening instruments at a background site to be selected in the field per established procedures. Field screening of the soil and visual observations of the soil (i.e., sediment/clay layer, organic debris) will be used to support worker health and safety monitoring.

Field screening instruments will be used, maintained, and calibrated in accordance with the manufacturer's specifications and other approved procedures. The RCT will record field screening results on the radiological field data record associated with the survey area.

3.3.4 Multi-Increment Soil Sampling and Analysis

The soil sampling plan is based on multi-increment sampling procedures that are designed to control the fundamental error (FE) for an average, based on collecting an adequate sample mass (Pitard 1993, *Pierre Gy's Sampling Theory and Sampling Practice: Heterogeneity, Sampling Correctness, and Statistical Process Control*; Ramsey, 2004, *Sampling for Environmental Activities*, DQO Training Course). The following steps are involved in determining an adequate sample mass to collect in the field and the proper particle size for the analytical laboratory to measure for chemical and radiological analysis.

1. The investigation area is 1 hectare. The systematic grid used for radiological surveys provides 100 grid boxes. Of these, 50 grid box locations will be sampled beginning with a random start.

2. Select or measure a reasonable maximum sample particle size in the field. Because soils are typically defined as being comprised of particles ≤ 2 mm, it will be assumed that the maximum particle size is 2 mm or 0.2 cm. This will be achieved by sieving the soil samples to exclude the > 2 mm size particles.

3. Select the desired FE, which has been specified as 10%. This corresponds to a standard error of 10% on the mean concentration. This value was selected to be low relative to other sources of error (i.e. analytical measurement error is typically 30%).

4. Calculate the mass of sample (M) needed based on the FE and particle size (d, in cm) as

$$M = 22.5\frac{d^3}{FE^2}.$$

   If d=0.2 cm and FE=0.1 (10%), then M=18 g.

5. Using a scoop large enough to capture the maximum particle size, collect enough sample increments (k=50) to at least equal the mass calculated in step #4 and place in a container, combining increments into one "sample" (m). Care will be taken to obtain consistent and representative samples for the desired sample depth, and the multi-increment sample will be formed such that the material is representative of the particle size fractions that are less than 2 mm. Sufficient sample mass will be collected for all laboratory analyses.

6. Repeat step 5 within the investigation area to obtain two field replicate samples (as specified in Table 3-3) by sampling from two additional sets of 50 systematic locations, each with a different random start.

7. Deliver the samples and QC samples to the lab.

8. Because sufficient sample mass of <2 mm screened soil will be collected for all laboratory analyses, the laboratory is expected to analyze the entire mass for each test method. According to item #4 above, this is a minimum of 18 g per analysis.

9. Calculate the concentration from the sample.

10. Concentration represents average concentration or activity in the investigation area.

The multi-increment soil sampling will be based on the grid pattern used for radiological field data collection. Of the 100 grid boxes in each hectare plot, 50 grid boxes will be used for soil sampling. The soil sample increments will be collected from each investigation area to provide a single multi-increment sample representing the 0-6-in. (0-15 cm) depth.

If the results of the gamma field data indicate that the investigation area is heterogeneous in COPEC concentrations, then the field team leader may elect to subdivide the investigation area into more equal contaminant levels. Within each subarea, the multi-increment sample strategy will be employed.

Each multi-increment sample will be submitted to the analytical laboratory for analysis of PCBs/pesticides (by EPA Method 8082/8081A [SW-846]), TAL metals (including hexavalent chromium, mercury, and cyanide), and radionuclides (Cs-137, Sr-90, isotopic plutonium, and isotopic uranium).

During Phase I sampling a location near or on a road previously treated with oil for dust suppression should be identified. The field team then will identify additional locations that will be sampled and analyzed for PCBs. Five samples and a field duplicate will be collected at the PCB site.

Information regarding the samples will be recorded in the sampler's field logbook. The sampling field logbook includes, but is not limited to, the soil description, sample depths, sample locations, HEIS database sample numbers, relevant and/or pertinent events, general information about the sample or locations, and any other information that may be useful to meet the objectives of the FSP.

The investigation-derived waste generated during this activity will be handled according to applicable procedures in Section 3.8 of this SAP.

3.3.5 Summary of Soil Sampling Activities

A summary of the number and types of soil samples to be collected is presented in Table 3-3. This table lists the specific waste sites based on field reconnaissance surveys that were performed during the DQO process. Of the nine waste sites proposed in Table 1-3, six sites were retained for sampling. In addition, Table 3-3 identifies a reference site and a PCB sampling site. The UPR-200-W-8 and 2607-E1 waste sites were dropped from sampling consideration because they had marginal vegetation cover. The 218-W-4C Burial Ground also was dropped from the Phase I sampling, because the portion of the burial grounds that displayed vibrant habitat and which consequently held ecological interest was discovered to be an unused extension of the burial grounds. Because there is no buried waste in this segment of the burial grounds, it does not serve the purpose of this study.

3.4 BIOTA SAMPLING PROCESS

For each type of biological data collected, the effort required to collect the target number of organisms or sample mass will be recorded. This information will provide a semiquantitative measure of the abundance of biota at each investigation area. This semiquantitative measure of abundance is similar to that used in wildlife or fisheries studies where catch is related to population density. For example, the number of trap days will be recorded, or the number of man-hours (where applicable) will be recorded for each data type. Animals caught opportunistically during other activities also will be noted in the sampling checklists or logbook. To the extent practicable, data will be recorded in a consistent manner. This may be most easily accomplished through use of a standardized data entry form or forms (e.g., checklists).

Table 3-3. Summary of Projected Soil Sample Collection Requirements. (2 Pages)

Site Identification	Primary Samples	Quality Control Samples
2607-E6	1 sample from 50 locations	-
216-A-25	1 sample from 50 locations	-
216-B-3	1 sample from 50 locations	-
216-S-10D connected to 216-S-10P	1 sample from 50 locations	-
216-B-63	1 sample from 50 locations	-
216-U-10	1 sample from 50 locations	-
Near road site (analyzed for PCBs only)	a	a
Reference Site	1 sample from 50 locations	-
Field Replicate	-	2 additional samples, each from another 50 systematic locations, each with a different random start. Field team will select investigation area
Equipment Blank	-	1 sample of clean soil/sand or water
Laboratory QC	-	2 additional samples; laboratory triplicate performed on primary multi-increment sample from field QC site
Totals	8	5
Total number of multi-increment soil samples to analyze	12	

[a] PCB site sampling will consist of 5 soil grab samples and 1 field duplicate.

3.4.1 Plant Cover Surveys

A modified Daubenmire method (Daubenmire 1959) will be used to estimate canopy cover of dominant plant species, bare ground, and cryptogam cover. The Daubenmire method typically consists of systematically placing a 20- x 50-cm quadrant frame along a tape on permanently located transects. The following vegetation attributes are typically monitored using the Daubenmire method: canopy cover, frequency, and composition by canopy cover. The canopy cover will only be visually estimated. It is important that the same investigators collect these data to minimize differences in observer bias. The data will be consistently recorded to ensure that all pertinent information is noted in all areas sampled.

Each investigation area will be divided into 0.25 hectare sections. Within each 0.25 hectare subarea, 4 to 10 Daubenmire plots will be placed at random. The number of plots will be determined by the biologist based on the variability of cover noted between plots. Thus, cover information will be recorded at 16 to 40 plots that encompass the entire investigation area. In addition, photographs will be taken at each plot.

3.4.2 Insects

Pitfall traps will be used to capture invertebrates for COPEC analysis. The pitfall traps will be located within a 70 x 70 m grid in the center of the 100 x 100 m grid (see Figure 3-1). Ground-dwelling invertebrates such as darkling beetles, harvester ants, and spiders represent the soil biota guild specified in WAC 173-340-7493, "Site-Specific Terrestrial Ecological Evaluation

Procedures." Individual pitfall traps or drift fences with traps at each end will be used within the grid at each of the waste sites to collect invertebrates. Pitfall traps consist of 3.8 L (1-gal) metal or plastic containers buried at grade.

Pitfall traps will be left open for at least five nights at each sampling area. Invertebrates caught during trapping will be collected and composited for each sampling area for contaminant analysis. A trained entomologist will identify the invertebrate orders and/or families represented in the traps and each fraction shall be weighed. Pitfall trapping will continue (to be determined by the field team leader) until sufficient sample mass is obtained. The number of trap-days will be recorded for a relative measure of invertebrate abundance. If insufficient sample mass is obtained from the pitfall traps, then invertebrates can be manually collected or collected by other means (e.g., sweep nets). If alternate methods are used for invertebrate collection, then each fraction will be sorted, weighed, separated, and an approximate effort (person-days) for each collection method will be recorded. Coordinates for pitfall trap locations will be recorded to the nearest grid marker. The insects will be analyzed for PCBs/pesticides, TAL metals (including mercury and cyanide), and radionuclides (Cs-137, Sr-90, isotopic plutonium, and isotopic uranium). Invertebrates will not be depurated, because these data are used mainly to assess risks to upper trophic levels, and depuration does not occur before predation. The invertebrate sample will be rinsed with deionized water by the analytical laboratory to remove any exterior contamination, to minimize any bias introduced from soil potentially accumulating in the pitfall traps.

3.4.3 Lizards

The field team will note the presence of lizards on their visits to the waste sites when the radiological field data is collected, when soil samples are collected, and during the installation of the pitfall traps. Lizards will be captured by using the pitfall traps or alternate methods such as a noose or by stunning them with a rubber band. After capture, the entire lizard will be used as the sample. Only lizards that are located within the inner 70 x 70 m part of the investigation area will be captured. Within each grid, they will be analyzed for PCBs/pesticides, TAL metals (including mercury and cyanide), and radionuclides (Cs-137, Sr-90, isotopic plutonium, and isotopic uranium).

The lizard sample will be rinsed with deionized water by the analytical laboratory to remove any exterior contamination. Lizard tissues are to be analyzed exclusive of external concentrations so that these data will be better suited to developing bioaccumulation models. In addition, the exposure models incorporate incidental soil ingestion and rinsing the lizards prevents double counting soil ingestion in exposure model calculations. Coordinates for each lizard location will be recorded based on the nearest grid marker. At least six lizards will be captured, and analyzed for COPECs at each investigation area. The number of trap-days required to get at least six lizards per species will be recorded. This will provide a relative measure of animal density. Captured lizards will be examined for physical abnormalities, and data on total length, snout-vent length, and gender will be recorded before the animals are released. Abnormalities, which include coloration (e.g., albino), extra or missing digits, or two heads, should be photographed. Causes of abnormalities include disease, contaminants, missed predation, ultraviolet radiation, or

a combination of these stressors (Blaustein and Johnson, 2003, "The Complexity of Deformed Amphibians").

3.4.4 Small Mammals

Deer mice and pocket mice likely are present in the Central Plateau, particularly where adequate vegetation exists. These mice are respectively, omnivores and granivores and are considered the best representatives for the mammalian predator guild (as recommended in WAC 173-340-7490 et seq.). Deer mouse and pocket mouse sampling will be accomplished using live traps laid in the 70 x 70 m array in the center of the 100 x 100 m investigation area. Small mammal trapping will be conducted between April and September, when animals are most likely to be active.

Typically, two trap lines, each consisting of approximately seven Sherman live traps[6] (3 in. wide by 3.5 in. high by 9 in. long) will be placed parallel with the edges of the 70 x 70 m array. Identical trapping methods will be employed in similar habitats at the reference locations. The number of trap lines, number of traps per line, line spacing, and trap spacing may be varied to maintain comparable trapping efforts between sites and to ensure that results are comparable between the waste areas and reference locations. Such adjustments will be made as a function of the size of the area and type of the plant community in the vicinity. The grid location for the trap where the animal was captured will be noted in the field logbook.

Trapping arrays will be limited to one habitat type, if possible. The animals will be trapped over enough nights to obtain at least six small mammals from each investigation area; to the extent possible, the same species will be sampled at all Phase I and II investigation areas. The number of trap days required to get at least six animals for a species will be recorded. This will provide a relative measure of animal density. Individuals of other species may be collected if insufficient numbers of one species can be captured to meet the minimum of six small mammals per investigation area. The team members will consistently record information on all animals captured by use of standardized data entry procedures. Data recorded will include animal condition (e.g., species, sex, weight, reproductive class) and deformities. The relative density estimates will be interpreted with regard to field notes and weather conditions to make inferences about comparability of results among different investigation areas.

The mammals (whole animal) will be analyzed for PCBs/pesticides, TAL metals (including mercury and cyanide), and radionuclides (Cs-137, Sr-90, isotopic plutonium, and isotopic uranium). The mammals will be rinsed with deionized water by the analytical laboratory to remove any exterior contamination. Small mammal tissues are to be analyzed exclusive of external concentrations so that these data will be better suited to developing bioaccumulation models. In addition, the exposure models incorporate incidental soil ingestion and rinsing the mammals prevents double counting soil ingestion in exposure model calculations.

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[6] Sherman trap is a trademark of the H. B. Sherman Company, Tallahassee, Florida.

3.4.5 Summary of Biota Sampling Activities

A summary of the number and types of biota samples to be collected is presented in Table 3-4 for the same waste sites identified in Table 3-3, with the exception of the road site that was sampled for polychlorinated biphenyls.

Table 3-4. Summary of Projected Biota Sample Collection Requirements.

Site Identification	Invertebrate Samples[a]	Small Mammal	Lizards
2607-E6	3	6	6
216-A-25	3	6	6
216-B-3	3	6	6
216-S-10D connected to 216-S-10P	3	6	6
216-B-63	3	6	6
216-U-10	3	6	6
Reference Site	3	6	6
Total	**21**	**42**	**42**

[a]Assume sufficient mass for three samples.

3.4.6 Potential Sample Design Limitations

The sample design developed for this SAP has several potential limitations that may affect the sampling results. Some of the factors that have the potential to affect the outcome of this sampling effort include the following:

- Ability to collect sufficient sample mass for analytical measurements of biota
- Timing of data collection to maximum abundance of biota.

3.4.7 Sampling Contingencies

This SAP includes an assessment of the possible contingency considerations to offset the possible limitations encountered during sampling in the Central Plateau. The Fluor Hanford task lead will evaluate the need to implement these contingencies on a case-by-case basis.

The current climatological conditions may impede the field collection of biota samples due to drought-suppressed population levels. A greater trapping effort will necessarily extend the field schedule and this may push sampling into a suboptimal collection season. For these reasons, fewer animals may be available to address analytical uncertainties (e.g., detection limits) than is planned.

If insufficient mass of invertebrates is obtained from the pitfall traps, then additional duration will be added or other methods will be used. Such methods include hand picking large insects to collect invertebrates. If the target numbers of small mammals or lizards cannot be obtained, then additional sampling will be considered.

If there are difficulties in locating an analytical laboratory to successfully complete steps 8-11 in Section 3.3.3, then the analytical laboratory will be directed to run triplicate analyses on each original sample. In addition, the field team will instruct the analytical laboratory to run triplicate analysis on two of the QC samples.

If insufficient mass of invertebrates is obtained from the pitfall traps, then additional duration will be added or other methods will be used. Such methods include hand picking large insects to collect invertebrates. If the target numbers of small mammals or lizards cannot be obtained, then additional sampling will be considered. The small mammal trapping from some arrays may not yield sufficient numbers of deer mice or pocket mice. If this should be the case, then at least three deer mice and three pocket mice should be submitted for analysis from each trapping array. However, the decision on what species to collect should be made after trapping an array for at least four nights, based on consultation with the project task lead. If sample volumes from the biotic sampling still are not sufficient to meet analytical needs, analyses will be performed in accordance with the priority listed in Tables 2-3 to 2-6. Detection limits higher than the levels in Table 2-2 or reduced analyte lists are significant deviations and must be documented and communicated to the project team.

During the radiological field data collection, the sampling locations may not correspond to the locations of vegetation. The radiological field data locations may be moved slightly to accommodate the plant spacing. If this is not feasible because of lack of vegetation at the grid location, then the closest plant will be surveyed. This deviation or other deviations will be noted in the radiological field data record associated with the implementation of the task instruction and will be conveyed to the task lead.

3.5 SAMPLE HANDLING, SHIPPING, AND CUSTODY REQUIREMENTS

All field sample handling, shipping, and custody requirements will be consistent with established procedures. Sample transportation shall be in compliance with the applicable regulations for packaging, marking, labeling, and shipping hazardous materials, hazardous substances, and hazardous waste that are mandated by the U.S. Department of Transportation (49 CFR 171-177, Chapter 1, "Research and Special Programs Administration, Department of Transportation," Part 171, "General Information, Regulations, and Definitions," through Part 177, "Carriage By Public Highway") in association with the International Air Transportation Authority, U.S. Department of Energy requirements, and applicable program-specific implementing procedures. Sample custody during laboratory analysis is addressed in the applicable laboratory standard operating procedures. Laboratory custody procedures will ensure that sample integrity and identification are maintained throughout the analytical process.

3.6 SAMPLING AND ONSITE ENVIRONMENTAL MEASUREMENT PROCEDURES

Procedures for field measurements are specified in the subcontractor's or manufacturer's manuals. The sampling and onsite environmental measurement procedures to be implemented in the field will be consistent with established procedures.

3.7 SAMPLE MANAGEMENT

Sample management activities will be consistent with established procedures. Any laboratory performing work will be compliant with SW-846 requirements.

3.8 MANAGEMENT OF INVESTIGATION-DERIVED WASTE

Waste generated by sampling activities will be managed consistent with an established waste management plan. Unused samples and associated laboratory waste for analysis will be dispositioned in accordance with the laboratory contract and agreements for return to the Hanford Site. In accordance with 40 CFR 300.440, "National Oil and Hazardous Substances Pollution Contingency Plan," "Procedures for Planning and Implementing Off-Site Response Actions," task lead approval is required before unused samples or waste are returned from offsite laboratories.

4.0 HEALTH AND SAFETY

All field operations will be performed in accordance with Duratek health and safety requirements and the applicable portions of the *Washington Administrative Code* and RCW 43.21C, "State Government – Executive," "State Environmental Policy," (State Environmental Policy Act). In addition, work control documents will be prepared that will further control site operations. The safety documentation will include an activity hazard analysis, and applicable Fluor Hanford radiological work permits.

The sampling procedures and associated activities will implement as low as reasonably achievable (ALARA) practices to minimize the radiation exposure to the sampling team, consistent with the requirements defined in 10 CFR 835, "Occupational Radiation Protection," *Code of Federal Regulations,* as amended. All field operations will be performed in accordance with Fluor Hanford health and safety requirements. Duratek will comply with the Fluor Hanford Radiological Protection Program.

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APPENDIX A

CONTAMINANTS OF POTENTIAL CONCERN

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APPENDIX A

CONTAMINANTS OF POTENTIAL CONCERN

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TERMS

AMSCO	Allen Maintenance Supply Company, Inc.
COPC	contaminant of potential concern
COPEC	contaminant of potential ecological concern
OU	operable unit
PFP	Plutonium Finishing Plant
PRF	Plutonium Reclamation Facility
PUREX	Plutonium-Uranium Extraction Plant or process
RECUPLEX	Recovery of Uranium and Plutonium by Extraction Plant or process
REDOX	Reduction-Oxidation Plant or process
RG	rubber glove (line)
RMA	remote mechanical "A" (line)
RMC	remote mechanical "C" (line)
TBP	tributyl phosphate
URP	Uranium Recovery Process
WESF	225-B Waste Encapsulation and Storage Facility

APPENDIX A

CONTAMINANTS OF POTENTIAL CONCERN

This attachment presents the logic used to select sites for potential characterization and the logic used to select a list of contaminants of potential concern (COPC) that serve as one of the inputs to the selection of contaminants of potential ecological concern (COPEC). The term COPC is used in the context of the preliminary contaminant screening. The term COPEC specifically refers to the logic and output presented in Chapter 3.0 of WMP-20570, *Central Plateau Terrestrial Ecological Risk Assessment Data Quality Objectives Summary Report.*

A1.0 DEVELOPMENT OF CONTAMINANTS OF POTENTIAL CONCERN

A list of constituents was developed based on process and waste site knowledge using all Central Plateau process-based operable unit (OU) remedial investigation/feasibility study data quality objectives documents including CP-13196, *Remedial Investigation Data Quality Objective Summary Report – 200-IS-1 and 200-ST-1 Operable Units*. The initial list was screened for characteristics that would result in minimal ecological risk from specific contaminants, such as minimal use or having undergone numerous half-lives of radioactive decay. Similarly, many of the contaminants possess qualities that render them unlikely to present a risk to ecological receptors beyond the waste site boundaries. Substances resulting from Central Plateau waste streams that had high volatility, rapid environmental degradation relative to the age of the waste site, low potential for bioaccumulation, and low bioavailability likely would not represent important ecological risks and were excluded. Conversely, contaminants with properties of high persistence, slow degradation, high bioavailability, and high potential for bioaccumulation could pose ecological risks, and were retained as COPCs. The development of the COPC list is illustrated in Figure A-1. The list of COPCs produced from this evaluation is further screened using the logic in WMP-20570, Chapter 3.0.

For the purposes of this sampling and analysis plan, both the Central Plateau constituents (Table A-1) and the constituents listed in WAC 173-340-900, "Tables," Table 749-3 (Table A-2) are considered as the starting point for development of the COPECs list.

Some contaminants routinely are excluded from consideration as contaminants of concern for Hanford Site assessments (documents such as CP-13196). These substances are listed in Figure A-1, box D4Y, and include the following:

- Short-lived radionuclides having undergone more than eight half-life disintegrations (indicating that a maximum of only 0.07 percent of the initial concentration is present)
- Radionuclides that constitute less than 1 percent of the fission product inventory and for which historical sampling indicates nondetection
- Naturally occurring isotopes that were not created as a result of Hanford Site operations

- Constituents with atomic mass numbers greater than 242 that represent less than 1 percent of the actinide activities
- Progeny radionuclides that build insignificant activities within 50 years and/or for which parent/progeny relationships exist that permit progeny estimation
- Constituents that would be neutralized and/or decomposed by facility processes
- Chemicals in a gaseous state that cannot accumulate in soil media
- Chemicals used in minor quantities relative to the bulk production chemicals consumed in the normal processes; these chemicals are not likely to be present in toxic or elevated concentrations
- Chemicals that are not persistent in the environment because of volatilization, biological/physical/chemical degradation, or other natural mitigating features
- Chemicals that are not persistent in the vadose zone because of high mobility or as evidenced by previous confirmatory sampling/analysis activities.

Radionuclide constituents known or suspected to be present in the 200 Areas, that survived the exclusion evaluation are listed in Figure A-1, box D4N.

Nonradionuclide constituents that are not identified in WAC 173-340-900, Table 749-3, have been or will be evaluated as COPCs in the Central Plateau through the OU-specific data quality objectives processes. Once the remedial investigation data are available, detected constituents will be evaluated for potential ecological risks in accordance with this document and the U.S. Environmental Protection Agency guidance.

A2.0 HANFORD SITE CENTRAL PLATEAU CHEMICAL PROCESSES

The following sections illustrate the five main Hanford Site processes for chemical separation and waste treatment operations conducted in the Central Plateau.

Bismuth Phosphate Process. The bismuth phosphate process was an inorganic, step-wise, precipitation process that separated plutonium from uranium and fission products. This process occurred in the 221-B and 221-T Canyon Buildings and used sodium hydroxide to remove aluminum cladding and concentrated nitric acid to dissolve the fuel rods. Bismuth phosphate and bismuth oxynitrate were used to support precipitation of plutonium, while hydrogen peroxide, sodium dichromate, ferrous hydroxide, and ferrous ammonium sulfates were used to change the plutonium valence during the oxidation reactions. Phosphoric, sulfuric, and nitric acids were added to dissolve the precipitants formed. The bismuth phosphate process preferentially attracted plutonium from the solution and, as a precipitate, was physically separated by centrifuging.

The second part of the bismuth phosphate process included the lanthanum fluoride process. It was performed in the 224-B and 224-T Concentration Facilities and further purified the dilute

plutonium solution created in the last step of the bismuth phosphate process. The dilute plutonium nitrate supernatant was oxidized with sodium metabismuthate. Phosphoric acid was added to precipitate impurities, and the resulting solution was treated with oxalic and hydrofluoric acids and lanthanum salt. As a result, lanthanum fluoride and plutonium fluorides were co-precipitated. Next, the lanthanum and plutonium fluoride solids were converted to hydroxides by the addition of a hot potassium hydroxide solution. The hydroxides were washed with water, dissolved in nitric acid, and heated to form a concentrated plutonium nitrate solution. This solution was sent to the isolation building (231-Z Plutonium Isolation Plant) for further purification treatments and evaporation. A concentrated plutonium nitrate paste was the final product. For every batch (760 L [200 gal]) of dilute, unpurified plutonium solution entering the 224-B and 224-T Concentration Facilities, an estimated 30 L (8 gal) of purified concentrated weapons-grade plutonium was produced (HW-10475, *Hanford Engineer Works Technical Manual (T/B Plants)*).

Uranium Recovery Process U/UO_3 Plant and Scavenging Operations and PUREX Process. The Uranium Recovery Process (URP) was implemented at U Plant to recover the spent uranium from the metal waste and first-cycle waste streams generated in T and B Plants for reuse in weapons-grade plutonium production. The URP was performed in three phases. The first phase included the removal of bismuth/phosphate waste (metal waste, first-cycle supernatants, and cell 5 and 6 drainage) from the T, TX, TY, B, BX, and BY Tank Farms and preparation of the sludge/slurry solution, using nitric acid to dissolve the uranium metal and jet it into the plant. The second phase consisted of the separation of the uranium from remaining plutonium, fission products, and nonradiological constituents by a solvent extraction process. The counter-current solvent extraction process used tributyl phosphate (TBP) in a normal paraffin hydrocarbon diluent such as AMSCO[1] or kerosene to bond with the uranium. Sulfamic acid and ferrous ammonia sulfate were used to ensure that the correct valence state was obtained. The separated uranyl nitrate hexahydrate was sent to the 224-U (Concentration Facility) Building or the UO_3 Plant where it was calcined or heated to 400 °F to drive off nitrate, resulting in UO_3. The UO_3 powder was removed from the vessels, packaged, and shipped offsite to Oak Ridge, Tennessee, where it was converted to uranium metal; then it was sent back to the 300 Area at the Hanford Site to be reincorporated into the uranium fuel rod production (HW-19140, *Uranium Recovery Technical Manual*).

In 1953, tests to further treat URP aqueous waste streams generated at the T, U, and B Plants during the bismuth/phosphate campaign proved successful. The "scavenging" process separated the long-lived fission products (including Sr-90 and Cs-137) from the waste solutions by precipitation. The order of operations often was modified throughout the duration of the scavenging process. After URP processing, TBP column wastes were sent to a neutralization tank at the U Plant, where the pH was adjusted to 9 ± 1. Chemicals used to scavenge fission products included potassium and sodium derivatives of the metal/ferrocyanide complex ion. The most notable and widely used metals (used to assist precipitation) were iron, nickel, and cobalt. Calcium nitrate and/or strontium nitrate often were added to enhance the precipitation of Sr-90.

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[1] AMSCO is the trade name of a kerosene-based solvent, and is a trademark of Allen Maintenance Supply Company, Inc., Allentown, Pennsylvania.

Phosphate ions also were added to aid the soil retention of Sr-90. After the TBP waste had been scavenged, it was returned to the B, BX, BY, T, TX, and TY Tank Farms to allow the solids (containing the fission products and scavenging chemicals) to settle. The waste was sampled from the tanks at various depths and analyzed before the liquid effluent was sent to cribs and/or trenches (pending the concentrations of Cs-137 and Sr-90) or was rerouted to other nearby tanks, where settling continued. The U/UO_3 and scavenging operations process samples were analyzed at the 222-U or 222-S Laboratories.

The Plutonium-Uranium Extraction (PUREX) process was an advanced solvent extraction process that replaced the Reduction-Oxidation (REDOX) process. PUREX used a recyclable salting agent, nitric acid (which greatly lessened costs and the amount of waste generated), and TBP in a normal paraffin hydrocarbon diluent such as AMSCO or kerosene solution as a solvent, just like the URP process. The main purpose of the PUREX facility (202-A Canyon Building) was to extract, purify, and concentrate plutonium, uranium, and neptunium contained in irradiated uranium fuel rods discharged from Hanford Site reactors. Fuel decladding was performed with a boiling sodium hydroxide/sodium nitrate solution or a boiling solution of ammonium fluoride and ammonium nitrate. Feed dissolution used concentrated nitric acid and ammonium nitrate nonahydrate. The prepared feed entered the pulsing, counter-current solvent extraction column, where TBP in a normal paraffin hydrocarbon diluent was fed to the bottom of the column and the aqueous phase (sodium nitrite/nitric acid salting agent solution) was fed to the column from the top. Dilute nitric acid, ferrous sulfamate, and sulfamic acid descended from the top of the second column to remove uranium and neptunium from plutonium. Chemical separation processes were based on conducting multiple purification operations on the resulting aqueous nitrate solution containing each of the separated products. The driving forces for the separations consisted of varying partition coefficients between aqueous and organic phases, controlled by valence state changes of the element of interest (DOE/RL-92-04, *PUREX Plant Source Aggregate Area Management Study Report*). The solvent and salting agent (nitric acid) were recovered, treated, and recycled back into the process operations. An analytical laboratory also was housed within the 202-A (A Plant Canyon) Building.

REDOX. The REDOX process, used until 1967, was a solvent-extraction process that extracted plutonium and uranium from dissolved fuel rods into a methyl isobutyl ketone (or hexone) solvent. The solvent-extraction process was based on the preferential distribution of uranyl nitrate and the nitrates of plutonium between an aqueous phase and an immiscible organic phase (DOE/RL-91-60, *S Plant Source Aggregate Area Management Study Report*). The REDOX process included fuel decladding with boiling sodium hydroxide/sodium nitrate solution or a boiling solution of ammonium fluoride and ammonium nitrate. Feed dissolution using concentrated nitric acid and plutonium oxidation was completed simultaneously with potassium permanganate and sodium dichromate. The prepared feed entered the packed counter-current solvent extraction column, where acidified hexone was fed to the bottom of the column and the aqueous phase (ammonium nitrate nonahydrate scrub solution or salting agent) was fed to the column from the top. The aqueous solubility of the uranium and plutonium nitrates was reduced by increasing the nitrate concentration in the aqueous phase. The uranium and plutonium were extracted into the organic phase and routed to the second extraction column, while the fission products remained in the aqueous phase. Uranium and plutonium (present in the organic phase) were chemically separated in the second extraction column using ferrous sulfamate solution containing ammonium nitrate nonahydrate to reduce the plutonium to the +III valence state.

Further purification cycles of uranium and plutonium were conducted during operations using the same chemical constituents. The solvent was recovered and recycled back into the process after sampling and analysis. Waste generated in the 202-S REDOX or Canyon Building also was treated and routed to cribs after sampling and analysis. Radioactive and radioactive mixed liquid wastes from the laboratory were treated in the 219-S Waste Handling Facility.

Waste Recovery/Fractionation/WESF. From 1961 (Hot Semiworks) and 1963 to 1966 (B Plant), strontium, cerium, and rare earths were recovered using an acid-side, oxalate-precipitation process. The waste recovery/fractionation process included a thermal evaporation to concentrate process wastewaters before disposal. This system was used to concentrate low-level radioactive waste once the cesium and strontium waste fractionation process was shut down in 1984. Double-shell tank waste was received at the 221-B Canyon Building (B Plant) to be processed through the low-level waste concentrator from 1968 to 1986. Other sources of low-level waste included miscellaneous sumps and drains in WESF, which diverted decontamination waste solutions generated in the 225-B Waste Encapsulation and Storage Facility (WESF) process cells. Another contributor was a liquid collection system located beneath the 40 cells in the 221-B Building that collected cell drainage from decontamination work and water washdowns in the processing section of the 221-B Canyon Building. The concentrator also processed wastes produced by the cleanout process vessels at the 221-B Canyon Building and WESF from 1968 to 1986 (DOE/RL-92-05, *B Plant Source Aggregate Area Management Study Report*). The strontium recovery process was performed via solvent extraction using a complexant di-2-ethyl-hexyl phosphoric acid to extract strontium from acid solutions of waste fuels.

The Z Plant Complex (231-Z and 234-5Z). At the Z Plant Complex, the recovered, purified plutonium was refined to one of several forms, depending on the era and available process. At the start of Hanford Site operations (1945 to 1949), plutonium was refined in the 231-Z Plutonium Isolation Plant Building, where it was converted to a nitrate paste before being shipped off site. In 1949, the 231-Z Plutonium Isolation Plant Building was converted into a plutonium metallurgy laboratory (Materials Engineering Laboratory) and operated in this capacity from the 1950s until the 1970s. The research included tensile strength, stress testing, coating, and other material science properties of plutonium and plutonium alloys. Beginning in the 1960s, the U.S. Atomic Energy Commission's Division of Military Application began the design, development, and fabrication of experimental weapons that supported the weapons testing program at the Nevada Test Site. Other projects including state-of-the-art sampling methods for plutonium buttons, new coating processes, and development work in reactor fuels containing plutonium and other alpha-emitting materials also were completed at the 231-Z Materials Engineering Laboratory Building in the late 1960s and early 1970s. In 1975, the experimental work performed by the Division of Military Application was phased out (HNF-EP-0924, *History and Stabilization of the Plutonium Finishing Plant (PFP) Complex, Hanford Site*). Shortly thereafter, however, a more elaborate plant, the 234-5Z Plutonium Finishing Plant (PFP), was constructed with the capability to convert plutonium into metal, nitrate, or oxide forms. A number of process lines in the 234-5Z Building were used between 1949 and 1989. Initially, batch inorganic chemical steps were used to refine and convert plutonium to the desired form. Later, elaborate mechanical extraction processes were developed. The PFP was used to fabricate plutonium into weapons shapes and reprocessing scrap plutonium, using solvent extraction techniques based on TBP mixed with carbon tetrachloride (Recovery of

Uranium and Plutonium by Extraction or RECUPLEX process). Processes at the Z Plant Complex that generated the primary waste streams into the 200-PW-1 OU waste sites included the following. (It should be noted that 200-PW-1 waste sites did not receive any waste from the 231-Z Building and its operations.)

- Plutonium finishing: Conducted at the PFP or the 234-5Z Building, these processes operated continuously from 1949 to 1973, and intermittently between 1985 and 1988. Waste generated by these processes included hydroiodic, hydrofluoric, hydrochloric, nitric, and sulfuric acids in addition to oxalate, potassium permanganate, magnesium oxide, lanthanum, gallium, polychlorinated biphenyls, acetone, lard oil, and various other oils and solvents used for plutonium metal machining.

- Rubber glove (RG) line: Operation was then transferred to the newly constructed 234-5 Building in 1949 and operated until 1953, when it was abandoned for remote mechanical operations. Waste generated by this process included hydrofluoric, sulfuric, and nitric acids, as well as peroxide, plutonium, and other transuranic metals.

- Remote mechanical "A" line: The remote mechanical "A" (RMA) line was constructed in 1949 and began operations in 1953. The RMA line operated until it was upgraded to remote mechanical C (RMC) line operations. The process was the same as the RG line chemically; however, the plutonium was handled by remote mechanical means. Thus, the RMA produced the same waste as the RG line.

- Remote Mechanical "C" line: The RMC line was constructed in 1957 and began operations in 1960. The RMC line operated until 1973 and again from 1985 to 1989. The process was the same as the RG and RMA lines chemically; however, the plutonium was handled remotely by mechanical means, with additional mechanical upgrades to increase the safety of the operators. Thus, the RMC produced the same waste as the RG and RMA lines.

- Plutonium metal fabrication: Weapons-grade plutonium metal was cut and milled into weapons shapes for quick assembly into nuclear weapons in the late 1950s. Waste generated by this process included mixed lard and carbon tetrachloride, as well as other volatile organics used as cutting fluids.

- RECUPLEX: This plutonium recovery process operated inside the 234-5Z Building from 1951 to 1962, at which time it was terminated after a criticality event (uncontrolled nuclear reaction) within the PFP. Waste generated by this process included hydroiodic, hydrofluoric, sulfuric, and nitric acids, plus silver, carbon tetrachloride and TBP, plutonium, and other transuranic metals.

- Americium recovery: An americium recovery process operated in the 242-Z Waste Treatment Facility Building between 1964 and 1976. It was shut down in 1976 after an explosion occurred in one of the recovery units. Waste generated by this process included hydrochloric, hydrofluoric, phosphoric, and nitric acids, as well as dibutyl butyl phosphonate, carbon tetrachloride and TBP, plutonium, and other transuranic metals.

- Plutonium Reclamation Facility: In 1964, a replacement scrap solution recovery facility, the Plutonium Reclamation Facility (PRF), was brought on line in the 236-Z Building. The PRF operated from 1964 to 1979 and from 1984 to 1987. Waste generated by this process included hydrofluoric, phosphoric, and nitric acids, along with silver, hydroxyl amines, dibutyl butyl phosphonate, carbon tetrachloride and TBP, uranium, plutonium, and other transuranic metals.

The Critical Mass Laboratory (209-E Building) conducted criticality experiments from 1960 to 1983 using plutonium nitrate and enriched uranium solutions. Criticality research also was conducted with solid nuclear materials and fuels such as plutonium blocks, uranium blocks and slabs, and fuel assemblies from the Fast Flux Test Facility and other reactors (DOE/RL-92-18, *Semiworks Plant Source Aggregate Area Management Study Report*).

A3.0 CENTRAL PLATEAU FACILITY WASTES

A number of other facilities in the Central Plateau have contributed to the collective Central Plateau facility waste groupings. Some of these waste sources are as follows:

- Decontamination efforts
- Solid wastes in burial grounds from offsite sources
- Laundry waste effluents
- Powerhouse solid debris and effluents
- 200-CW-3 waste sites or 200 Area North operational discharges
- Central Plateau shops, dumps, chemical landfill wastes.

Two types of decontamination operations were conducted in the 200 West Area. These included decontamination and refurbishment of highly contaminated process equipment and the decontamination of heavy equipment and vehicles. Where known, decontamination wastes from process equipment were grouped with their respective chemical process/waste handling operation. Typical decontamination efforts involved chemical and water flushes, but techniques other than water and chemical flushes also were used. Sand blasting and ultrasonic cleaning were used when considered suitable.

Over the course of equipment decontamination and refurbishment operations at the various facilities, numerous chemical compounds including phosphate-based soaps and complexants were used. Tables in WHC-EP-0172, *Inventory of Chemicals Used at Hanford Site Production Plants and Support Operations (1944-1980)*, provide a listing of compounds that were used at either the 221-T or the U Plant over the period from 1961 through 1980. Decontamination wastes from the 221-T Plant were routed through tanks and ultimately to the 216-T-27 and 216-T-28 Cribs. Decontamination wastes from the 221-U Plant were routed to the 216-U-4A and 216-U-4B French Drains.

Contamination of heavy equipment, railcars, and vehicles usually consisted of particles of fission products (e.g., ruthenium, zirconium, niobium, iodine). These particles were drawn into the radiator and other engine components and became attached to oily surfaces of the engine compartment. To continue use of this equipment, a decontamination facility was established at

the 269-W Garage. Removal of contamination was accomplished using commercial cleaners (Actresol, Kerful Cleaner, Aeso Wash[2]) and a steam jet spray on the radiators, engines, and undercarriages. Painted automobile surfaces and all interior surfaces and materials were hand cleaned using mild detergents such as Calgon.[2] Sometimes external surfaces required more stringent methods, such as aggressive chemicals like Kleeno Bowl and other harsh acids and caustics, and occasional sandblasting (HW-63110, *Decontamination*).

These decontamination operations initially were performed outdoors in open pit areas such as the 216-U-13 Trench (1952 to 1956) and the 216-T-13 Trench (1954 to 1988). These sites had limited facilities for handling steam and water. Provisions for waste collection, drainage, and disposal were considered unsatisfactory. Cold and inclement weather further complicated the work. In 1964, a new decontamination facility, the 2706-T Building (originally known as 2706-W), was completed. This facility provided improved steam, high-pressure water, and chemical cleaning capabilities for all of the site's railroad equipment and heavy and light duty automotive equipment. Means for adding chemicals to the steam spray or high-pressure water were made available. Adequate waste collection, drainage, and disposal facilities were provided. Commercial chemicals were tested for their application to this decontamination work. Among the waste sites used for disposal of decontamination wastes from the 2706-T Building were the 216-T-33 Crib in the 200-MW-1 OU and the 216-T-27 and 216-T-28 Cribs in the 200-LW-1 OU. After the pipeline to the 216-T-33 Crib plugged in February 1963, waste was routed to the 216-T-28 Crib. The 216-T-27 and 216-T-28 Cribs were active from February 1960 to December 1966.

A4.0 EXCLUSIONS AND CONTAMINANTS OF POTENTIAL CONCERN

Table A-3 lists the constituents that were excluded, with supporting rationale and references. The constituents that survived the exclusion process are identified as contaminants of potential concern and are shown in Table A-4.

A5.0 REFERENCES

CP-13196, 2002, *Remedial Investigation Data Quality Objective Summary Report – 200-IS-1 and 200-ST-1 Operable Units*, Draft A, Fluor Hanford, Inc., Richland, Washington.

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

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Figure A-1. Contaminants of Potential Concern Evaluation Process.

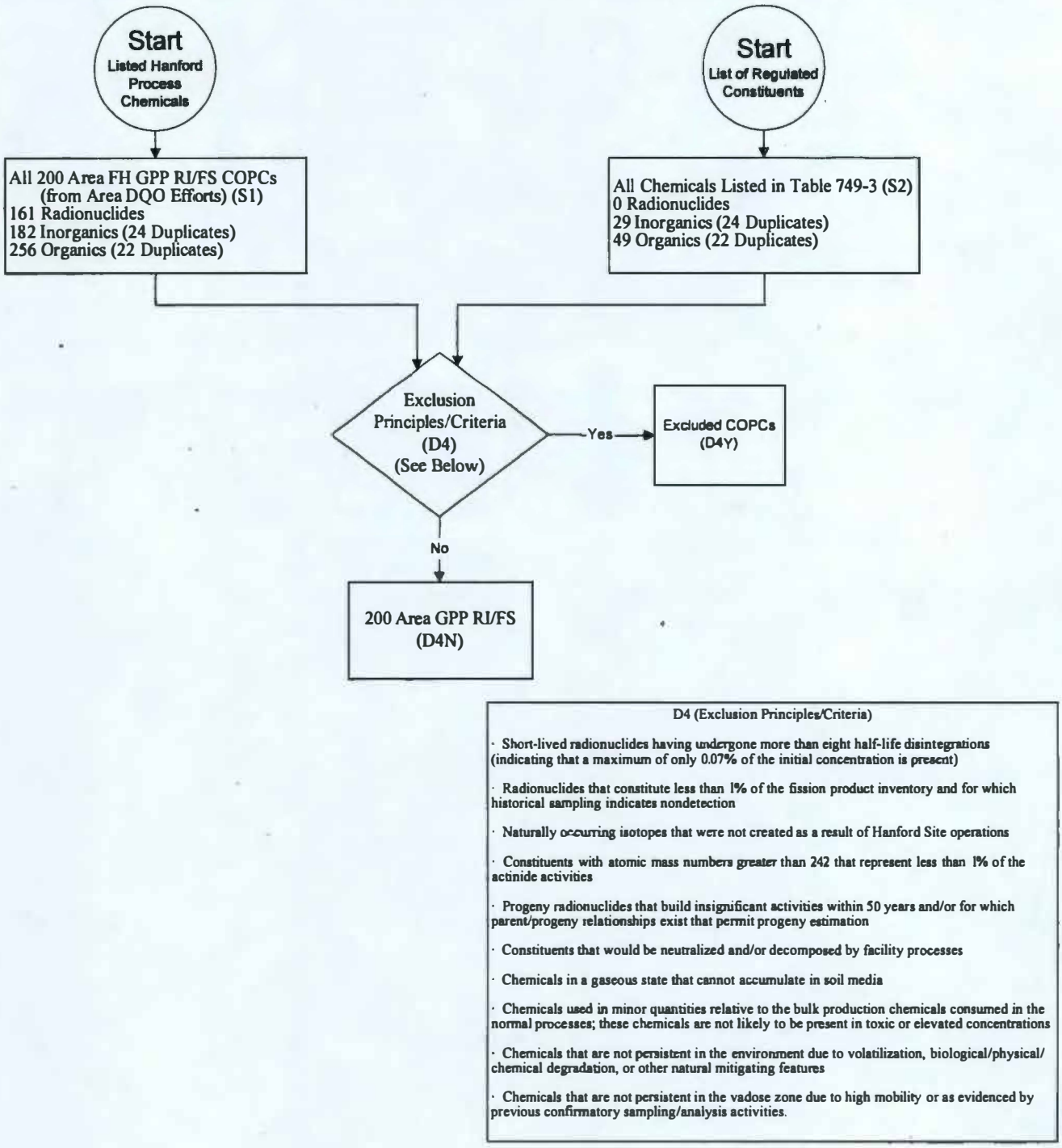

Table A-1. Central Plateau Process Contaminants. (8 Pages)

Number	Constituent	Number	Constituent
Radionuclides			
1	Actinium-225	46	Francium-221
2	Actinium-227	47	Francium-223
3	Aluminum-28	48	Gadolinium-152
4	Americium-241	49	Gadolinium-153
5	Americium-242	50	Germanium-68
6	Americium-242m	51	Gold-195
7	Americium-243	52	Hydrogen-3 (tritium)
8	Antimony-122	53	Iodine-123
9	Antimony-123	54	Iodine-125
10	Antimony-124	55	Iodine-129
11	Antimony-125	56	Iodine-131
12	Antimony-126	57	Iron-55
13	Antimony-126m	58	Iron-59
14	Barium-133	59	Krypton-85
15	Barium-135m	60	Lanthanum-140
16	Barium-137	61	Lead-209
17	Barium-137m	62	Lead-210
18	Barium-140	63	Lead-211
19	Beryllium-10	64	Lead-212
20	Bismuth-210	65	Lead-214
21	Bismuth-213	66	Manganese-54
22	Bismuth-214	67	Molybdenum-93
23	Cadmium-109	68	Neodymium-147
24	Cadmium-113m	69	Neptunium-237
25	Carbon-14	70	Neptunium-239
26	Cerium-141	71	Nickel-59
27	Cerium-144	72	Nickel-63
28	Cesium-134	73	Niobium-93m
29	Cesium-135	74	Niobium-94
30	Cesium-137	75	Niobium-95
31	Cesium-141	76	Niobium-96
32	Cesium-144	77	Niobium-98
33	Chlorine-36	78	Palladium-107
34	Chromium-51	79	Phosphorus-32
35	Cobalt-57	80	Plutonium-238
36	Cobalt-58	81	Plutonium-239/240
37	Cobalt-60	82	Plutonium-241
38	Curium-242	83	Plutonium-242
39	Curium-243	84	Polonium-210
40	Curium-244	85	Polonium-211
41	Curium-245	86	Polonium-212
42	Ensteinium-254	87	Polonium-213
43	Europium-152	88	Polonium-214
44	Europium-154	89	Polonium-215

Table A-1. Central Plateau Process Contaminants. (8 Pages)

Number	Constituent	Number	Constituent
Radionuclides (cont)			
45	Europium-155	90	Polonium-216
91	Polonium-218	127	Tellurium-127
92	Potassium-40	128	Tellurium-129
93	Praseodymium-143	129	Tellurium-129m
94	Praseodymium-144	130	Thallium-204
95	Promethium-143	131	Thallium-207
96	Promethium-147	132	Thallium-208
97	Protactinium-231	133	Thallium-209
98	Protactinium-233	134	Thorium-227
99	Protactinium-234	135	Thorium-228
100	Radium-223	136	Thorium-229
101	Radium-224	137	Thorium-230
102	Radium-226	138	Thorium-231
103	Radium-228	139	Thorium-232
104	Radon-219	140	Thorium-233
105	Radon-220	141	Thorium-234
106	Radon-222	142	Thulium-170
107	Rhenium-187	143	Tin-113
108	Rhodium-106	144	Tin-123
109	Ruthenium-103	145	Tin-123m
110	Ruthenium-106	146	Tin-125
111	Samarium-147	147	Tin-126
112	Samarium-149	148	Uranium-232
113	Samarium-151	149	Uranium-233
114	Selenium-75	150	Uranium-234
115	Selenium-79	151	Uranium-235
116	Silver-108	152	Uranium-236
117	Silver-110m	153	Uranium-237
118	Sodium-22	154	Uranium-238
119	Strontium-85	155	Vanadium-49
120	Strontium-89	156	Yttrium-88
121	Strontium-90	157	Yttrium-90
122	Sulfer-35	158	Yttrium-91
123	Tantalum-182	159	Zinc-65
124	Technetium-99	160	Zirconium-93
125	Tellurium-121	161	Zirconium-95
126	Tellurium-125m		

Table A-1. Central Plateau Process Contaminants. (8 Pages)

Number	Constituent	Number	Constituent
Inorganics			
162	Aluminum	207	Chromium Nitrate
163	Aluminum Nitrate (Mono Basic)	208	Chromous Sulfate
164	Aluminum Nitrate (Nonahydrate)	209	Clayton Kerful Cleaner
165	Aluminum Sulfate	210	Clorox
166	Ammonia/Ammonium	211	Cobalt
167	Ammonium Chloride	212	Cobalt Sulfate
168	Ammonium Fluoride	213	Copper
169	Ammonium Hydroxide	214	Cyanide
170	Ammonium Nitrate	215	Dichromate
171	Ammonium Silicofluoride	216	Ferric Ammonium Sulfate
172	Ammonium Sulfate	217	Ferric Nitrate
173	Ammonium Sulfite	218	Ferric Sulfate
174	Antimony	219	Ferrous Ammonium Sulfate
175	Arsenic	220	Ferrous Sulfamate
176	Barium	221	Ferrous Sulfate
177	Barium Nitrate	222	Fluorine (as fluoride)
178	Beryllium	223	Gallium
179	Bismuth	224	Gallium Oxide
180	Boron	225	Germanium
181	Borate(s)	226	Gold
182	Boric Acid	227	Hafnium
183	Borox (Boric Acid)	228	Hydrobromic Acid
184	Bromine	229	Hydrochloric Acid
185	Cadmium	230	Hydrofluoric Acid
186	Cadmium Nitrate	231	Hydrogen
187	Calcium	232	Hydrogen Fluoride
188	Calcium Carbonate	233	Hydrogen Peroxide
189	Calcium Chloride	234	Hydroiodic Acid
190	Calcium Nitrate	235	Hydroxide
191	Carbon	236	Indium
192	Carbon Dioxide	237	Iodine
193	Carbon Disulfide	238	Iron
194	Carbonate(axb)	239	Kleen-o-bowl
195	Cerium	240	Lanthanum
196	Ceric Ammonium Nitrate	241	Lanthanum Fluoride
197	Ceric Fluoride	242	Lanthanum Hydroxide
198	Ceric Iodate	243	Lanthanum Nitrate
199	Ceric Nitrate	244	Lanthanum-Neodynium Nitrate
200	Ceric Sulfate	245	Lead
201	Cesium	246	Lead Nitrate
202	Cesium Chloride	247	Lithium
203	Chloride	248	Magnesium
204	Chloroplatinic Acid	249	Magnesium Carbonate
205	Chromium	250	Magnesium Nitrate

Table A-1. Central Plateau Process Contaminants. (8 Pages)

Number	Constituent	Number	Constituent
Inorganics (cont)			
206	Chromium (VI)	251	Magnesium Oxide
252	Magnesium Silicate (Mistron)	296	Silicon
253	Manganese	297	Silver
254	Mercury (inorganic)	298	Silver Nitrate
255	Mercuric Nitrate	299	Silver Oxide
256	Mercuric Thiocyanate	300	Sodium
257	Molybdenum	301	Sodium Acetate
258	Neodymium	302	Sodium Bismuthate
259	Nickel	303	Sodium Bisulfate
260	Nickel Nitrate	304	Sodium Bromate
261	Nickel Sulfate	305	Sodium Carbonate
262	Nitrate/Nitrite	306	Sodium Dichromate
263	Nitric Acid	307	Sodium Ferrocyanide
264	Nitrogen	308	Sodium Fluoride
265	Oakite LSD	309	Sodium Hydroxide
266	Osmium	310	Sodium Nitrate
267	Oxides	311	Sodium Nitrite
268	Oxygen	312	Sodium Oxalate
269	Ozone	313	Sodium Persulfate
270	Perchlorate	314	Sodium Phosphate
271	Periodic Acid	315	Sodium Sulfate
272	Permanganate	316	Sodium Thiosulfate
273	Phosphorus	317	Spic-n-Span
274	Phosphate	318	Strontium
275	Phosphoric Acid	319	Strontium Fluoride
276	Phosphorous Pentoxide	320	Strontium Nitrate
277	Phosphotungstic Acid	321	Sulfamates
278	Platinum	322	Sulfamic Acid
279	Plutonium	323	Sulfate/Sulfite
280	Potassium	324	Sulfonate
281	Potassium Acetate	325	Sulfuric Acid
282	Potassium Bicarbonate	326	Tantalum
283	Potassium Carbonate	327	Tellurium
284	Potassium Dichromate	328	Tin
285	Potassium Ferrocyanide	329	Titanium
286	Potassium Fluoride	330	Titanium Chloride
287	Potassium Hydroxide	331	Tungsten
288	Potassium Iodate	332	Turco 4306 B, C, and D
289	Potassium Oxalate	333	Turco 4502D
290	Potassium Permanganate	334	Turco 4512 A
291	Potassium Persulfate	335	Uranium (chemical toxicity)
292	Rhodium	336	Vanadium
293	Ruthenium	337	Yttrium

Table A-1. Central Plateau Process Contaminants. (8 Pages)

Number	Constituent	Number	Constituent
Inorganics (cont)			
294	Sani-Flush	338	Zeolite AW-500 (IX Resin)
295	Selenium	339	Zinc
340	Zinc Amalgam		
341	Zirconium		
342	Zirconyl Nitrate		
343	Zirconyl Phosphate		
Organics			
344	1,1-dichloroethane (DCA)	383	Acenaphthylene
345	1,1-dichloroethene	384	Acetic Acid
346	1,1-dimethylhydrazine	385	Acetic Acid Ethyl Ester
347	1,1,1-trichloroethane (TCA)	386	Acetic acid n-butyl-ester
348	1,1,2-trichloroethane	387	Acetone
349	1,1,2,2-tetrachloroethane	388	Acetonitrile
350	1,2-dichloro-1,1,2,2-tetrafluoroethane (Freon 114)	389	Acetophenone
351	1,2-dichlorobenzene	390	Acrolein
352	1,2-dichloroethane (DCA)	391	Acrylonitrile
353	1,2,2-trichloro-1,1,2-trifluoroethane	392	Aldrin
354	1,2,4-trichlorobenzene	393	Alizarin Yellow
355	1,3-butadiene	394	alpha-BHC
356	1,3-dichlorobenzene	395	Ammonium Oxalate
357	1,4-dinitrobenzene	396	Ammonium Perfluorooctanoate
358	1,4-dioxane	397	AMSCO
359	1-chloroethene (Vinyl Chloride)	398	Anthracene
360	1-methylpropyl Alcohol (2-butanol)	399	Anti-Foam 60 (GE)
361	2,4-dinitrophenol	400	Arsenzao III
362	2,4-dinitrotoluene	401	Benzene
363	2,4,5-trichlorophenol	402	Benzene hexachloride
364	2,6-bis(tert-butyl)-4-methylphenol	403	Benzo(a)anthracene
365	2-butanone (Methyl Ethyl Ketone/MEK)	404	Benzo(a)pyrene
366	2-butenaldehyde (2-butenal)	405	Benzo(b)fluoranthene
367	2-heptanone	406	Benzo(ghi)perylene
368	2-hexanone	407	Benzo(k)fluoranthene
369	2-methyl-2-propanol	408	Benzyl Alcohol
370	2-methyl-2-propenenitrile	409	beta-BHC [Lindane]
371	2-methylphenol (o-cresol)	410	Biphenyl
372	2-pentanone	411	Bromocresol Purple
373	2-propenoic acid	412	Bromomethane
374	2-sec-butyl-4,6-dinitrophenol (dinoseb)	413	Bromonaphthalene
375	3-chloropropene	414	Butane
376	3-heptanone	415	Butanol
377	3-methyl-2-butanone	416	Carbazole
378	3-pentanone	417	Carbon Tetrachloride
379	4-heptanone	418	Chlordane
380	4-methylphenol (p-cresol)	419	Chlorobenzene

Table A-1. Central Plateau Process Contaminants. (8 Pages)

Number	Constituent	Number	Constituent
Organics (cont)			
381	5-methyl-2-hexanone	420	Chlorodifluoromethane (Freon 22)
382	Acenaphthene	421	Chloroethane
422	Chloroform	464	Heptachlor
423	Chloromethane	465	Hexachlorobenzene
424	Chrysene	466	Hexachlorobutadiene
425	Cis-1,2-dichloroethylene	467	Hexachloroethane
426	Cis-1,3-dichloropropene	468	Hexachloronaphthalene
427	Citric Acid	469	Hexafluoroacetone
428	Cyclohexane	470	Hexanal
429	Cyclohexanone	471	Hydrazine
430	Cycleohexene	472	Hydroxyacetic Acid
431	Cyclopentane	473	Hydroxylamine Hydrochloride
432	DDT/DDD/DDE (total)	474	Hydroxylamine Nitrate (HN)
433	Decane	475	Hydroxyquinoline
434	Di-(2-ethylhexyl) Phosphoric Acid	476	Hyflo-Super-Cel
435	Diacetone Alcohol	477	Immunol 1468-2
436	Dibenz[a,h]anthracene	478	Ionac A-580/Permutit [SKA] (IX Resin)
437	Dibenzofuran	479	Isodrin
438	Dibutyl Butyl Phosphonate (DBBP)	480	Isopropyl Alcohol
439	Dibutyl Phosphate (DBP)	481	Jasco Paint Stripper
440	Dichlorodifluoromethane	482	Kelite 25E
441	Dichlorofluoromethane (Freon 21)	483	Keraff
442	Dichloromethane (Methylene Chloride)	484	Kerosene
443	Dieldrin	485	Lard Oil
444	Diethylphthalate	486	Mandelic Acid
445	Di-n-butylphthalate	487	Methanol
446	Diversy Chemical 159	488	Methyl Isobutyl Ketone (MIBK/Hexone)
447	Dodecane	489	Methyl Isocyanate
448	Dow Anti-Foam B	490	Methyl Lactic Acid
449	Dowex 21 K/Amberlite XE-270 (IX Resin)	491	Methylcyclohexane
450	Duolite ARC-359 (IX Resin)	492	Methylhydrazine
451	Endrin	493	Mineral Oil
452	Ethanol	494	Miscellaneous Commercial Products
453	Ethyl Benzene	495	Molybdate-Citrate Reagent
454	Ethyl Ether	496	Mono-2-ethylhexyl Phosphoric Acid
455	Ethylene Dibromide	497	Monobutyl Phosphate (MBP)
456	Ethylene Glycol	498	m-xylene
457	Ethylene-diamine Tetraacetic Acid (EDTA)	499	Naphthalene
458	Fluoranthene	500	Naphthylamine
459	Formaldehyde	501	n-butyl Benzene
460	Formic Acid	502	n-heptane

Table A-1. Central Plateau Process Contaminants. (8 Pages)

Number	Constituent	Number	Constituent
Organics (cont)			
461	gamma-BHC (Lindane)	503	n-hexane
462	Glycerol	504	Nitrilotriacetic Acid (NTA)
463	Greases	505	Nitrobenzene
506	n,n-diphenylamine	549	Super Gel Hyflo
507	n-nitroso-n,n-dimethylamine	550	Tartaric Acid
508	n-nonane	551	Tetrabromoethane
509	n-octane	552	Tetrachloroethylene (PCE)
510	Normal Paraffin Hydrocarbons	553	Tetrachloronaphthalene
511	n-pentane	554	Tetradecane
512	n-propionaldehyde	555	Tetrahydrofuran
513	n-propyl Alcohol (1-propanol)	556	Tetraphenyl Boron
514	Oakite Clear Guard	557	Thenyltrifluoroacetone
515	Oakite Rust Stripper	558	Thymolphthalein
516	Oakite Swiff	559	Tide
517	Octachloronaphthalene	560	Toluene
518	o-phenanthroline	561	Total Organic Carbon
519	Orvus K	562	Toxaphene
520	Oxalic Acid	563	Trans-1,2-dichloroethylene
521	Oxirane (Ethylene Oxide)	564	Trans-1,3-dichloropropene
522	o-xylene	565	Tributyl Phosphate (TBP)
523	Pace-S-Teen	566	Trichloroethylene (TCE)
524	Pentachloronaphthalene	567	Trichlorofluoromethane
525	Pentachlorophenol	568	Triethylamine
526	Pentasodium Diethylene Triamine Penta Acetate (DTPA)	569	Tri-iso-octylamine
527	Penvert 192	570	Tri-n-dodecylamine
528	Peroklean	571	Tri-n-octylamine
529	Phenanthrene	572	Tris (hydroxymethyl) Amino Methane
530	Phenol	573	Trisodium hydroxyethyl Ethylene-diamine triacetate (HEDTA)
531	Phosphotungstic Acid (PTA)	574	Trisodium Nitrilo Triacetate (NTA)
532	Picric Acid	575	Turco (Fabricfilm)
533	p-nitrochlorobenzene	576	Turco 2822
534	Polychlorinated Biphenyls (PCB)	577	Turco 2844
535	Propionitrile	578	Turco 4358-4A
536	p-xylene	579	Turco 4501 A
537	Pyrene	580	Turco 4518
538	Pyridine	581	Turco 4521
539	Saf-tee Solvent F.O. 128	582	Turco 4605-8
540	s-diphenyl Carbazide	583	Turco 4669
541	Shell E-2342	584	Turco 4715
542	Shell Spray Base	585	Turco 4738 (Thin)
543	Sodium Gluconate	586	Turco Alkaline (Rust Remover)
544	Sodium Tartrate	587	Turco Deseal Zit 2
545	Soltrol-170	588	Turco EPO Strip

Table A-1. Central Plateau Process Contaminants. (8 Pages)

Number	Constituent	Number	Constituent
Organics (cont)			
546	Spartan DC 13	589	Turco EPO Strip NP
547	Sugar	590	Turco Plaudit
548	Sulfonic Acid (chloro)	591	Turco T-5561
592	Turco T-5589	596	Wyandotte Kelvar
593	Urea	597	Wyandotte MF
594	West Lode Degreaser	598	Wyandotte P1075
595	Wyandotte 1112	599	Xylene

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

Table A-2. Ecological Indicator Soil Concentrations (mg/kg) for Protection of Terrestrial Plants and Animals[a] (WAC 173-340-900, Table 749-3) (4 Pages)

Hazardous Substance[b]	Plants[c]	Soil Biota[d]	Wildlife[e]
METALS[f]:			
Aluminum (soluble salts)	50	[b]	
Antimony	5	[b]	
Arsenic III	[b]	[b]	7
Arsenic V	10	60	132
Barium	500	[b]	102
Beryllium	10	[b]	
Boron	0.5	[b]	
Bromine	10	[b]	
Cadmium	4	20	14
Chromium (total)	42[g]	42[g]	67
Cobalt	20	[b]	
Copper	100	50	217
Fluorine	200	[b]	
Iodine	4	[b]	
Lead	50	500	118
Lithium	35[g]	[b]	
Manganese	1,100[g]	[b]	1,500
Mercury, inorganic	0.3	0.1	5.5
Mercury, organic	[b]	[b]	0.4
Molybdenum	2	[b]	7
Nickel	30	200	980
Selenium	1	70	0.3
Silver	2	[b]	

Table A-2. Ecological Indicator Soil Concentrations (mg/kg) for Protection of Terrestrial Plants and Animals[a] (WAC 173-340-900, Table 749-3) (4 Pages)

Hazardous Substance[b]	Plants[c]	Soil Biota[d]	Wildlife[e]
Technetium	0.2	b	
Thallium	1	b	
Tin	50	b	
Uranium	5	b	
Vanadium	2	b	
Zinc	86[g]	b	
PESTICIDES:			
Aldrin	b	b	0.1
Benzene hexachloride (including lindane)	b	b	6
Chlordane	b	1	2.7
DDT/DDD/DDE (total)	b	b	0.75
Dieldrin	b	b	0.07
Endrin	b	b	0.2
Hexachlorobenzene	b	b	17
Heptachlor/heptachlor epoxide (total)	b	b	0.4
Pentachlorophenol	3	6	4.5
OTHER CHLORINATED ORGANICS:			
1,2,3,4-tetrachlorobenzene	b	10	
1,2,3-trichlorobenzene	b	20	
1,2,4-trichlorobenzene	b	20	
1,2-dichloropropane	b	700	
1,4-dichlorobenzene	b	20	
2,3,4,5-tetrachlorophenol	b	20	
2,3,5,6-tetrachloroaniline	20	20	
2,4,5-trichloroaniline	20	20	
2,4,5-trichlorophenol	4	9	
2,4,6-trichlorophenol	b	10	
2,4-dichloroaniline	b	100	
3,4-dichloroaniline	b	20	
3,4-dichlorophenol	20	20	
3-chloroaniline	20	30	
3-chlorophenol	7	10	
Chlorinated Dibenzofurans (total)	b	b	2.00 E-06
Chloroacetamide	b	2	

Table A-2. Ecological Indicator Soil Concentrations (mg/kg) for Protection of Terrestrial Plants and Animals[a] (WAC 173-340-900, Table 749-3) (4 Pages)

Hazardous Substance[b]	Plants[c]	Soil Biota[d]	Wildlife[e]
Chlorobenzene	b	40	
Dioxins	b	b	2.00 E-06
Hexachlorocyclopentadiene	10	b	
Polychlorinated biphenyl mixtures (total)	40	b	0.65
Pentachloroaniline	b	100	
Pentachlorobenzene	b	20	
OTHER NONCHLORINATED ORGANICS:			
2,4-dinitrophenol	20	b	
4-nitrophenol	b	7	
Acenaphthene	20	b	
Benzo(a)pyrene	b	b	12
Biphenyl	60	b	
Diethylphthalate	100	b	
Dimethylphthalate	b	200	
Di-n-butyl phthalate	200	b	
Fluorene	b	30	
Furan	600	b	
Nitrobenzene	b	40	
n-nitrosodiphenylamine	b	20	
Phenol	70	30	
Styrene	300	b	
Toluene	200	b	
PETROLEUM:			
Gasoline Range Organics	b	100	5,000 mg/kg except that the concentration shall not exceed residual saturation at the soil surface.
Diesel Range Organics	b	200	6,000 mg/kg except that the concentration shall not exceed residual saturation at the soil surface.

REFERENCES:

Ecology 94-115, 1994, *Natural Background Soil Metals Concentrations in Washington State*, Toxics Cleanup Program, Washington State Department of Ecology, Olympia, Washington.

Table A-2. Ecological Indicator Soil Concentrations (mg/kg) for Protection of Terrestrial Plants and Animals[a] (WAC 173-340-900, Table 749-3) (4 Pages)

Hazardous Substance[b]	Plants[c]	Soil Biota[d]	Wildlife[e]

ES/ER/TM-85/R3, 1997, *Toxicological Benchmarks for Screening Potential Contaminants of Concern for Effects on Terrestrial Plants: 1997 Revision*, Lockheed Martin Energy Systems, Inc., Oak Ridge, Tennessee.

ES/ER/TM-126/R2, 1997, *Toxicological Benchmarks for Screening Potential Contaminants of Concern for Effects on Soil and Litter Invertebrates and Heterotrophic Processes: 1997 Revision*, Lockheed Martin Energy Systems, Inc., Oak Ridge, Tennessee.

WAC 173-340-900, "Tables," *Washington Administrative Code*, as amended, Washington State Department of Ecology, Olympia, Washington.

WAC 173-340-7493(1)(b)(i), "Site-Specific Terrestrial Ecological Evaluation Procedures," "Purpose," *Washington Administrative Code*, as amended, Washington State Department of Ecology, Olympia, Washington.

WAC 173-340-7493(2)(a)(i), "Site-Specific Terrestrial Ecological Evaluation Procedures," "Problem Formulation Step," "The Chemicals of Ecological Concern," *Washington Administrative Code*, as amended, Washington State Department of Ecology, Olympia, Washington.

WAC 173-340-7493(2)(a)(ii), "Site-Specific Terrestrial Ecological Evaluation Procedures," "Problem Formulation Step," "Exposure Pathways," *Washington Administrative Code*, as amended, Washington State Department of Ecology, Olympia, Washington.

WAC 173-340-7493(3), "Site-Specific Terrestrial Ecological Evaluation Procedures," "Selection of Appropriate Terrestrial Ecological Evaluation Methods," *Washington Administrative Code*, as amended, Washington State Department of Ecology, Olympia, Washington.

WAC 173-340-7493(4), "Site-Specific Terrestrial Ecological Evaluation Procedures," "Literature Surveys," *Washington Administrative Code*, as amended, Washington State Department of Ecology, Olympia, Washington.

a Caution on misusing ecological indicator concentrations: Exceedances of the values in this table do not necessarily trigger requirements for cleanup action under WAC 173-340-7493. Natural background concentrations may be substituted for ecological indicator concentrations provided in this table. The table is not intended for purposes such as evaluating sludges or wastes.

This list does not imply that sampling must be conducted for each of these chemicals at every site. Sampling should be conducted for those chemicals that might be present based on available information, such as current and past uses of chemicals at the site.

b For hazardous substances where a value is not provided, plant and soil biota indicator concentrations will be based on a literature survey conducted in accordance with WAC 173-340-7493(4), "Site-Specific Terrestrial Ecological Evaluation Procedures," "Literature Surveys," and calculated using methods described in the publications listed below in footnotes c and d. Methods to be used for developing wildlife indicator concentrations are described in WAC 173-340-900, Tables 749-4 and 749-5.

c Based on benchmarks published in ES/ER/TM-85/R3, *Toxicological Benchmarks for Screening Potential Contaminants of Concern for Effects on Terrestrial Plants: 1997 Revision.*

d Based on benchmarks published in ES/ER/TM-126/R2, *Toxicological Benchmarks for Potential Contaminants of Concern for Effects on Soil and Litter Invertebrates and Heterotrophic Process: 1997 Revision.*

e Calculated using the exposure model provided in WAC 173-340-900, Table 749-4, and chemical-specific values provided in WAC 173-340-900, Table 749-5. Where both avian and mammalian values are available, the wildlife value is the lower of the two.

f For arsenic, use the valence state most likely to be appropriate for site conditions, unless laboratory information is available. Where soil conditions alternate between saturated-anaerobic and unsaturated-aerobic states, resulting in the alternating presence of arsenic III and arsenic V, the arsenic III concentrations shall apply.

g Benchmark replaced by Washington State natural background concentration (Ecology 94-115, 1994, *Natural Background Soil Metals Concentrations in Washington State*).

Note: These values represent soil concentrations that are expected to be protective at any waste site and are provided for use in eliminating hazardous substances from further consideration under WAC 173-340-7493 (2)(a)(i), "Site-Specific Terrestrial Ecological Evaluation Procedures," "Problem Formulation Step," "The Chemicals of Ecological Concern." Where these values are exceeded, various options are provided for demonstrating that the hazardous substance does not pose a threat to ecological receptors at a site, or for developing site-specific remedial standards for eliminating threats to ecological receptors. See WAC 173-340-7493 (1)(b)(i), "Site-Specific Terrestrial Ecological Evaluation Procedures," "Purpose," WAC 173-340-7493 (2)(a)(ii), "Site-Specific Terrestrial Ecological Evaluation Procedures," "Problem Formulation Step," "Exposure Pathways," and WAC 173-340-7493(3), "Site-Specific Terrestrial Ecological Evaluation Procedures," "Selection of Appropriate Terrestrial Ecological Evaluation Methods."

Table A-3. Excluded Contaminants. (42 Pages)

Contaminant	Description	Reference [a]
Radionuclides		
Actinium-225	Short-lived radionuclide (half-life <3 years). ($t_{1/2}$= 10 d)	Parrington et al. 1996
Actinium-227	Progeny radionuclide that builds insignificant activities within 50 years and can be estimated from U-235 parent.	
Aluminum-28	Short-lived radionuclide (half-life <3 years). ($t_{1/2}$= 12.75 d)	Parrington et al. 1996
Americium-242	Constituent with atomic mass number greater than or equal to 242 that represents < 1% of the actinide activity.	Based on ORIGEN2 modeling of Hanford reactor production (ORNL-5621)
Americium-242m	Constituent with atomic mass number greater than or equal to 242 that represents < 1% of the actinide activity.	Based on ORIGEN2 modeling of Hanford reactor production (ORNL-5621)
Americium-243	Constituent with atomic mass number greater than or equal to 242 that represents < 1% of the actinide activity.	Based on ORIGEN2 modeling of Hanford reactor production (ORNL-5621)
Antimony-122	Short-lived radionuclide (half-life <3 years). ($t_{1/2}$= 2.72 d)	Parrington et al. 1996
Antimony-123	Naturally occurring isotope.	Parrington et al. 1996
Antimony-124	Short-lived radionuclide (half-life <3 years). ($t_{1/2}$= 60.2 d)	Parrington et al. 1996
Antimony-126	Short-lived radionuclide (half-life <3 years). ($t_{1/2}$= 12.4 d)	Parrington et al. 1996
Antimony-126m	Short-lived radionuclide (half-life <3 years). ($t_{1/2}$= 11 s)	Parrington et al. 1996
Barium-133	Is a Ba-132 neutron activation product. However, Ba-132 is present at 0.101% of the natural barium isotopes. Ba-133 can also be produced from proton bombardment of Cs-133. However, bombardment was not done at Hanford. ORIGEN2 modeling of high burn-up N-reactor fuels (highest yields) shows no yield for this isotope.	Based on ORIGEN2 modeling of Hanford reactor production (ORNL-5621)
Barium-135m	Short-lived radionuclide (half-life <3 years). ($t_{1/2}$= 1.2 d)	Parrington et al. 1996
Barium-137	Naturally occurring isotope.	Parrington et al. 1996
Barium-137m	Short-lived daughter of Cs-137 (which is a final COPEC).	Parrington et al. 1996
Barium-140	Short-lived radionuclide (half-life <3 years). ($t_{1/2}$= 12.75 d)	Parrington et al. 1996
Beryllium-10	It is the product of neutron activation of Be-9. The only presence would be from the beryllium braze used to close the ends of Zircalloy clad fuel. ORIGEN2 modeling of high burn-up N-reactor fuels (highest yields) shows production at approximately 1 μCi per metric ton of uranium fuel. This calculates to approximately 1 pCi of Be-10 per gram of fuel. Chemical processing of the fuel would dilute this concentration further.	Based on ORIGEN2 modeling of Hanford reactor production (ORNL-5621)

Table A-3. Excluded Contaminants. (42 Pages)

Contaminant	Description	Reference [a]
Radionuclides (cont)		
Bismuth-210	Progeny radionuclide that builds insignificant activities within 50 years and can be estimated from U-238 parent.	RadDecay Version 3, Parrington et al. 1996
Bismuth-213	Short-lived radionuclide (half-life <3 years). ($t_{1/2}$= 45.6 m)	Parrington et al. 1996
Bismuth-214	Short-lived radionuclide (half-life <3 years). ($t_{1/2}$= 19.9 m)	Parrington et al. 1996
Cadmium-109	Short-lived radionuclide (half-life <3 years). ($t_{1/2}$= 462 d)	Parrington et al. 1996
Cadmium-113m	Less than 1% of cesium-137 activity. Insignificant contribution to dose.	Based on ORIGEN2 modeling of Hanford reactor production (ORNL-5621)
Cerium-141	Short-lived radionuclide (half-life <3 years). ($t_{1/2}$= 32.5 d)	Parrington et al. 1996
Cerium-144	Short-lived radionuclide (half-life <3 years). ($t_{1/2}$= 284.6 d)	Parrington et al. 1996
Cesium-135	Constituent generated at less than 5.0 E-05 times Cs-137 activity.	Parrington et al. 1996
Cesium-141	Short-lived radionuclide (half-life <3 years). ($t_{1/2}$= 24.9 s)	Parrington et al. 1996
Cesium-144	Short-lived radionuclide (half-life <3 years). ($t_{1/2}$= 1.01 s)	Parrington et al. 1996
Chlorine-36	ORIGEN2 modeling of high burn-up N-reactor fuels (highest yields) shows no yield for this isotope.	Based on ORIGEN2 modeling of Hanford reactor production (ORNL-5621)
Chromium-51	Short-lived radionuclide (half-life <3 years). ($t_{1/2}$= 27.7 d)	Parrington et al. 1996
Cobalt-57	Short-lived radionuclide (half-life <3 years). ($t_{1/2}$= 271.8 d)	Parrington et al. 1996
Cobalt-58	Short-lived radionuclide (half-life <3 years). ($t_{1/2}$= 70.88 d)	Parrington et al. 1996
Curium-242	Constituent with atomic mass number greater than or equal to 242 that represents < 1% of the actinide activity.	Based on ORIGEN2 modeling of Hanford reactor production (ORNL-5621)
Curium-243	Constituent with atomic mass number greater than or equal to 242 that represents < 1% of the actinide activity.	Based on ORIGEN2 modeling of Hanford reactor production (ORNL-5621)
Curium-244	Constituent with atomic mass number greater than or equal to 242 that represents less than 1% of the actinide activity. May be reported via americium isotopic analysis.	Based on ORIGEN2 modeling of Hanford reactor production (ORNL-5621)
Curium-245	Constituent with atomic mass number greater than or equal to 242 that represents < 1% of the actinide activity.	Based on ORIGEN2 modeling of Hanford reactor production (ORNL-5621)
Ensteinium-254	Short-lived radionuclide (half-life <3 years). ($t_{1/2}$= 276 d)	Parrington et al. 1996

Table A-3. Excluded Contaminants. (42 Pages)

Contaminant	Description	Reference [a]
Radionuclides (cont)		
Francium-221	Short-lived radionuclide (half-life <3 years). ($t_{1/2}$= 4.8 m)	Parrington et al. 1996
Francium-223	Short-lived radionuclide (half-life <3 years). ($t_{1/2}$= 21.8 m)	Parrington et al. 1996
Gadolinium-152	Naturally occurring isotope.	Parrington et al. 1996
Gadolinium-153	Short-lived radionuclide (half-life <3 years). ($t_{1/2}$= 241.6 d)	Parrington et al. 1996
Germanium-68	Short-lived radionuclide (half-life <3 years). ($t_{1/2}$= 270.8 d)	Parrington et al. 1996
Gold-195	Short-lived radionuclide (half-life <3 years). ($t_{1/2}$= 186.12 d)	Parrington et al. 1996
Iodine-123	Short-lived radionuclide (half-life <3 years). ($t_{1/2}$= 13.2 h)	Parrington et al. 1996
Iodine-125	Short-lived radionuclide (half-life <3 years). ($t_{1/2}$= 59.4 d)	Parrington et al. 1996
Iodine-129	Constituent generated at less than 5.0 E-05 times Cs-37 activity, historical tank and vadose sampling indicates nondetection; highly mobile constituent found mainly in groundwater.	Based on ORIGEN2 modeling of Hanford reactor production (ORNL-5621)
Iodine-131	Volatile gas emission; short-lived radionuclide (half-life <3 years). ($t_{1/2}$= 8 d)	Parrington et al. 1996, Rickard and McShane 1984
Iron-55	Short-lived radionuclide (half-life <3 years). ($t_{1/2}$= 2.73 y)	Parrington et al. 1996
Iron-59	Short-lived radionuclide (half-life <3 years). ($t_{1/2}$= 44.51 d)	Parrington et al. 1996
Krypton-85	Gas.	
Lanthanum-140	Short-lived radionuclide (half-life <3 years). ($t_{1/2}$= 1.678 d)	Parrington et al. 1996
Lead-209	Short-lived radionuclide (half-life <3 years). ($t_{1/2}$= 3.25 h)	Parrington et al. 1996
Lead-210	Progeny radionuclide that builds insignificant activities within 50 years and can be estimated from U-238 parent.	RadDecay Version 3, Parrington et al. 1996
Lead-211	Short-lived radionuclide (half-life <3 years). ($t_{1/2}$= 36.1 m)	Parrington et al. 1996
Lead-212	Short-lived radionuclide (half-life <3 years). ($t_{1/2}$= 10.64 h)	Parrington et al. 1996
Lead-214	Short-lived radionuclide (half-life <3 years). ($t_{1/2}$= 27 m)	Parrington et al. 1996
Manganese-54	Short-lived radionuclide (half-life <3 years). ($t_{1/2}$= 312.1 d)	Parrington et al. 1996

Table A-3. Excluded Contaminants. (42 Pages)

Contaminant	Description	Reference [a]
Radionuclides (cont)		
Molybdenum-93	The product of neutron activation of Mo-92, but Mo-92 is present at 14.84% of the natural molybdenum isotopes and has a low neutron cross section. ORIGEN2 modeling of high burn-up N-reactor fuels (highest yields) shows yields of less than 50 pCi/g and processing should have diluted this isotope further.	Based on ORIGEN2 modeling of Hanford Site reactor production (ORNL-5621)
Neodymium-147	Short-lived radionuclide (half-life <3 years). ($t_{1/2}$= 10.98 d)	Parrington et al. 1996
Neptunium-239	Short-lived radionuclide (half-life <3 years). ($t_{1/2}$= 2.355 d)	Parrington et al. 1996
Nickel-59	Activity will be <5% of Ni-63 activity and may be estimated from that isotope.	Based on ORIGEN2 modeling of Hanford Site reactor production (ORNL-5621)
Niobium-93m	Constituent generated at less than 5.0 E-05 times Cs-137 activity.	Based on ORIGEN2 modeling of Hanford Site reactor production (ORNL-5621)
Niobium-94	ORIGEN2 modeling of high burn-up N-reactor fuels (highest yields) shows yields less than 10 pCi/g and chemical processing should have diluted this isotope further.	Based on ORIGEN2 modeling of Hanford Site reactor production (ORNL-5621)
Niobium-95	Short-lived radionuclide (half-life <3 years). ($t_{1/2}$= 34.97 d)	Parrington et al. 1996
Niobium-96	Short-lived radionuclide (half-life <3 years). ($t_{1/2}$= 23.4 h)	Parrington et al. 1996
Niobium-98	Short-lived radionuclide (half-life <3 years). ($t_{1/2}$= 51 m)	Parrington et al. 1996
Palladium-107	Constituent generated at less than 5.0 E-05 times Cs-137 activity.	Based on ORIGEN2 modeling of Hanford Site reactor production (ORNL-5621)
Phosphorus-32	Short-lived radionuclide (half-life <3 years). ($t_{1/2}$= 14.28 d)	Parrington et al. 1996
Plutonium-241	Not detected by normal plutonium analysis; can infer from americium/plutonium results.	Parrington et al. 1996
Plutonium-242	Constituent with atomic mass number greater than or equal to 242 that represents < 1% of the actinide activity.	Based on ORIGEN2 modeling of Hanford Site reactor production (ORNL-5621)
Polonium-210	Short-lived radionuclide (half-life <3 years). ($t_{1/2}$= 138.38 d)	Parrington et al. 1996
Polonium-211	Short-lived radionuclide (half-life <3 years). ($t_{1/2}$= 25.2 s)	Parrington et al. 1996
Polonium-212	Short-lived radionuclide (half-life <3 years). ($t_{1/2}$= 45 s)	Parrington et al. 1996

Table A-3. Excluded Contaminants. (42 Pages)

Contaminant	Description	Reference [a]
Radionuclides (cont)		
Polonium-213	Short-lived radionuclide (half-life <3 years). ($t_{1/2}$= 4 μs)	Parrington et al. 1996
Polonium-214	Short-lived radionuclide (half-life <3 years). ($t_{1/2}$= 163.7 μs)	Parrington et al. 1996
Polonium-215	Short-lived radionuclide (half-life <3 years). ($t_{1/2}$= 1.87 μs)	Parrington et al. 1996
Polonium-216	Short-lived radionuclide (half-life <3 years). ($t_{1/2}$= 0.145 μs)	Parrington et al. 1996
Polonium-218	Short-lived radionuclide (half-life <3 years). ($t_{1/2}$= 3.1 m)	Parrington et al. 1996
Potassium-40	Naturally occurring isotope.	Parrington et al. 1996
Praseodymium-143	Short-lived radionuclide (half-life <3 years). ($t_{1/2}$= 13.57 d)	Parrington et al. 1996
Praseodymium-144	Short-lived radionuclide (half-life <3 years). ($t_{1/2}$= 17.28 m)	Parrington et al. 1996
Promethium-143	Short-lived radionuclide (half-life <3 years). ($t_{1/2}$= 265 d)	Parrington et al. 1996
Promethium-147	Short-lived radionuclide (half-life <3 years). ($t_{1/2}$= 13.4 m)	Parrington et al. 1996
Protactinium-231	Progeny radionuclide that builds insignificant activities within 50 years and can be estimated from U-235 parent.	
Protactinium-233	Short-lived radionuclide (half-life <3 years). ($t_{1/2}$= 27 d)	Parrington et al. 1996
Protactinium-234	Short-lived radionuclide (half-life <3 years). ($t_{1/2}$= 6.69 h)	Parrington et al. 1996
Radium-223	Short-lived radionuclide (half-life <3 years). ($t_{1/2}$= 11.44 d)	Parrington et al. 1996
Radium-224	Thorium-232 decay daughter value can be calculated from Th-232/Ra-228 if present.	Parrington et al. 1996, RadDecay Version 3
Radon-219	Short-lived radionuclide (half-life <3 years). ($t_{1/2}$= 3.96 s)	Parrington et al. 1996
Radon-220	Short-lived radionuclide (half-life <3 years). ($t_{1/2}$= 55.6 s)	Parrington et al. 1996
Radon-222	Short-lived radionuclide (half-life <3 years). ($t_{1/2}$= 3.82 d)	Parrington et al. 1996
Rhenium-187	Naturally occurring isotope.	Parrington et al. 1996
Rhodium-106	Short-lived radionuclide (half-life <3 years). ($t_{1/2}$= 2.18 h)	Parrington et al. 1996
Ruthenium-103	Short-lived radionuclide (half-life <3 years). ($t_{1/2}$= 39.27 d)	Parrington et al. 1996
Ruthenium-106	Short-lived radionuclide (half-life <3 years). ($t_{1/2}$= 1.02 y)	Parrington et al. 1996
Samarium-147	Naturally occurring isotope.	Parrington et al. 1996

Table A-3. Excluded Contaminants. (42 Pages)

Contaminant	Description	Reference [a]
Radionuclides (cont)		
Samarium-149	Stable.	Parrington et al. 1996
Samarium-151	Less than 1% of Cs-137 activity. Insignificant contribution to dose.	Based on ORIGEN2 modeling of Hanford reactor production (ORNL-5621)
Selenium-75	Short-lived radionuclide (half-life <3 years). ($t_{1/2}$= 119.78 d)	Parrington et al. 1996
Selenium-79	Constituent generated at less than 5.0 E-05 times Cs-137 activity.	Based on ORIGEN2 modeling of Hanford reactor production (ORNL-5621)
Silver-108	Less than 10% of Ag-108m decays through Ag-108. ORIGEN2 shows yields less than 2 pCi/g for high burn-up N-reactor fuels and chemical processing should have diluted this isotope further.	Based on ORIGEN2 modeling of Hanford reactor production (ORNL-5621)
Silver-110m	Short-lived radionuclide (half-life <3 years). ($t_{1/2}$= 249.8 d)	Parrington et al. 1996
Sodium-22	Short-lived radionuclide (half-life <3 years). ($t_{1/2}$= 2.60 y)	Parrington et al. 1996
Strontium-85	Short-lived radionuclide (half-life <3 years). ($t_{1/2}$= 64.84 d)	Parrington et al. 1996
Strontium-89	Short-lived radionuclide (half-life <3 years). ($t_{1/2}$= 50.52 d)	Parrington et al. 1996
Sulfer-35	Short-lived radionuclide (half-life <3 years). ($t_{1/2}$= 87.2 d)	Parrington et al. 1996
Tantalum-182	Short-lived radionuclide (half-life <3 years). ($t_{1/2}$= 114.43 d)	Parrington et al. 1996
Tellurium-121	Short-lived radionuclide (half-life <3 years). ($t_{1/2}$= 154 d)	Parrington et al. 1996
Tellurium-125m	Short-lived radionuclide (half-life <3 years). ($t_{1/2}$= 58 d)	Parrington et al. 1996
Tellurium-127	Short-lived radionuclide (half-life <3 years). ($t_{1/2}$= 109 d)	Parrington et al. 1996
Tellurium-129	Short-lived radionuclide (half-life <3 years). ($t_{1/2}$= 33.6 d)	Parrington et al. 1996
Tellurium-129m	Short-lived radionuclide (half-life <3 years). ($t_{1/2}$= 1.16 h)	Parrington et al. 1996
Thallium-204	ORIGEN2 shows no yield for this isotope.	Based on ORIGEN2 modeling of Hanford reactor production (ORNL-5621)
Thallium-207	Short-lived radionuclide (half-life <3 years). ($t_{1/2}$= 4.77 m)	Parrington et al. 1996
Thallium-208	Short-lived radionuclide (half-life <3 years). ($t_{1/2}$= 3.05 m)	Parrington et al. 1996
Thallium-209	Short-lived radionuclide (half-life <3 years). ($t_{1/2}$= 2.16 m)	Parrington et al. 1996

Table A-3. Excluded Contaminants. (42 Pages)

Contaminant	Description	Reference [a]
Radionuclides (cont)		
Thorium-227	Short-lived radionuclide (half-life <3 years). ($t_{1/2}$= 18.72 d)	Parrington et al. 1996
Thorium-228	Short-lived radionuclide (half-life <3 years). ($t_{1/2}$= 1.91 y)	Parrington et al. 1996
Thorium-229	Progeny radionuclide that builds insignificant activities within 50 years and can be estimated from U-233 parent.	RadDecay Version 3, Parrington et al. 1996
Thorium-230	Progeny radionuclide that builds insignificant activities within 50 years and can be estimated from U-238 parent.	RadDecay Version 3, Parrington et al. 1996
Thorium-231	Short-lived radionuclide (half-life <3 years). ($t_{1/2}$= 1.06 d)	Parrington et al. 1996
Thorium-233	Short-lived radionuclide (half-life <3 years). ($t_{1/2}$= 22.3 m)	Parrington et al. 1996
Thorium-234	Short-lived radionuclide (half-life <3 years). ($t_{1/2}$= 24.1 d)	Parrington et al. 1996
Thallium-170	Short-lived radionuclide (half-life <3 years). ($t_{1/2}$= 128.6 d)	Parrington et al. 1996
Tin-113	Short-lived radionuclide (half-life <3 years). ($t_{1/2}$= 115.1 d)	Parrington et al. 1996
Tin-123	Short-lived radionuclide (half-life <3 years). ($t_{1/2}$= 129.2 d)	Parrington et al. 1996
Tin-123m	Short-lived radionuclide (half-life <3 years). ($t_{1/2}$= 40.1 m)	Parrington et al. 1996
Tin-125	Short-lived radionuclide (half-life <3 years). ($t_{1/2}$= 9.63 d)	Parrington et al. 1996
Tin-126	Constituent generated at less than 5.0 E-05 times Cs-137 activity (GEA will be reported if detected).	Based on ORIGEN2 modeling of Hanford reactor production (ORNL-5621)
Uranium-232	<2.0 E-03 times U-238 activity.	Based on ORIGEN2 modeling of Hanford reactor production (ORNL-5621)
Uranium-233	Measurement cannot resolve U-234 + U-233 isotopes, reported as U-234.	
Uranium-236	Measurement cannot resolve U-235 + U-236 isotopes, reported as U-235.	Parrington et al. 1996
Uranium-237	Short-lived radionuclide (half-life <3 years). ($t_{1/2}$= 6.75 d)	Parrington et al. 1996
Vanadium-49	Short-lived radionuclide (half-life <3 years). ($t_{1/2}$= 337 d)	Parrington et al. 1996
Yttrium-88	Short-lived radionuclide (half-life <3 years). ($t_{1/2}$= 106.65 d)	Parrington et al. 1996
Yttrium-90	Short-lived daughter of Sr-90 (which is a final COPEC).	Parrington et al. 1996
Yttrium-91	Short-lived radionuclide (half-life <3 years). ($t_{1/2}$= 58.5 d)	Parrington et al. 1996
Zinc-65	Short-lived radionuclide (half-life <3 years).	Parrington et al. 1996

Table A-3. Excluded Contaminants. (42 Pages)

Contaminant	Description	Reference [a]
	($t_{1/2}$= 243.8 d)	
Radionuclides (cont)		
Zirconium-93	Constituent generated at less than 5.0 E-05 times Cs-137 activity.	Based on ORIGEN2 modeling of Hanford reactor production (ORNL-5621)
Zirconium-95	Short-lived radionuclide (half-life <3 years).	Parrington et al. 1996
	($t_{1/2}$= 64.02 d)	
Inorganics		
Aluminum Nitrate (Mono Basic)	Contains aluminum and nitrate, which have been previously identified as COCs.	
Aluminum Nitrate Nonahydrate		
Aluminum Sulfate	Contains aluminum and sulfate, which have been previously identified as COCs.	
Ammonium Chloride	Contains aluminum and chloride, which have been previously identified as COCs.	
Ammonium Fluoride	Contains aluminum and fluoride, which have been previously identified as COCs.	
Ammonium Hydroxide	Contains ammonium, which has been previously identified as a COC, and hydroxide, which has been previously excluded.	
Ammonium Nitrate	Contains ammonium and nitrate, which have been previously identified as COCs.	
Ammonium Silicofluoride	Contains ammonium and fluoride, which have been previously identified as COCs, and silicon, which has been previously excluded.	
Ammonium Sulfate	Contains ammonium and sulfate, which have been previously identified as COCs.	
Ammonium Sulfite	Contains ammonium and sulfite, which have been previously identified as COCs.	
Barium Nitrate	Contains barium and nitrate, which have been previously identified as COCs.	
Boron	This substance was not used routinely or significantly during Hanford Site Central Plateau Operations.	
Borate(s)	Material used in very low or trace quantities at Hanford.	
Boric Acid	Contains boron, which has been previously excluded; acid determined by pH.	
Borox (Boric Acid)	Product name for boric acid, which has been previously excluded.	
Bromine	This substance was not used routinely or significantly during Hanford Site Central Plateau Operations.	
Cadmium Nitrate	Contains cadmium and nitrate, which has been previously identified as COCs.	
Calcium	Not a Washington State toxic and not an underlying hazardous constituent as defined in 40 CFR 268.2.	
Calcium Carbonate	Contains calcium, which has been previously excluded; contains carbonate, which degrades to carbon dioxide which has been previously excluded.	
Calcium Chloride	Contains calcium, which has been previously excluded, and chloride, which has been previously identified as a COC.	

Table A-3. Excluded Contaminants. (42 Pages)

Contaminant	Description	Reference [a]
Inorganics (cont)		
Calcium Nitrate	Contains calcium, which has been previously excluded, and nitrate, which has been previously identified as a COC.	
Carbon	Inorganic carbon used at the Hanford site is only found as a gas. Total organic carbon will be measured.	
Carbon Dioxide	Gas.	
Carbon Disulfide	Gas.	
Carbonate (axb)	This inorganic substance is unlikely to be present in toxic concentrations. Screened for potential effect on pH.	
Cerium	Material used in low or trace quantities at Hanford. No cleanup levels established in Ecology 94-145, Section 3.1 tables.	
Ceric Ammonium Nitrate	Contains cerium, which has been previously excluded, and ammonium and nitrate, which has been previously identified as a COC.	
Ceric Fluoride	Contains cerium, which has been previously excluded, and fluoride, which has been previously identified as a COC.	
Ceric Iodate	Contains cerium, which has been previously excluded, and iodine, which has been previously identified as a COC.	
Ceric Nitrate	Contains cerium, which has been previously excluded, and nitrate, which has been previously identified as a COC.	
Ceric Sulfate	Contains cerium, which has been previously excluded, and sulfate, which has been previously identified as a COC.	
Cesium	Material used in low or trace quantities at Hanford. No cleanup levels established in Ecology 94-145, Section 3.1 tables.	
Cesium Chloride	Contains cesium, which has been previously excluded, and chloride, which has been previously identified as a COC.	
Chloroplatinic Acid	Contains platinum, which has been previously excluded; chlorine detected by anion analysis.	
Chromium Nitrate	Contains chromium and nitrate, which have been previously identified as COCs.	
Chromous Sulfate	Contains chromium and sulfate, which have been previously identified as COCs.	
Clayton Kerful Cleaner	Product name for sodium hydroxide, which has been previously excluded. pH will be assessed separately.	
Clorox	Commercial product, sodium hypochlorite; sodium has been previously excluded and chloride which has been previously identified as a COC.	
Cobalt Sulfate	Contains cobalt, which is excluded, and sulfate, which has been previously identified as a COC.	
Dichromate	Contains chromium, which has been previously identified as a COC.	
Ferric Ammonium Sulfate	Contains iron, which has been previously excluded, and ammonium and sulfate, which have been previously identified as COCs.	
Ferric Nitrate	Contains iron, which has been previously excluded, and nitrate, which has been previously identified as a COC.	

Table A-3. Excluded Contaminants. (42 Pages)

Contaminant	Description	Reference [a]
Inorganics (cont)		
Ferric Sulfate	Contains iron, which has been previously excluded, and sulfate, which has been previously identified as a COC.	
Ferrous Ammonium Sulfate	Contains iron, which has been previously excluded, and ammonium and sulfate, which have been previously identified as COCs.	
Ferrous Sulfamate	Contains iron, which has been previously excluded; and sulfamate which degrades to sulfate and ammonium which have been previously identified as COCs.	
Ferrous Sulfate	Contains iron, which has been previously excluded, and sulfate, which has been previously identified as a COC.	
Gallium	Material used in low or trace quantities at Hanford. Not a Washington State toxic and not an underlying hazardous constituent as defined in 40 CFR 268.2.	
Gallium Oxide	Contains gallium, which has been excluded.	
Germanium	Material used in low or trace quantities at Hanford. No cleanup levels established in Ecology 94-145, Section 3.1 tables.	
Gold	Material used in low or trace quantities at Hanford. Not a Washington State toxic and not an underlying hazardous constituent as defined in 40 CFR 268.2.	
Hafnium	This inorganic substance is unlikely to be present in toxic or high concentrations owing to minimal use in Hanford Site Central Plateau processes.	
Hydrobromic Acid	Contains bromine, which has been previously identified as a COC; acid determined by pH.	
Hydrochloric Acid	Contains chlorine, which has been previously identified as a COC; acid determined by pH.	
Hydrofluoric Acid	Contains fluorine, which has been previously identified as a COC; acid determined by pH.	
Hydrogen	Gas.	
Hydrogen Fluoride	Contains fluorine, which has been previously identified as a COC; acid determined by pH.	
Hydrogen Peroxide	Degrades to water.	
Hydroiodic Acid	Contains iodine, which has been previously identified as a COC; acid determined by pH.	
Hydroxide	Not a Washington State toxic and not an underlying hazardous constituent as defined in 40 CFR 268.2	
Indium	Not a Washington State toxic and not an underlying hazardous constituent as defined in 40 CFR 268.2	
Iron	Not a Washington State toxic and not an underlying hazardous constituent as defined in 40 CFR 268.2	
Kleen-o-bowl	Product name for ammonium chloride and hydrochloric acid, which have been previously identified as COCs.	
Lanthanum	Not a Washington State toxic and not an underlying hazardous constituent as defined in 40 CFR 268.2	
Lanthanum Fluoride	Contains lanthanum, which has been previously excluded; and fluoride which has been previously identified as a COC.	
Lanthanum Hydroxide	Contains lanthanum and hydroxide, which have been previously excluded.	

Table A-3. Excluded Contaminants. (42 Pages)

Contaminant	Description	Reference [a]
Inorganics (cont)		
Lanthanum Nitrate	Contains lanthanum, which has been previously excluded; and nitrate which has been previously identified as a COC.	
Lanthanum-Neodynium Nitrate	Contains lanthanum and neodymium, which have been previously excluded; and nitrate which has been previously identified as a COC.	
Lead Nitrate	Contains lead and nitrate, which have been previously identified as COCs.	
Magnesium	Not a Washington State toxic and not an underlying hazardous constituent as defined in 40 CFR 268.2.	
Magnesium Carbonate	Contains magnesium and carbonate, which have been previously excluded.	
Magnesium Nitrate	Contains magnesium, which has been previously excluded; and nitrate which has been previously identified as a COC.	
Magnesium Oxide	Contains magnesium and oxide, which has been previously excluded.	
Magnesium Silicate (Mistron)	Contains magnesium and silicon, which have been previously excluded.	
Mercury (organic)	No identified use in Hanford Site Central Plateau processing to retain this constituent listed in WAC 173-340-900, "Tables," Table 749-3; and WAC 173-340-7493 (2)(a)(i).	
Mercuric Nitrate	Contains mercury and nitrate, which have been previously identified as a COC.	
Mercuric Thiocyanate	Contains mercury and cyanide, which have been previously identified as a COC.	
Neodynium	Not a Washington State toxic and not an underlying hazardous constituent as defined in 40 CFR 268.2.	
Nickel Nitrate	Contains nickel and nitrate, which have been previously identified as COCs.	
Nickel Sulfate	Contains nickel and sulfate, which have been previously identified as COCs.	
Nitric Acid	Contains nitrate, which is included as a COC; acid assessment through pH analysis.	
Nitrogen	Gas.	
Oakite LSD	Product name for sodium hydroxide; which have been previously excluded.	
Osmium	Not a Washington State toxic and not an underlying hazardous constituent as defined in 40 CFR 268.2	
Oxides	Anion form which typically has minimal effect on potential toxicity of total compounds. Reactive oxides will have degraded to hydroxide (excluded) or oxygen a gas (also excluded).	
Oxygen	Gas.	
Ozone	Gas.	
Perchlorate	Has degraded to chlorine, which is a previously identified COC; and oxygen which has previously been excluded.	
Periodic Acid	Contains iodine, which has been previously identified as a COC; acids assessed through pH analysis.	

Table A-3. Excluded Contaminants. (42 Pages)

Contaminant	Description	Reference [a]
Inorganics (cont)		
Permanganate	Contains potassium and oxygen, which have been previously excluded; and manganese which has been previously identified as a COC.	
Phosphorus	Not a Washington State toxic and not an underlying hazardous constituent as defined in 40 CFR 268.2	
Phosphoric Acid	Contains phosphate, which has been previously identified as a COC; acid assessment through pH analysis.	
Phosphorous Pentoxide	Contains phosphorous, which has been previously identified as a COC; and oxide which has been previously excluded.	
Phosphotungstic Acid	Contains phosphate which is a final COC and tungsten which has been previously excluded.	
Platinum	Material used in low or trace quantities at Hanford, typically as metallic components. No cleanup levels established in Ecology 94-145, Section 3.1 tables.	
Plutonium	Will be identified via radionuclide analysis.	
Potassium	Material used in low quantities at Hanford. No cleanup levels established in Ecology 94-145, Section 3.1 tables.	
Potassium Acetate	Contains potassium and acetate, which have been previously excluded.	
Potassium Bicarbonate	Contains potassium and carbonate, which have been previously excluded.	
Potassium Carbonate	Contains potassium and carbonate, which have been previously excluded.	
Potassium Dichromate	Contains potassium which has been previously excluded and dichromate which has been previously identified as a final COC.	
Potassium Ferrocyanide	Contains potassium and iron which have been previously excluded and cyanide which has been previously identified as a final COC.	
Potassium Fluoride	Contains potassium which has been previously excluded and fluoride which has been previously identified as a final COC.	
Potassium Hydroxide	Contains potassium and hydroxide which have been previously excluded.	
Potassium Iodate	Contains potassium which has been previously excluded and iodine which has been previously identified as a final COC.	
Potassium Oxalate	Contains potassium and oxalate, which have been previously excluded.	
Potassium Permanganate	Contains potassium and oxygen which have been previously excluded, and manganese which has been previously identified as a final COC.	
Potassium Persulfate	Contains potassium which has been previously excluded, and sulfate which has been previously identified as a final COC.	
Rhodium	This inorganic substance is unlikely to be present in toxic or high concentrations owing to minimal use in Hanford Site Central Plateau processes.	

Table A-3. Excluded Contaminants. (42 Pages)

Contaminant	Description	Reference [a]
Inorganics (cont)		
Ruthenium	Material used in low or trace quantities at Hanford. No cleanup levels established in Ecology 94-145, Section 3.1 tables.	
Sani-Flush	Commercial chemical. Generates sulfuric acid (sulfate) on contact with water. Sulfate has been previously identified as a COC.	
Silicon	No cleanup levels established in Ecology 94-145, Section 3.1 tables. No known discharge of respirable silica (potentially hazardous form) to the included sites.	
Silver Nitrate	Contains silver and nitrate which have been previously identified as COCs.	
Silver Oxide	Contains silver which has been previously identified as a COC, and oxide which has been previously excluded.	
Sodium	Not a Washington State toxic and not an underlying hazardous constituent as defined in 40 CFR 268.2. Routine analyte reported by ICP analysis.	
Sodium Acetate	Contains sodium and acetate, which have been previously excluded.	
Sodium Bismuthate	Contains sodium, bismuth, and oxygen which have been previously excluded.	
Sodium Bisulfate	Contains sodium which has been previously excluded, and sulfate which has been previously identified as a COC.	
Sodium Bromate	Contains sodium, boron, and oxygen which have been previously excluded.	
Sodium Carbonate	Contains sodium and carbonate, which have been previously excluded.	
Sodium Dichromate	Contains sodium which has been previously excluded, and chromium which has been previously identified as a COC.	
Sodium Ferrocyanide	Contains sodium and iron which have been previously excluded, and cyanide which has been previously identified as a COC.	
Sodium Fluoride	Contains sodium which has been previously excluded, and fluoride which has been previously identified as a COC.	
Sodium Hydroxide	Contains sodium and hydroxide, which have been previously excluded.	
Sodium Nitrate	Contains sodium which has been previously excluded, and nitrate which has been previously identified as a COC.	
Sodium Nitrite	Contains sodium which has been previously excluded, and nitrite which has been previously identified as a COC.	
Sodium Oxalate	Contains sodium and oxalate, which have been previously excluded.	
Sodium Persulfate	Contains sodium, which has been previously excluded; contains persulfate, which degrades to sulfate and has been previously identified as a COC.	
Sodium Phosphate	Contains sodium which has been previously excluded, and phosphate which has been previously identified as a COC.	
Sodium Sulfate	Contains sodium, which has been previously excluded; and sulfate which has been previously identified as a COC.	

Table A-3. Excluded Contaminants. (42 Pages)

Contaminant	Description	Reference [a]
Inorganics (cont)		
Sodium Thiosulfate	Contains sodium, which has been previously excluded; contains thiosulfate, which degrades to sulfate and has been previously identified as a COC.	
Spic-n-Span	Commercial product, cleaning agent, no standard analytical method in place for its analysis. Contains ammonia which has been previously identified as a COC.	
Strontium Fluoride	Contains strontium and fluoride which have been previously identified as COCs.	
Strontium Nitrate	Contains strontium and nitrate which have been previously identified as COCs.	
Sulfamates	Degrades to sulfates which has been previously identified as a COC.	
Sulfamic Acid	Degrades to sulfate and ammonia, which have been previously identified as COCs.	
Sulfonate	Degrades to sulfate, which has been previously identified as a COC.	
Sulfuric Acid	Chemical has degraded to sulfate, which has been previously identified as a COC.	
Tantalum	Material used in low or trace quantities at Hanford, typically as metallic components. Not a Washington State toxic and not an underlying hazardous constituent as defined in 40 CFR 268.2.	
Technetium	Only radioactive technetium was disposed of from Hanford Site Central Plateau Operations. Chemical technetium was never introduced. Will be identified via radionuclide analysis.	
Tellurium	Material used in low or trace quantities at Hanford, typically as metallic components. Not a Washington State toxic and not an underlying hazardous constituent as defined in 40 CFR 268.2.	
Thallium	Only radioactive Thallium was disposed of from Hanford Site Central Plateau Operations. Chemical thallium was never introduced. Will be identified via radionuclide analysis.	
Titanium	Material used in low or trace quantities at Hanford, typically as metallic components. Not a Washington State toxic and not an underlying hazardous constituent as defined in 40 CFR 268.2.	
Titanium Chloride	Chemical contains titanium, which has been previously excluded, and chlorine which has been previously identified as a COC.	
Tungsten	Material used in low or trace quantities at Hanford, typically as metallic components. Not a Washington State toxic and not an underlying hazardous constituent as defined in 40 CFR 268.2.	
Turco 4306 B, C, and D	Product name for sodium sulfate compounds. Sodium has been previously excluded and sulfate has been previously identified as a COC.	

Table A-3. Excluded Contaminants. (42 Pages)

Contaminant	Description	Reference [a]
Inorganics (cont)		
Turco 4502D	Product name for potassium hydroxide, dichromate, and permanganate compounds. Potassium and hydroxide have been previously excluded and chromium and manganese have previously been identified as COCs.	
Turco 4512 A	Product name for phosphoric compounds, which have already been identified as COCs.	
Yttrium	This inorganic substance is unlikely to be present in toxic or high concentrations owing to minimal use in Hanford Site Central Plateau processes.	
Zeolite AW-500 (IX Resin)	Commercial product that contains aluminum, silicon, and hydroxide which have previously been excluded.	
Zinc Amalgam	Contains zinc which has been previously excluded and mercury which has been previously identified as a COC.	
Zirconium	Not a Washington State toxic and not an underlying hazardous constituent as defined in 40 CFR 268.2.	
Zirconyl Nitrate	Chemical contains zirconium, which has been previously excluded, and nitrate which has been previously identified as a COC.	
Zirconyl Phosphate	Contains zirconium which has been previously excluded and phosphate which has been previously identified as a COC.	
Organics		
1,1-dimethylhydrazine	Based on evaluation of the sources identified in CP-13196, Table 1-4, chemicals are used in minute quantities relative to the bulk production chemicals consumed in the normal processes; these chemicals have no suspected introduction to waste streams except in incidental quantities. Reactive material with minimal lifetime in Hanford Site environment. No direct standard analytical technique available.	
1,2-dichloro-1,1,2,2-tetrafluoroethane (Freon 114)	Gas above 48 degrees C.	
1,2-dichloropropane	Based on evaluation of the sources identified in CP-13196, Table 1-4, chemicals are used in minute quantities relative to the bulk production chemicals consumed in the normal processes; these chemicals have no suspected introduction to waste streams except in incidental quantities.	
1,2,2-trichloro-1,1,2-trifluoroethane	Based on evaluation of the sources identified in CP-13196, Table 1-4, chemicals are used in minute quantities relative to the bulk production chemicals consumed in the normal processes; these chemicals have no suspected introduction to waste streams except in incidental quantities.	
1,2,3,4-tetrachlorobenzene	No identified use in Hanford Site Central Plateau processing to retain this constituent listed in WAC 173-340-900, "Tables," Table 749-3; and WAC 173-340-7493 (2)(a)(i).	

Table A-3. Excluded Contaminants. (42 Pages)

Contaminant	Description	Reference [a]
Organics (cont)		
1,2,3-trichlorobenzene	No identified use in Hanford Site Central Plateau processing to retain this constituent listed in WAC 173-340-900, "Tables," Table 749-3; and WAC 173-340-7493 (2)(a)(i).	
1,2,4-trichlorobenzene	No identified use in Hanford Site Central Plateau processing to retain this constituent listed in WAC 173-340-900, "Tables," Table 749-3; and WAC 173-340-7493 (2)(a)(i).	
1,3-butadiene	Gas.	
1,4-dichlorobenzene	No identified use in Hanford Site Central Plateau processing to retain this constituent listed in WAC 173-340-900, "Tables," Table 749-3; and WAC 173-340-7493 (2)(a)(i).	
1,4-dinitrobenzene	No identified use in Hanford Site Central Plateau processing. Based on evaluation of the sources identified in CP-13196, Table 1-4, chemicals are used in minute quantities relative to the bulk production chemicals consumed in the normal processes; these chemicals have no suspected introduction to waste streams except in incidental quantities. VOA/SVOA (via GCMS) of soils from high-organic inventory tank farms (T,TX,TY WMA) reported nondetection for this and similar compounds. Not on routine analytical calibration lists. GCMS TIC searches could be used to screen for potential presence.	
1,4-dioxane	No identified use in Hanford Site Central Plateau processing. Based on evaluation of the sources identified in CP-13196, Table 1-4, chemicals are used in minute quantities relative to the bulk production chemicals consumed in the normal processes; these chemicals have no suspected introduction to waste streams except in incidental quantities. VOA/SVOA (via GCMS) of soils from high-organic inventory tank farms (T,TX,TY WMA) reported nondetection for this and similar compounds. Not on routine analytical calibration lists. GCMS TIC searches could be used to screen for potential presence.	
1-chloroethene (vinyl chloride)	Gas.	
1-methylpropyl Alcohol (2-butanol)	Butanol has been previously identified as a COC.	
2,3,4,5-tetrachlorophenol	No identified use in Hanford Site Central Plateau processing to retain this constituent listed in WAC 173-340-900, "Tables," Table 749-3; and WAC 173-340-7493 (2)(a)(i).	
2,3,5,6-tetrachloroaniline	No identified use in Hanford Site Central Plateau processing to retain this constituent listed in WAC 173-340-900, "Tables," Table 749-3; and WAC 173-340-7493 (2)(a)(i).	
2,4-dichloroaniline	No identified use in Hanford Site Central Plateau processing to retain this constituent listed in WAC 173-340-900, "Tables," Table 749-3; and WAC 173-340-7493 (2)(a)(i).	

Table A-3. Excluded Contaminants. (42 Pages)

Contaminant	Description	Reference [a]
Organics (cont)		
2,4-dinitrophenol	Based on evaluation of the sources identified in CP-13196, Table 1-4, chemicals are used in minute quantities relative to the bulk production chemicals consumed in the normal processes; these chemicals have no suspected introduction to waste streams except in incidental quantities.	
2,4,5-trichloroaniline	No identified use in Hanford Site Central Plateau processing to retain this constituent listed in v	
2,4,5-trichlorophenol	No identified use in Hanford Site Central Plateau processing to retain this constituent listed in WAC 173-340-900, "Tables," Table 749-3; and WAC 173-340-7493 (2)(a)(i).	
2,4,6-trichlorophenol	No identified use in Hanford Site Central Plateau processing to retain this constituent listed in WAC 173-340-900, "Tables," Table 749-3; and WAC 173-340-7493 (2)(a)(i).	
2,6-bis(tert-butyl)-4-methylphenol	No identified use in Hanford Site Central Plateau processing. Based on evaluation of the sources identified in CP-13196, Table 1-4, chemicals are used in minute quantities relative to the bulk production chemicals consumed in the normal processes; these chemicals have no suspected introduction to waste streams except in incidental quantities. VOA/SVOA (via GCMS) of soils from high-organic inventory tank farms (T,TX,TY WMA) reported nondetection for this and similar compounds. Not on routine analytical calibration lists. GCMS TIC searches could be used to screen for potential presence.	
2-butenaldehyde (2-butenal)	No identified use in Hanford Site Central Plateau processing. Based on evaluation of the sources identified in CP-13196, Table 1-4, chemicals are used in minute quantities relative to the bulk production chemicals consumed in the normal processes; these chemicals have no suspected introduction to waste streams except in incidental quantities. VOA/SVOA (via GCMS) of soils from high-organic inventory tank farms (T,TX,TY WMA) reported nondetection for this and similar compounds. Not on routine analytical calibration lists. GCMS TIC searches could be used to screen for potential presence.	
2-heptanone	No identified use in Hanford Site Central Plateau processing. Based on evaluation of the sources identified in CP-13196, Table 1-4, chemicals are used in minute quantities relative to the bulk production chemicals consumed in the normal processes; these chemicals have no suspected introduction to waste streams except in incidental quantities. VOA/SVOA (via GCMS) of soils from high-organic inventory tank farms (T,TX,TY WMA) reported nondetection for this and similar compounds. Not on routine analytical calibration lists. GCMS TIC searches could be used to screen for potential presence.	

Table A-3. Excluded Contaminants. (42 Pages)

Contaminant	Description	Reference [a]
Organics (cont)		
2-methyl-2-propanol	No identified use in Hanford Site Central Plateau processing. Based on evaluation of the sources identified in CP-13196, Table 1-4, chemicals are used in minute quantities relative to the bulk production chemicals consumed in the normal processes; these chemicals have no suspected introduction to waste streams except in incidental quantities. VOA/SVOA (via GCMS) of soils from high-organic inventory tank farms (T,TX,TY WMA) reported nondetection for this and similar compounds. Not on routine analytical calibration lists. GCMS TIC searches could be used to screen for potential presence.	
2-methyl-2-propenenitrile	Based on evaluation of the sources identified in CP-13196, Table 1-4, chemicals are used in minute quantities relative to the bulk production chemicals consumed in the normal processes; these chemicals have no suspected introduction to waste streams except in incidental quantities.	
2-pentanone	No identified use in Hanford Site Central Plateau processing. Based on evaluation of the sources identified in CP-13196, Table 1-4, chemicals are used in minute quantities relative to the bulk production chemicals consumed in the normal processes; these chemicals have no suspected introduction to waste streams except in incidental quantities. VOA/SVOA (via GCMS) of soils from high-organic inventory tank farms (T,TX,TY WMA) reported nondetection for this and similar compounds. Not on routine analytical calibration lists. GCMS TIC searches could be used to screen for potential presence.	
2-propenoic acid	Based on evaluation of the sources identified in CP-13196, Table 1-4, chemicals are used in minute quantities relative to the bulk production chemicals consumed in the normal processes; these chemicals have no suspected introduction to waste streams except in incidental quantities.	
2-sec-butyl-4,6-dinitrophenol (dinoseb)	Pesticide (EPA Method 8081, SW-846). Based on evaluation of the sources identified in CP-13196, Table 1-4, chemicals are used in minute quantities relative to the bulk production chemicals consumed in the normal processes; these chemicals have no suspected introduction to waste streams except in incidental quantities.	
3,4-dichloroaniline	No identified use in Hanford Site Central Plateau processing to retain this constituent listed in WAC 173-340-900, "Tables," Table 749-3; and WAC 173-340-7493 (2)(a)(i).	
3,4-dichlorophenol	No identified use in Hanford Site Central Plateau processing to retain this constituent listed in WAC 173-340-900, "Tables," Table 749-3; and WAC 173-340-7493 (2)(a)(i).	
3-chloroaniline	No identified use in Hanford Site Central Plateau processing to retain this constituent listed in WAC 173-340-900, "Tables," Table 749-3; and WAC 173-340-7493 (2)(a)(i).	

Table A-3. Excluded Contaminants. (42 Pages)

Contaminant	Description	Reference [a]
Organics (cont)		
3-chlorophenol	No identified use in Hanford Site Central Plateau processing to retain this constituent listed in WAC 173-340-900, "Tables," Table 749-3; and WAC 173-340-7493 (2)(a)(i).	
3-chloropropene	Gas above 45 degrees C.	
3-heptanone	No identified use in Hanford Site Central Plateau processing. Based on evaluation of the sources identified in CP-13196, Table 1-4, chemicals are used in minute quantities relative to the bulk production chemicals consumed in the normal processes; these chemicals have no suspected introduction to waste streams except in incidental quantities. VOA/SVOA (via GCMS) of soils from high-organic inventory tank farms (T,TX,TY WMA) reported nondetection for this and similar compounds. Not on routine analytical calibration lists. GCMS TIC searches could be used to screen for potential presence.	
3-methyl-2-butanone	No identified use in Hanford Site Central Plateau processing. Based on evaluation of the sources identified in CP-13196, Table 1-4, chemicals are used in minute quantities relative to the bulk production chemicals consumed in the normal processes; these chemicals have no suspected introduction to waste streams except in incidental quantities. VOA/SVOA (via GCMS) of soils from high-organic inventory tank farms (T,TX,TY WMA) reported nondetection for this and similar compounds. Not on routine analytical calibration lists. GCMS TIC searches could be used to screen for potential presence.	
3-pentanone	No identified use in Hanford Site Central Plateau processing. Based on evaluation of the sources identified in CP-13196, Table 1-4, chemicals are used in minute quantities relative to the bulk production chemicals consumed in the normal processes; these chemicals have no suspected introduction to waste streams except in incidental quantities. VOA/SVOA (via GCMS) of soils from high-organic inventory tank farms (T,TX,TY WMA) reported nondetection for this and similar compounds. Not on routine analytical calibration lists. GCMS TIC searches could be used to screen for potential presence.	
4-heptanone	No identified use in Hanford Site Central Plateau processing. Based on evaluation of the sources identified in CP-13196, Table 1-4, chemicals are used in minute quantities relative to the bulk production chemicals consumed in the normal processes; these chemicals have no suspected introduction to waste streams except in incidental quantities. VOA/SVOA (via GCMS) of soils from high-organic inventory tank farms (T,TX,TY WMA) reported nondetection for this and similar compounds. Not on routine analytical calibration lists. GCMS TIC searches could be used to screen for potential presence.	

Table A-3. Excluded Contaminants. (42 Pages)

Contaminant	Description	Reference [a]
Organics (cont)		
4-nitrophenol	No identified use in Hanford Site Central Plateau processing to retain this constituent listed in WAC 173-340-900, "Tables," Table 749-3; and WAC 173-340-7493 (2)(a)(i).	
5-methyl-2-hexanone	No identified use in Hanford Site Central Plateau processing. Based on evaluation of the sources identified in CP-13196, Table 1-4, chemicals are used in minute quantities relative to the bulk production chemicals consumed in the normal processes; these chemicals have no suspected introduction to waste streams except in incidental quantities. VOA/SVOA (via GCMS) of soils from high-organic inventory tank farms (T,TX,TY WMA) reported nondetection for this and similar compounds. Not on routine analytical calibration lists. GCMS TIC searches could be used to screen for potential presence.	
Acenaphthene	No identified use in Hanford Site Central Plateau processing to retain this constituent listed in WAC 173-340-900, "Tables," Table 749-3; and WAC 173-340-7493 (2)(a)(i).	
Acenaphthylene	Based on evaluation of the sources identified in CP-13196, Table 1-4, chemicals are used in minute quantities relative to the bulk production chemicals consumed in the normal processes; these chemicals have no suspected introduction to waste streams except in incidental quantities.	
Acetic Acid	Available as food-grade chemical (for example, vinegar). Potential pH effects will be determined. Has dissolved into a complexing agent that could have affected the mobility of certain COCs. Unexpected mobility of COCs will indicate the presence of complexing agents. Not a Washington State toxic and not an underlying hazardous constituent as defined in 40 CFR 268.2. No direct standard analytical technique available.	
Acetic acid ethyl ester	No identified use in Hanford Site Central Plateau processing. Based on evaluation of the sources identified in CP-13196, Table 1-4, chemicals are used in minute quantities relative to the bulk production chemicals consumed in the normal processes; these chemicals have no suspected introduction to waste streams except in incidental quantities. VOA/SVOA (via GCMS) of soils from high-organic inventory tank farms (T,TX,TY WMA) reported nondetection for this and similar compounds. Not on routine analytical calibration lists. GCMS TIC searches could be used to screen for potential presence.	

Table A-3. Excluded Contaminants. (42 Pages)

Contaminant	Description	Reference [a]
Organics (cont)		
Acetic acid n-butyl-ester	No identified use in Hanford Site Central Plateau processing. Based on evaluation of the sources identified in CP-13196, Table 1-4, chemicals are used in minute quantities relative to the bulk production chemicals consumed in the normal processes; these chemicals have no suspected introduction to waste streams except in incidental quantities. VOA/SVOA (via GCMS) of soils from high-organic inventory tank farms (T,TX,TY WMA) reported nondetection for this and similar compounds. Not on routine analytical calibration lists. GCMS TIC searches could be used to screen for potential presence.	
Acetone	Very soluble in water; likely to have migrated or vaporized if exposed; reasonably biodegradable. Not likely to be present in toxic and/or flammable concentrations.	
Acetonitrile	Based on evaluation of the sources identified in CP-13196, Table 1-4, chemicals are used in minute quantities relative to the bulk production chemicals consumed in the normal processes; these chemicals have no suspected introduction to waste streams except in incidental quantities.	
Acetophenone	Based on evaluation of the sources identified in CP-13196, Table 1-4, chemicals are used in minute quantities relative to the bulk production chemicals consumed in the normal processes; these chemicals have no suspected introduction to waste streams except in incidental quantities.	
Acrolein	Based on evaluation of the sources identified in CP-13196, Table 1-4, chemicals are used in minute quantities relative to the bulk production chemicals consumed in the normal processes; these chemicals have no suspected introduction to waste streams except in incidental quantities.	
Acrylonitrile	Based on evaluation of the sources identified in CP-13196, Table 1-4, chemicals are used in minute quantities relative to the bulk production chemicals consumed in the normal processes; these chemicals have no suspected introduction to waste streams except in incidental quantities.	
Aldrin	Pesticide (EPA Method 8081, SW-846). Based on evaluation of the sources identified in CP-13196, Table 1-4, chemicals are used in minute quantities relative to the bulk production chemicals consumed in the normal processes; these chemicals have no suspected introduction to waste streams except in incidental quantities.	
Alizarin Yellow	Laboratory indicator. Typically used in drop quantities as <1% solutions. No analytical technology or toxicity issues identified.	
Alpha-BHC	Pesticide (EPA Method 8081, SW-846). Based on evaluation of the sources identified in CP-13196, Table 1-4, chemicals are used in minute quantities relative to the bulk production chemicals consumed in the normal processes; these chemicals have no suspected introduction to waste streams except in incidental quantities.	

Table A-3. Excluded Contaminants. (42 Pages)

Contaminant	Description	Reference [a]
Organics (cont)		
Ammonium Oxalate	Contains ammonium, which has been previously identified as a COC, and oxalate, which has been previously excluded.	
Ammonium Perfluorooctanoate	Based on evaluation of the sources identified in CP-13196, Table 1-4, chemicals are used in minute quantities relative to the bulk production chemicals consumed in the normal processes; these chemicals have no suspected introduction to waste streams except in incidental quantities. No direct standard analytical technique available.	
AMSCO	Commercial product containing normal paraffin hydrocarbon, which has been previously identified as a COC.	
Anthracene	Based on evaluation of the sources identified in CP-13196, Table 1-4, chemicals are used in minute quantities relative to the bulk production chemicals consumed in the normal processes; these chemicals have no suspected introduction to waste streams except in incidental quantities.	
Anti-Foam 60 (GE)	Commercial product, no standard analytical method in place for its analysis.	
Arsenzao III	Commercial product, no standard analytical method in place for its analysis.	
Benzene hexachloride (including lindane)	Pesticide (EPA Method 8081, SW-846). Based on evaluation of the sources identified in CP-13196, Table 1-4, chemicals are used in minute quantities relative to the bulk production chemicals consumed in the normal processes; these chemicals have no suspected introduction to waste streams except in incidental quantities.	
Benzo(a)anthracene	Based on evaluation of the sources identified in CP-13196, Table 1-4, chemicals are used in minute quantities relative to the bulk production chemicals consumed in the normal processes; these chemicals have no suspected introduction to waste streams except in incidental quantities.	
Benzo(a)pyrene	Based on evaluation of the sources identified in CP-13196, Table 1-4, chemicals are used in minute quantities relative to the bulk production chemicals consumed in the normal processes; these chemicals have no suspected introduction to waste streams except in incidental quantities.	
Benzo(b)fluoranthene	Based on evaluation of the sources identified in CP-13196, Table 1-4, chemicals are used in minute quantities relative to the bulk production chemicals consumed in the normal processes; these chemicals have no suspected introduction to waste streams except in incidental quantities.	
Benzo(ghi)perylene	Based on evaluation of the sources identified in CP-13196, Table 1-4, chemicals are used in minute quantities relative to the bulk production chemicals consumed in the normal processes; these chemicals have no suspected introduction to waste streams except in incidental quantities.	

Table A-3. Excluded Contaminants. (42 Pages)

Contaminant	Description	Reference [a]
Organics (cont)		
Benzo(k)fluoranthene	Based on evaluation of the sources identified in CP-13196, Table 1-4, chemicals are used in minute quantities relative to the bulk production chemicals consumed in the normal processes; these chemicals have no suspected introduction to waste streams except in incidental quantities.	
Benzyl Alcohol	Available as food grade material. Minimal use of this compound at Hanford. The WAC 173-340-745 direct exposure limit is 24,000 mg/kg. Semivolatile analysis could report presence as TIC.	
Beta-BHC [Lindane]	Pesticide (EPA Method 8081, SW-846). Based on evaluation of the sources identified in CP-13196, Table 1-4, chemicals are used in minute quantities relative to the bulk production chemicals consumed in the normal processes; these chemicals have no suspected introduction to waste streams except in incidental quantities.	
Biphenyl	If present, will be identified in polychlorinated biphenyls (PCB), which previously were identified as a COC.	
Bromocresol Purple	Laboratory indicator. Typically used in drop quantities as <1% solutions. No analytical technology or toxicity issues identified.	
Bromomethane	Gas.	
Bromonaphthalene	Based on evaluation of the sources identified in CP-13196, Table 1-4, chemicals are used in minute quantities relative to the bulk production chemicals consumed in the normal processes; these chemicals have no suspected introduction to waste streams except in incidental quantities.	
Butane	Gas.	
Carbazole	Based on evaluation of the sources identified in CP-13196, Table 1-4, chemicals are used in minute quantities relative to the bulk production chemicals consumed in the normal processes; these chemicals have no suspected introduction to waste streams except in incidental quantities.	
Chlordane	Pesticide (EPA Method 8081, SW-846). Based on evaluation of the sources identified in CP-13196, Table 1-4, chemicals are used in minute quantities relative to the bulk production chemicals consumed in the normal processes; these chemicals have no suspected introduction to waste streams except in incidental quantities.	
Chlorinated Dibenzofurans (total)	No identified use in Hanford Site Central Plateau processing to retain this constituent listed in WAC 173-340-900, "Tables," Table 749-3; and WAC 173-340-7493 (2)(a)(i).	
Chloroacetamide	No identified use in Hanford Site Central Plateau processing to retain this constituent listed in WAC 173-340-900, "Tables," Table 749-3; and WAC 173-340-7493 (2)(a)(i).	
Chlorodifluoromethane (Freon 22)	Gas.	

Table A-3. Excluded Contaminants. (42 Pages)

Contaminant	Description	Reference [a]
Organics (cont)		
Chloroethane	Gas.	
Chloromethane	Gas.	
Chrysene	Based on evaluation of the sources identified in CP-13196, Table 1-4, chemicals are used in minute quantities relative to the bulk production chemicals consumed in the normal processes; these chemicals have no suspected introduction to waste streams except in incidental quantities.	
Cis-1,3-dichloropropene	Based on evaluation of the sources identified in CP-13196, Table 1-4, chemicals are used in minute quantities relative to the bulk production chemicals consumed in the normal processes; these chemicals have no suspected introduction to waste streams except in incidental quantities.	
Citric Acid	Available as food-grade material. Potential pH effects will be determined. Has dissolved to a complexing agent that could have affected the mobility of certain COCs. Unexpected mobility of COCs will indicate the presence of complexants. Material used in low or trace quantities at Hanford. Not a Washington State toxic and not an underlying hazardous constituent as defined in 40 CFR 268.2. No direct standard analytical technique available.	
Cyclohexane	No identified use in Hanford Site Central Plateau processing. Based on evaluation of the sources identified in CP-13196, Table 1-4, chemicals are used in minute quantities relative to the bulk production chemicals consumed in the normal processes; these chemicals have no suspected introduction to waste streams except in incidental quantities. VOA/SVOA (via GCMS) of soils from high-organic inventory tank farms (T,TX,TY WMA) reported nondetection for this and similar compounds. Not on routine analytical calibration lists. GCMS TIC searches could be used to screen for potential presence.	
Cyclohexanone	No identified use in Hanford Site Central Plateau processing. Based on evaluation of the sources identified in CP-13196, Table 1-4, chemicals are used in minute quantities relative to the bulk production chemicals consumed in the normal processes; these chemicals have no suspected introduction to waste streams except in incidental quantities. VOA/SVOA (via GCMS) of soils from high-organic inventory tank farms (T,TX,TY WMA) reported nondetection for this and similar compounds. Not on routine analytical calibration lists. GCMS TIC searches could be used to screen for potential presence.	

Table A-3. Excluded Contaminants. (42 Pages)

Contaminant	Description	Reference [a]
Organics (cont)		
Cyclohexene	No identified use in Hanford Site Central Plateau processing. Based on evaluation of the sources identified in CP-13196, Table 1-4, chemicals are used in minute quantities relative to the bulk production chemicals consumed in the normal processes; these chemicals have no suspected introduction to waste streams except in incidental quantities. VOA/SVOA (via GCMS) of soils from high-organic inventory tank farms (T,TX,TY WMA) reported nondetection for this and similar compounds. Not on routine analytical calibration lists. GCMS TIC searches could be used to screen for potential presence.	
Cyclopentane	No identified use in Hanford Site Central Plateau processing. Based on evaluation of the sources identified in CP-13196, Table 1-4, chemicals are used in minute quantities relative to the bulk production chemicals consumed in the normal processes; these chemicals have no suspected introduction to waste streams except in incidental quantities. VOA/SVOA (via GCMS) of soils from high-organic inventory tank farms (T,TX,TY WMA) reported nondetection for this and similar compounds. Not on routine analytical calibration lists. GCMS TIC searches could be used to screen for potential presence.	
DDT/DDD/DDE (total)	Pesticide (EPA Method 8081, SW-846). Based on evaluation of the sources identified in CP-13196, Table 1-4, chemicals are used in minute quantities relative to the bulk production chemicals consumed in the normal processes; these chemicals have no suspected introduction to waste streams except in incidental quantities.	
Decane	Contains normal paraffin hydrocarbon, which has been previously identified as a COC.	
Di-(2-ethylhexyl) Phosphoric Acid	Has dissolved to a complexing agent that could have affected the mobility of certain COCs. Unexpected mobility of COCs will indicate the presence of complexants. Degradation products include phosphate (final COC). Not a Washington State toxic and not an underlying hazardous constituent as defined in 40 CFR 268.2. No direct standard analytical technique available.	
Diacetone Alcohol	Based on evaluation of the sources identified in CP-13196, Table 1-4, chemicals are used in minute quantities relative to the bulk production chemicals consumed in the normal processes; these chemicals have no suspected introduction to waste streams except in incidental quantities.	
Dibenz[a,h]anthracene	Based on evaluation of the sources identified in CP-13196, Table 1-4, chemicals are used in minute quantities relative to the bulk production chemicals consumed in the normal processes; these chemicals have no suspected introduction to waste streams except in incidental quantities.	

Table A-3. Excluded Contaminants. (42 Pages)

Contaminant	Description	Reference [a]
Organics (cont)		
Dibenzofuran	Based on evaluation of the sources identified in CP-13196, Table 1-4, chemicals are used in minute quantities relative to the bulk production chemicals consumed in the normal processes; these chemicals have no suspected introduction to waste streams except in incidental quantities.	
Dibutyl Butyl Phosphonate (DBBP)	DBBP was widely used as a solvent during the PRF americium recovery operations. Will degrade to phosphate and butanol (final COCs). Not a Washington State toxic and not an underlying hazardous constituent as defined in 40 CFR 268.2. No direct standard analytical procedure available.	
Dibutyl Phosphate (DBP)	This compound is a degradation product of TBP and is unlikely to be present in toxic or high concentrations. Will degrade to phosphate and butanol (final COCs). Not a Washington State toxic and not an underlying hazardous constituent as defined in 40 CFR 268.2. No direct standard analytical technique available.	
Dichlorodifluoromethane	Gas.	
Dichlorofluoromethane (Freon 21)	Gas.	
Dieldrin	Pesticide (EPA Method 8081, SW-846). Based on evaluation of the sources identified in CP-13196, Table 1-4, chemicals are used in minute quantities relative to the bulk production chemicals consumed in the normal processes; these chemicals have no suspected introduction to waste streams except in incidental quantities.	
Diethylphthalate	Based on evaluation of the sources identified in CP-13196, Table 1-4, chemicals are used in minute quantities relative to the bulk production chemicals consumed in the normal processes; these chemicals have no suspected introduction to waste streams except in incidental quantities.	
Dimethylphthalate	No identified use in Hanford Site Central Plateau processing to retain this constituent listed in WAC 173-340-900, "Tables," Table 749-3; and WAC 173-340-7493 (2)(a)(i).	
Di-n-butyl phthalate	Based on evaluation of the sources identified in CP-13196, Table 1-4, chemicals are used in minute quantities relative to the bulk production chemicals consumed in the normal processes; these chemicals have no suspected introduction to waste streams except in incidental quantities.	
Dioxins	No identified use in Hanford Site Central Plateau processing to retain this constituent listed in WAC 173-340-900, "Tables," Table 749-3; and WAC 173-340-7493 (2)(a)(i).	
Diversy Chemical 159	Commercial product, no standard analytical method in place for its analysis.	
Dodecane	Contains normal paraffin hydrocarbon, which has been previously identified as a COC.	

Table A-3. Excluded Contaminants. (42 Pages)

Contaminant	Description	Reference [a]
Organics (cont)		
Dow Anti-Foam B	Commercial product that contains silicon, which has been previously excluded.	
Dowex 21 K/Amberlite XE-270 (IX Resin)	Commercial product in which no standard analytical method in place for its analysis.	
Duolite ARC-359 (IX Resin)	Commercial product that contains sulfate and phenol which have been previously identified as COCs. No standard analytical method in place for its analysis.	
Endrin	Pesticide (EPA Method 8081, SW-846). Based on evaluation of the sources identified in CP-13196, Table 1-4, chemicals are used in minute quantities relative to the bulk production chemicals consumed in the normal processes; these chemicals have no suspected introduction to waste streams except in incidental quantities.	
Ethanol	Material used in low quantities at Hanford. No cleanup levels established in Ecology 94-145, Section 3.1 tables. Available as food-grade material; not likely to be present in flammable concentrations.	
Ethyl Ether	Based on evaluation of the sources identified in CP-13196, Table 1-4, chemicals are used in minute quantities relative to the bulk production chemicals consumed in the normal processes; these chemicals have no suspected introduction to waste streams except in incidental quantities. Compound could be measured as VOA TIC.	
Ethylene Dibromide	Based on evaluation of the sources identified in CP-13196, Table 1-4, chemicals are used in minute quantities relative to the bulk production chemicals consumed in the normal processes; these chemicals have no suspected introduction to waste streams except in incidental quantities.	
Ethylene Glycol	Based on evaluation of the sources identified in CP-13196, Table 1-4, chemicals are used in minute quantities relative to the bulk production chemicals consumed in the normal processes; these chemicals have no suspected introduction to waste streams except in incidental quantities.	
Ethylene-diamine tetra acetic acid (EDTA)	Available as food-grade material. Has dissolved to a complexing agent that could have affected the mobility of certain COCs. Unexpected mobility of COCs will indicate the presence of complexants. No direct standard analytical technique available.	
Fluoranthene	Based on evaluation of the sources identified in CP-13196, Table 1-4, chemicals are used in minute quantities relative to the bulk production chemicals consumed in the normal processes; these chemicals have no suspected introduction to waste streams except in incidental quantities.	
Fluorene	No identified use in Hanford Site Central Plateau processing to retain this constituent listed in WAC 173-340-900, "Tables," Table 749-3; and WAC 173-340-7493 (2)(a)(i).	

Table A-3. Excluded Contaminants. (42 Pages)

Contaminant	Description	Reference [a]
Organics (cont)		
Formaldehyde	Very soluble in water; likely to have migrated or vaporized if exposed; reasonably biodegradable. Available as food-grade material; not likely to be present in toxic and/or flammable concentrations.	
Formic acid	Has dissolved to a complexing agent that could have affected the mobility of certain COCs. Unexpected mobility of COCs will indicate the presence of complexants. Used in minimal quantities at Hanford. Based on evaluation of the sources identified in CP-13196, Table 1-4, chemicals are used in minute quantities relative to the bulk production chemicals consumed in the normal processes; these chemicals have no suspected introduction to waste streams except in incidental quantities. No direct standard analytical technique available.	
Furans	Based on evaluation of the sources identified in CP-13196, Table 1-4, chemicals are used in minute quantities relative to the bulk production chemicals consumed in the normal processes; these chemicals have no suspected introduction to waste streams except in incidental quantities.	
gamma-BHC (Lindane)	Pesticide (EPA Method 8081, SW-846). Based on evaluation of the sources identified in CP-13196, Table 1-4, chemicals are used in minute quantities relative to the bulk production chemicals consumed in the normal processes; these chemicals have no suspected introduction to waste streams except in incidental quantities.	
Glycerol	Available as food-grade material. Material used in low or trace quantities at Hanford. Not a Washington State toxic and not an underlying hazardous constituent as defined in 40 CFR 268.2.	
Greases	Can be measured as normal paraffin hydrocarbon which has been previously identified as a COC or can be measured as a semivolatile TIC.	
Heptachlor/Heptachlor Epoxide (total)	Pesticide (EPA Method 8081, SW-846). Based on evaluation of the sources identified in CP-13196, Table 1-4, chemicals are used in minute quantities relative to the bulk production chemicals consumed in the normal processes; these chemicals have no suspected introduction to waste streams except in incidental quantities.	
Hexachlorobenzene	Pesticide (EPA Method 8081, SW-846). Based on evaluation of the sources identified in CP-13196, Table 1-4, chemicals are used in minute quantities relative to the bulk production chemicals consumed in the normal processes; these chemicals have no suspected introduction to waste streams except in incidental quantities.	

Table A-3. Excluded Contaminants. (42 Pages)

Contaminant	Description	Reference [a]
Organics (cont)		
Hexachlorobutadiene	Based on evaluation of the sources identified in CP-13196, Table 1-4, chemicals are used in minute quantities relative to the bulk production chemicals consumed in the normal processes; these chemicals have no suspected introduction to waste streams except in incidental quantities.	
Hexachloroethane	Based on evaluation of the sources identified in CP-13196, Table 1-4, chemicals are used in minute quantities relative to the bulk production chemicals consumed in the normal processes; these chemicals have no suspected introduction to waste streams except in incidental quantities.	
Hexachlorocyclopentadiene	No identified use in Hanford Site Central Plateau processing to retain this constituent listed in WAC 173-340-900, "Tables," Table 749-3; and WAC 173-340-7493 (2)(a)(i).	
Hexachloronaphthalene	No identified use in Hanford Site Central Plateau processing. Based on evaluation of the sources identified in CP-13196, Table 1-4, chemicals are used in minute quantities relative to the bulk production chemicals consumed in the normal processes; these chemicals have no suspected introduction to waste streams except in incidental quantities. VOA/SVOA (via GCMS) of soils from high-organic inventory tank farms (T,TX,TY WMA) reported nondetection for this and similar compounds. Not on routine analytical calibration lists. GCMS TIC searches could be used to screen for potential presence.	
Hexafluoroacetone	No identified use in Hanford Site Central Plateau processing. Based on evaluation of the sources identified in CP-13196, Table 1-4, chemicals are used in minute quantities relative to the bulk production chemicals consumed in the normal processes; these chemicals have no suspected introduction to waste streams except in incidental quantities. VOA/SVOA (via GCMS) of soils from high-organic inventory tank farms (T,TX,TY WMA) reported nondetection for this and similar compounds. Not on routine analytical calibration lists. GCMS TIC searches could be used to screen for potential presence.	
Hexanal	Based on evaluation of the sources identified in CP-13196, Table 1-4, chemicals are used in minute quantities relative to the bulk production chemicals consumed in the normal processes; these chemicals have no suspected introduction to waste streams except in incidental quantities.	
Hydrazine	Extremely reactive, soluble, and very likely to have degraded and not be present within waste stream.	

Table A-3. Excluded Contaminants. (42 Pages)

Contaminant	Description	Reference [a]
Organics (cont)		
Hydroxyacetic Acid	Available as food-grade material. Has dissolved to a complexing agent that could have affected the mobility of certain COCs. Unexpected mobility of COCs will indicate the presence of complexants. Material used in low or trace quantities at Hanford. No cleanup levels established in Ecology 94-145, Section 3.1 tables. No direct standard analytical technique available.	
Hydroxylamine Hydrochloride	Hydroxylamine was used during the PRF processes. Extremely reactive; very likely to have degraded to water, nitrogen, and ammonium hydroxide and not be present within waste stream. No direct standard analytical technique available. Chloride has been previously identified as a COC.	
Hydroxylamine Nitrate (HN)	Hydroxylamine was used during the PRF processes. Extremely reactive; very likely to have degraded to water, nitrogen, and ammonium hydroxide and not be present within waste stream. No direct standard analytical technique available. Nitrate has been previously identified as a COC.	
Hydroxyquinoline	Has dissolved to a complexing agent that could have affected the mobility of certain COCs. Unexpected mobility of COCs will indicate the presence of complexants. Material used in low or trace quantities at Hanford. No cleanup levels established in Ecology 94-145, Section 3.1 tables. No direct standard analytical technique available.	
Hyflo-Super-Cel	Commercial product, solid, no standard analytical method in place for its analysis.	
Immunol 1468-2	Commercial product, no standard analytical method in place for its analysis.	
Ionac A-580/Permutit [SKA] (IX Resin)	Commercial product which is a solid with active methyl groups. The active methyl groups will react or degrade during production operations, leaving a non-reactive or regulated plastic. No standard analytical method in place for its analysis.	
Isodrin	Pesticide (EPA Method 8081, SW-846). Based on evaluation of the sources identified in CP-13196, Table 1-4, chemicals are used in minute quantities relative to the bulk production chemicals consumed in the normal processes; these chemicals have no suspected introduction to waste streams except in incidental quantities.	
Isopropyl Alcohol	Extremely soluble, and very likely to have degraded and not be present within waste stream. Material used in low or trace quantities at Hanford.	
Jasco Paint Stripper	Commercial product that most likely contains methanol, methylene chloride, and/or caustics such as sodium hydroxide owing to time period used.	
Kelite 25E	Commercial product, no standard analytical method in place for its analysis.	
Keraff	Commercial product, no standard analytical method in place for its analysis.	

Table A-3. Excluded Contaminants. (42 Pages)

Contaminant	Description	Reference [a]
Organics (cont)		
Kerosene	Contains normal paraffin hydrocarbon, which has been previously identified as a COC.	
Lard Oil	This is a food-grade chemical with no applicable regulatory action levels. Based on evaluation of the sources identified in CP-13196, Table 1-4, chemicals are used in minute quantities relative to the bulk production chemicals consumed in the normal processes; these chemicals have no suspected introduction to waste streams except in incidental quantities.	
Mandelic Acid	Has dissolved to a complexing agent that could have affected the mobility of certain COCs. Unexpected mobility of COCs will indicate the presence of complexants. Material used in low or trace quantities at Hanford. No cleanup levels established in Ecology 94-145, Section 3.1 tables. No direct standard analytical technique available.	
Methanol	Extremely soluble, and very likely to have degraded and not be present within waste stream.	
Methyl Isocyanate	No identified use in Hanford Site Central Plateau processing. Based on evaluation of the sources identified in CP-13196, Table 1-4, chemicals are used in minute quantities relative to the bulk production chemicals consumed in the normal processes; these chemicals have no suspected introduction to waste streams except in incidental quantities. VOA/SVOA (via GCMS) of soils from high-organic inventory tank farms (T,TX,TY WMA) reported nondetection for this and similar compounds. Not on routine analytical calibration lists. GCMS TIC searches could be used to screen for potential presence.	
Methyl Lactic Acid	Has decomposed to a complexing agent that could have affected the mobility of certain COCs. Unexpected mobility of COCs will indicate the presence of complexants. Material used in low or trace quantities at Hanford. No cleanup levels established in Ecology 94-145, Section 3.1 tables. No direct standard analytical technique available.	
Methylcyclohexane	No identified use in Hanford Site Central Plateau processing. Based on evaluation of the sources identified in CP-13196, Table 1-4, chemicals are used in minute quantities relative to the bulk production chemicals consumed in the normal processes; these chemicals have no suspected introduction to waste streams except in incidental quantities. VOA/SVOA (via GCMS) of soils from high-organic inventory tank farms (T,TX,TY WMA) reported nondetection for this and similar compounds. Not on routine analytical calibration lists. GCMS TIC searches could be used to screen for potential presence.	

Table A-3. Excluded Contaminants. (42 Pages)

Contaminant	Description	Reference [a]
Organics (cont)		
Methylhydrazine	Used in minimal quantities at Hanford. Reactive material with minimal lifetime in Hanford environment. Based on evaluation of the sources identified in CP-13196, Table 1-4, chemicals are used in minute quantities relative to the bulk production chemicals consumed in the normal processes; these chemicals have no suspected introduction to waste streams except in incidental quantities. No direct standard analytical technique available.	
Mineral Oil	Commercial product, no standard analytical method in place for its analysis.	
Miscellaneous Commercial Products	Commercial product, no standard analytical method in place for its analysis.	
Molybdate-Citrate Reagent	Constituents analyzed as molybdenum and citrate which has been previously excluded. Has dissolved to a complexing agent that could have affected the mobility of certain COCs. Unexpected mobility of COCs will indicate the presence of complexants. Material used in low or trace quantities at Hanford. No direct standard analytical technique available.	
Mono-2-ethylhexyl Phosphoric Acid	Degradation product of Di-2-ethyl hexyl phosphoric acid. Degradation products include phosphate (final COC). Has dissolved to a complexing agent that could have affected the mobility of certain COCs. Unexpected mobility of COCs will indicate the presence of complexants. No direct standard analytical technique available.	
Monobutyl Phosphate (MBP)	This compound is a degradation product of TBP. Will degrade to phosphate and butanol, which have been previously identified as COCs. Not a Washington State toxic and not an underlying hazardous constituent as defined in 40 CFR 268.2. No direct standard analytical technique available.	
m-xylene	Measured as total Xylene (EPA Method 8260, SW-846).	
Naphthylamine	Based on evaluation of the sources identified in CP-13196, Table 1-4, chemicals are used in minute quantities relative to the bulk production chemicals consumed in the normal processes; these chemicals have no suspected introduction to waste streams except in incidental quantities.	
n-heptane	No identified use in Hanford Site Central Plateau processing. Based on evaluation of the sources identified in CP-13196, Table 1-4, chemicals are used in minute quantities relative to the bulk production chemicals consumed in the normal processes; these chemicals have no suspected introduction to waste streams except in incidental quantities. VOA/SVOA (via GCMS) of soils from high-organic inventory tank farms (T,TX,TY WMA) reported nondetection for this and similar compounds. Not on routine analytical calibration lists. GCMS TIC searches could be used to screen for potential presence.	

Table A-3. Excluded Contaminants. (42 Pages)

Contaminant	Description	Reference [a]
Organics (cont)		
n-hexane	No identified use in Hanford Site Central Plateau processing. Based on evaluation of the sources identified in CP-13196, Table 1-4, chemicals are used in minute quantities relative to the bulk production chemicals consumed in the normal processes; these chemicals have no suspected introduction to waste streams except in incidental quantities. VOA/SVOA (via GCMS) of soils from high-organic inventory tank farms (T,TX,TY WMA) reported nondetection for this and similar compounds. Not on routine analytical calibration lists. GCMS TIC searches could be used to screen for potential presence.	
Nitrilotriacetic Acid (NTA)	Based on evaluation of the sources identified in CP-13196, Table 1-4, chemicals are used in minute quantities relative to the bulk production chemicals consumed in the normal processes; these chemicals have no suspected introduction to waste streams except in incidental quantities.	
Nitrobenzene	Based on evaluation of the sources identified in CP-13196, Table 1-4, chemicals are used in minute quantities relative to the bulk production chemicals consumed in the normal processes; these chemicals have no suspected introduction to waste streams except in incidental quantities.	
n,n-diphenylamine	Based on evaluation of the sources identified in CP-13196, Table 1-4, chemicals are used in minute quantities relative to the bulk production chemicals consumed in the normal processes; these chemicals have no suspected introduction to waste streams except in incidental quantities.	
n-nitrosodiphenylamine	No identified use in Hanford Site Central Plateau processing to retain this constituent listed in WAC 173-340-900, "Tables," Table 749-3; and WAC 173-340-7493 (2)(a)(i).	
n-nitroso-n,n-dimethylamine	No identified use in Hanford Site Central Plateau processing. Based on evaluation of the sources identified in CP-13196, Table 1-4, chemicals are used in minute quantities relative to the bulk production chemicals consumed in the normal processes; these chemicals have no suspected introduction to waste streams except in incidental quantities. VOA/SVOA (via GCMS) of soils from high-organic inventory tank farms (T,TX,TY WMA) reported nondetection for this and similar compounds. Not on routine analytical calibration lists. GCMS TIC searches could be used to screen for potential presence.	

Table A-3. Excluded Contaminants. (42 Pages)

Contaminant	Description	Reference [a]
Organics (cont)		
n-nonane	No identified use in Hanford Site Central Plateau processing. Based on evaluation of the sources identified in CP-13196, Table 1-4, chemicals are used in minute quantities relative to the bulk production chemicals consumed in the normal processes; these chemicals have no suspected introduction to waste streams except in incidental quantities. VOA/SVOA (via GCMS) of soils from high-organic inventory tank farms (T,TX,TY WMA) reported nondetection for this and similar compounds. Not on routine analytical calibration lists. GCMS TIC searches could be used to screen for potential presence.	
n-octane	No identified use in Hanford Site Central Plateau processing. Based on evaluation of the sources identified in CP-13196, Table 1-4, chemicals are used in minute quantities relative to the bulk production chemicals consumed in the normal processes; these chemicals have no suspected introduction to waste streams except in incidental quantities. VOA/SVOA (via GCMS) of soils from high-organic inventory tank farms (T,TX,TY WMA) reported nondetection for this and similar compounds. Not on routine analytical calibration lists. GCMS TIC searches could be used to screen for potential presence.	
n-pentane	Gas above 36 degrees C.	
n-propionaldehyde	No identified use in Hanford Site Central Plateau processing. Based on evaluation of the sources identified in CP-13196, Table 1-4, chemicals are used in minute quantities relative to the bulk production chemicals consumed in the normal processes; these chemicals have no suspected introduction to waste streams except in incidental quantities. VOA/SVOA (via GCMS) of soils from high-organic inventory tank farms (T,TX,TY WMA) reported nondetection for this and similar compounds. Not on routine analytical calibration lists. GCMS TIC searches could be used to screen for potential presence.	
n-propyl Alcohol (1-propanol)	No identified use in Hanford Site Central Plateau processing. Based on evaluation of the sources identified in CP-13196, Table 1-4, chemicals are used in minute quantities relative to the bulk production chemicals consumed in the normal processes; these chemicals have no suspected introduction to waste streams except in incidental quantities. VOA/SVOA (via GCMS) of soils from high-organic inventory tank farms (T,TX,TY WMA) reported nondetection for this and similar compounds. Not on routine analytical calibration lists. GCMS TIC searches could be used to screen for potential presence.	
Oakite Clear Guard	Commercial product, no standard analytical method in place for its analysis.	
Oakite Rust Stripper	Commercial product, no standard analytical method in place for its analysis.	

Table A-3. Excluded Contaminants. (42 Pages)

Contaminant	Description	Reference [a]
Organics (cont)		
Oakite Swiff	This commercial chemical is trichloroethane, which has been previously identified as a COC.	
Octachloronaphthalene	No identified use in Hanford Site Central Plateau processing. Based on evaluation of the sources identified in CP-13196, Table 1-4, chemicals are used in minute quantities relative to the bulk production chemicals consumed in the normal processes; these chemicals have no suspected introduction to waste streams except in incidental quantities. VOA/SVOA (via GCMS) of soils from high-organic inventory tank farms (T,TX,TY WMA) reported nondetection for this and similar compounds. Not on routine analytical calibration lists. GCMS TIC searches could be used to screen for potential presence.	
o-phenanthroline	Based on evaluation of the sources identified in CP-13196, Table 1-4, chemicals are used in minute quantities relative to the bulk production chemicals consumed in the normal processes; these chemicals have no suspected introduction to waste streams except in incidental quantities.	
Orvus K	Commercial product, no standard analytical method in place for its analysis.	
Oxalic Acid	Has dissolved to a complexing agent that could have affected the mobility of certain COCs. Unexpected mobility of COCs will indicate the presence of complexants. Not a Washington State toxic and not an underlying hazardous constituent as defined in 40 CFR 268.2. No direct standard analytical technique available.	
Oxirane (Ethylene Oxide)	Gas.	
o-xylene	Measured as total Xylene (EPA Method 8260, SW-846).	
Pace-S-Teen	Commercial product, no standard analytical method in place for its analysis.	
Pentachloroaniline	No identified use in Hanford Site Central Plateau processing to retain this constituent listed in WAC 173-340-900, "Tables," Table 749-3; and WAC 173-340-7493 (2)(a)(i).	
Pentachlorobenzene	No identified use in Hanford Site Central Plateau processing to retain this constituent listed in WAC 173-340-900, "Tables," Table 749-3; and WAC 173-340-7493 (2)(a)(i).	
Pentachloronaphthalene	No identified use in Hanford Site Central Plateau processing. Based on evaluation of the sources identified in CP-13196, Table 1-4, chemicals are used in minute quantities relative to the bulk production chemicals consumed in the normal processes; these chemicals have no suspected introduction to waste streams except in incidental quantities. VOA/SVOA (via GCMS) of soils from high-organic inventory tank farms (T,TX,TY WMA) reported nondetection for this and similar compounds. Not on routine analytical calibration lists. GCMS TIC searches could be used to screen for potential presence.	

Table A-3. Excluded Contaminants. (42 Pages)

Contaminant	Description	Reference [a]
Organics (cont)		
Pentachlorophenol	Pesticide (EPA Method 8081, SW-846). Based on evaluation of the sources identified in CP-13196, Table 1-4, chemicals are used in minute quantities relative to the bulk production chemicals consumed in the normal processes; these chemicals have no suspected introduction to waste streams except in incidental quantities.	
Pentasodium Diethylene Triamine Penta Acetate (DTPA)	Has dissolved to a complexing agent that could have affected the mobility of certain COCs. Unexpected mobility of COCs will indicate the presence of complexants. Material used in low or trace quantities at Hanford. No cleanup levels established in Ecology 94-145, Section 3.1 tables. No direct standard analytical technique available.	
Penvert 192	Commercial product, no standard analytical method in place for its analysis.	
Peroklean	Commercial product, no standard analytical method in place for its analysis.	
Phenanthrene	Based on evaluation of the sources identified in CP-13196, Table 1-4, chemicals are used in minute quantities relative to the bulk production chemicals consumed in the normal processes; these chemicals have no suspected introduction to waste streams except in incidental quantities.	
Phosphotungstic Acid (PTA)	Will degrade to phosphate and butanol, which have been previously identified as COCs, and tungsten, which has been previously excluded. Not a Washington State toxic and not an underlying hazardous constituent as defined in 40 CFR 268.2. No direct standard analytical technique available.	
Picric Acid	No identified use in Hanford Site Central Plateau processing. Based on evaluation of the sources identified in CP-13196, Table 1-4, chemicals are used in minute quantities relative to the bulk production chemicals consumed in the normal processes; these chemicals have no suspected introduction to waste streams except in incidental quantities. VOA/SVOA (via GCMS) of soils from high-organic inventory tank farms (T,TX,TY WMA) reported nondetection for this and similar compounds. Not on routine analytical calibration lists. GCMS TIC searches could be used to screen for potential presence.	
p-nitrochlorobenzene	No identified use in Hanford Site Central Plateau processing. Based on evaluation of the sources identified in CP-13196, Table 1-4, chemicals are used in minute quantities relative to the bulk production chemicals consumed in the normal processes; these chemicals have no suspected introduction to waste streams except in incidental quantities. VOA/SVOA (via GCMS) of soils from high-organic inventory tank farms (T,TX,TY WMA) reported nondetection for this and similar compounds. Not on routine analytical calibration lists. GCMS TIC searches could be used to screen for potential presence.	

Table A-3. Excluded Contaminants. (42 Pages)

Contaminant	Description	Reference [a]
Organics (cont)		
Propionitrile	Based on evaluation of the sources identified in CP-13196, Table 1-4, chemicals are used in minute quantities relative to the bulk production chemicals consumed in the normal processes; these chemicals have no suspected introduction to waste streams except in incidental quantities.	
p-xylene	Measured as total Xylene (EPA Method 8260, SW-846).	
Pyrene	Based on evaluation of the sources identified in CP-13196, Table 1-4, chemicals are used in minute quantities relative to the bulk production chemicals consumed in the normal processes; these chemicals have no suspected introduction to waste streams except in incidental quantities.	
Pyridine	Based on evaluation of the sources identified in CP-13196, Table 1-4, chemicals are used in minute quantities relative to the bulk production chemicals consumed in the normal processes; these chemicals have no suspected introduction to waste streams except in incidental quantities.	
Saf-tee Solvent F.O. 128	Contains normal paraffin hydrocarbon, which has been previously identified as a COC.	
s-diphenyl Carbazide	Based on evaluation of the sources identified in CP-13196, Table 1-4, chemicals are used in minute quantities relative to the bulk production chemicals consumed in the normal processes; these chemicals have no suspected introduction to waste streams except in incidental quantities.	
Shell E-2342	Contains normal paraffin hydrocarbon, which has been previously identified as a COC.	
Shell Spray Base	Contains normal paraffin hydrocarbon, which has been previously identified as a COC.	
Sodium Gluconate	Available as food-grade material. Has dissolved to a complexing agent that could have affected the mobility of certain COCs. Unexpected mobility of COCs will indicate the presence of complexants. Material used in low or trace quantities at Hanford. Not a Washington State toxic and not an underlying hazardous constituent as defined in 40 CFR 268.2. No direct standard analytical technique available.	
Sodium Tartrate	Available as food-grade material. Has dissolved to a complexing agent that could have affected the mobility of certain COCs. Unexpected mobility of COCs will indicate the presence of complexants. Material used in low or trace quantities at Hanford. Not a Washington State toxic and not an underlying hazardous constituent as defined in 40 CFR 268.2. No direct standard analytical technique available.	
Soltrol-170	Contains normal paraffin hydrocarbon, which has been previously identified as a COC.	
Spartan DC 13	Commercial product, no standard analytical method in place for its analysis.	
Sugar	This is a food-grade chemical. Not a Washington State toxic and not an underlying hazardous constituent as defined in 40 CFR 268.2.	

Table A-3. Excluded Contaminants. (42 Pages)

Contaminant	Description	Reference [a]
Organics (cont)		
Sulfonic Acid (chloro)	This chemical has degraded to sulfate and chlorine, which have been previously identified as COCs.	
Styrene	No identified use in Hanford Site Central Plateau processing to retain this constituent listed in WAC 173-340-900, "Tables," Table 749-3; and WAC 173-340-7493 (2)(a)(i).	
Super Gel Hyflo	A chromatography medium (insoluble solid) that was used in determining if samples collected from various steps of the bismuth-phosphate process had successfully reacted, separated, etc. This substance is unlikely to be present in toxic concentrations.	
Tartaric Acid	Available as food-grade material. Has dissolved to a complexing agent that could have affected the mobility of certain COCs. Unexpected mobility of COCs will indicate the presence of complexants. Material used in low or trace quantities at Hanford. Not a Washington State toxic and not an underlying hazardous constituent as defined in 40 CFR 268.2. No direct standard analytical technique available.	
Tetrabromoethane.	Based on evaluation of the sources identified in CP-13196, Table 1-4, chemicals are used in minute quantities relative to the bulk production chemicals consumed in the normal processes; these chemicals have no suspected introduction to waste streams except in incidental quantities.	
Tetrachloronaphthalene	No identified use in Hanford Site Central Plateau processing. Based on evaluation of the sources identified in CP-13196, Table 1-4, chemicals are used in minute quantities relative to the bulk production chemicals consumed in the normal processes; these chemicals have no suspected introduction to waste streams except in incidental quantities. VOA/SVOA (via GCMS) of soils from high-organic inventory tank farms (T,TX,TY WMA) reported nondetection for this and similar compounds. Not on routine analytical calibration lists. GCMS TIC searches could be used to screen for potential presence.	
Tetradecane	Will be measured as a normal paraffin hydrocarbon, which has been previously identified as a COC.	
Tetrahydrofuran	Extremely soluble, and very likely to have degraded and not be present within waste stream. Material used in low or trace quantities at Hanford. No cleanup levels established in Ecology 94-145, Section 3.1 tables. Presence could be reported as a TIC from volatile organic analysis.	
Tetraphenyl Boron	Boron and phenyl constituents of this chemical have been previously listed.	
Thenyltrifluoroacetone	Has dissolved to a complexing agent that could have affected the mobility of certain COCs. Material used in low or trace quantities at Hanford. Not a Washington State toxic and not an underlying hazardous constituent as defined in 40 CFR 268.2. No direct standard analytical technique available.	

Table A-3. Excluded Contaminants. (42 Pages)

Contaminant	Description	Reference [a]
Organics (cont)		
Thymolphthalein	Laboratory indicator. Typically used in drop quantities as <1% solutions. No analytical or toxicity issues identified.	
Tide	This commercial chemical is sodium silicate, soap, and organic complexants, no standard analytical method in place for its analysis.	
Toxaphene	Pesticide (EPA Method 8081, SW-846). Based on evaluation of the sources identified in CP-13196, Table 1-4, chemicals are used in minute quantities relative to the bulk production chemicals consumed in the normal processes; these chemicals have no suspected introduction to waste streams except in incidental quantities.	
Trans-1,3-dichloropropene	Based on evaluation of the sources identified in CP-13196, Table 1-4, chemicals are used in minute quantities relative to the bulk production chemicals consumed in the normal processes; these chemicals have no suspected introduction to waste streams except in incidental quantities.	
Tributyl Phosphate (TBP)	Will degrade to phosphate and butanol, which have been previously identified as COCs. Not a Washington State toxic and not an underlying hazardous constituent as defined in 40 CFR 268.2. No direct standard analytical technique available.	
Trichlorofluoromethane	Gas above 24 degrees C.	
Triethylamine	No identified use in Hanford Site Central Plateau processing. Based on evaluation of the sources identified in CP-13196, Table 1-4, chemicals are used in minute quantities relative to the bulk production chemicals consumed in the normal processes; these chemicals have no suspected introduction to waste streams except in incidental quantities. VOA/SVOA (via GCMS) of soils from high-organic inventory tank farms (T,TX,TY WMA) reported nondetection for this and similar compounds. Not on routine analytical calibration lists. GCMS TIC searches could be used to screen for potential presence.	
Tri-iso-octylamine	Based on evaluation of the sources identified in CP-13196, Table 1-4, chemicals are used in minute quantities relative to the bulk production chemicals consumed in the normal processes; these chemicals have no suspected introduction to waste streams except in incidental quantities.	
Tri-n-dodecylamine	Based on evaluation of the sources identified in CP-13196, Table 1-4, chemicals are used in minute quantities relative to the bulk production chemicals consumed in the normal processes; these chemicals have no suspected introduction to waste streams except in incidental quantities.	
Tri-n-octylamine	Based on evaluation of the sources identified in CP-13196, Table 1-4, chemicals are used in minute quantities relative to the bulk production chemicals consumed in the normal processes; these chemicals have no suspected introduction to waste streams except in incidental quantities.	

Table A-3. Excluded Contaminants. (42 Pages)

Contaminant	Description	Reference [a]
Organics (cont)		
Tris (hydroxymethyl) Amino Methane	Very soluble. Available and used as pharmaceutical-grade material. Minimal potential for presence in toxic level quantities. Material used in low or trace quantities at Hanford. No cleanup levels established in Ecology 94-145, Section 3.1 tables. No direct standard analytical technique available.	
Trisodium Hydroxyethyl Ethylene-Diamine Triacetate (HEDTA)	Has dissolved to a complexing agent that could have affected the mobility of certain COCs. Unexpected mobility of COCs will indicate the presence of complexants. Based on evaluation of the sources identified in CP-13196, Table 1-4, chemicals are used in minute quantities relative to the bulk production chemicals consumed in the normal processes; these chemicals have no suspected introduction to waste streams except in incidental quantities. No direct standard analytical technique available.	
Trisodium nitrilo triacetate (NTA)	Has dissolved to a complexing agent that could have affected the mobility of certain COCs. Unexpected mobility of COCs will indicate the presence of complexants. Material used in low or trace quantities at Hanford. No cleanup levels established in Ecology 94-145, Section 3.1 tables. No direct standard analytical technique available.	
Turco (Fabricfilm)	Commercial chemical compound containing toluene, butanol, and isopropanol, which have been previously identified as COCs.	
Turco 2822	Commercial chemical compound containing methylene chloride and acetic acid, which have been previously identified as COCs.	
Turco 2844	Commercial product, no standard analytical method in place for its analysis.	
Turco 4358-4A	Commercial product, no standard analytical method in place for its analysis.	
Turco 4501 A	Commercial product which contains potassium hydroxide and hydroxydiamine compounds which have been previously excluded.	
Turco 4518	Commercial chemical compound containing benzene, sulfonate, and sodium, which have been previously identified as COCs.	
Turco 4521	Commercial chemical compound containing benzene, sulfonate, and sodium, which have been previously identified as COCs.	
Turco 4605-8	Commercial product, no standard analytical method in place for its analysis.	
Turco 4669	Commercial product, no standard analytical method in place for its analysis.	
Turco 4715	Commercial product, no standard analytical method in place for its analysis.	
Turco 4738 (Thin)	Commercial product, no standard analytical method in place for its analysis.	

Table A-3. Excluded Contaminants. (42 Pages)

Contaminant	Description	Reference [a]
Organics (cont)		
Turco Alkaline (Rust Remover)	Commercial chemical compound containing sodium hydroxide and kerosene, which have been previously identified as COCs.	
Turco Deseal Zit 2	Commercial chemical compound containing methylene chloride and acetic acid, which have been previously identified as COCs.	
Turco EPO Strip	Commercial product, no standard analytical method in place for its analysis.	
Turco EPO Strip NP	Commercial product, no standard analytical method in place for its analysis.	
Turco Plaudit	Commercial product, no standard analytical method in place for its analysis.	
Turco T-5561	Commercial chemical compound containing ethanol and mineral oil, which have been previously identified as COCs.	
Turco T-5589	Commercial chemical compound containing isopropanol and ammonium hydroxide, which have been previously identified as COCs.	
Urea	This is a constituent of some fertilizers. This compound will degrade to nitrogen, nitrate, and ammonia. Material used in low or trace quantities at Hanford. No cleanup levels established in Ecology 94-145, Section 3.1 tables. No standard analytical method in place for its analysis.	
West Lode Degreaser	Commercial chemical compound containing aromatic compounds such as benzene and phenol, which have been previously identified as COCs	
Wyandotte 1112	Commercial product, no standard analytical method in place for its analysis.	
Wyandotte Kelvar	Commercial product, no standard analytical method in place for its analysis.	
Wyandotte MF	Commercial product, no standard analytical method in place for its analysis.	
Wyandotte P1075	Commercial product, no standard analytical method in place for its analysis.	

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

40 CFR 268.2, "Land Disposal Restrictions," "Definitions Applicable to this Part," Title 40, *Code of Federal Regulations*, Part 268.2, as amended.

CP-13196, 2002, *Remedial Investigation Data Quality Objective Summary Report – 200-IS-1 and 200-ST-1 Operable Units*, Draft A, Fluor Hanford, Inc., Richland, Washington.

Ecology 94-145, 2001, *Cleanup Levels and Risk Calculations under the Model Toxics Control Act Cleanup Regulation; CLARC, Version 3.1*, Washington State Department of Ecology, Olympia, Washington.

ORNL-5621, 1980, *ORIGEN2-A Revised and Updated Version of the Oak Ridge Isotope Generation and Depletion Code*, Oak Ridge National Laboratory, Oak Ridge, Tennessee.

Parrington, Josef R., Harold D. Knox, Susan L. Breneman, Edward M. Baum, and Frank Feiner, 1996, *Nuclides and Isotopes: Chart of the Nuclides*, 15th ed., General Electric Co. and Knolls Atomic Power Laboratory, Inc., Schenectady, New York.

RadDecay, 1981, *RadDecay Software for Windows* (RadDecay.exe), Grove Engineering, Rockville, Maryland.

RadDecay = RadDecay is a registered trademark of Areva Radiation Software Products, Lynchburg, Virginia.

Table A-3. Excluded Contaminants. (42 Pages)

Contaminant	Description	Reference [a]

Rickard, W. H. and M. C. McShane, 1984, "Iodine in Terrestrial Wildlife on the U.S. Department of Energy's Hanford Site in South Central Washington," *Environ. Monitor. Assess.*, 4:379-388.

SW-846, 1999, *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, as amended*, Office of Solid Waste and Emergency Response, U.S. Environmental Protection Agency, Washington, D.C.

COC = contaminant of concern.
COPEC = contaminant of potential ecological concern.
EPA = U.S. Environmental Protection Agency.
GCMS = gas chromatograph/mass spectrometer.
GEA = gamma energy analysis.
ICP = inductively coupled plasma.
PRF = Plutonium Reclamation Facility.
SVOA = semivolatile organic analyte.
TBP = tri butyl phosphate.
TIC = tentatively identified compound.
VOA = volatile organic analyte.
WMA = Waste Management Area.

Table A-4. Central Plateau Contaminants of Potential Concern. (5 Pages)

Contaminant	Chemical Process	Reference
Radionuclides		
Americium-241	Bismuth phosphate, REDOX, PUREX/URP, Z Plant Complex, Sr/Cs Operations	LA-UR-96-3860; WHC-SD-WM-ER-133; ES/ER/TM-33/R2
Antimony-125	Bismuth phosphate, REDOX, PUREX/URP, Z Plant Complex, Sr/Cs Operations	Parrington et al. 1996
Carbon-14	Bismuth phosphate, REDOX, PUREX/URP, Z Plant Complex, Sr/Cs Operations	LA-UR-96-3860; WHC-SD-WM-ER-133
Cesium-134	Bismuth phosphate, REDOX, PUREX/URP, Z Plant Complex, Sr/Cs Operations	Parrington et al. 1996
Cesium-137	Bismuth phosphate, REDOX, PUREX/URP, Z Plant Complex, Sr/Cs Operations	HW-10475, Sections A, B, and C; WHC-SD-WM-ER-133; ES/ER/TM-33/R2
Cobalt-60	Bismuth phosphate, REDOX, PUREX/URP, Z Plant Complex, Sr/Cs Operations	HW-10475, Sections A, B, and C; WHC-SD-WM-ER-133; WHC-MR-0270; ES/ER/TM-33/R2
Europium-152	Bismuth phosphate, REDOX, PUREX/URP, Z Plant Complex, Sr/Cs Operations	HW-10475, Sections A, B, and C; HNF-1744
Europium-154	Bismuth phosphate, REDOX, PUREX/URP, Z Plant Complex, Sr/Cs Operations	HW-10475, Sections A, B, and C; HNF-1744
Europium-155	Bismuth phosphate, REDOX, PUREX/URP, Z Plant Complex, Sr/Cs Operations	HW-10475, Sections A, B, and C; WHC-SD-WM-ER-133
Hydrogen-3 (tritium)	Bismuth phosphate, REDOX, PUREX/URP, Z Plant Complex, Sr/Cs Operations	LA-UR-96-3860; WHC-SD-WM-ER-133
Neptunium-237	Bismuth phosphate, REDOX, PUREX/URP, Z Plant Complex, Sr/Cs Operations	LA-UR-96-3860; WHC-SD-WM-ER-133
Nickel-63	Bismuth phosphate, REDOX, PUREX/URP, Z Plant Complex, Sr/Cs Operations	LA-UR-96-3860; WHC-SD-WM-ER-133
Plutonium-238	Bismuth phosphate, REDOX, PUREX/URP, Z Plant Complex, Sr/Cs Operations	HW-10475, Sections A, B, and C
Plutonium-239/240	Bismuth phosphate, REDOX, PUREX/URP, Z Plant Complex, Sr/Cs Operations	HW-10475, Sections A, B, and C; ES/ER/TM-33/R2

Table A-4. Central Plateau Contaminants of Potential Concern. (5 Pages)

Contaminant	Chemical Process	Reference
Radionuclides (cont)		
Radium-226	Bismuth phosphate, REDOX, PUREX/URP, Z Plant Complex, Sr/Cs Operations	LA-UR-96-3860; WHC-SD-WM-ER-133; RadDecay Version 3
Radium-228	Bismuth phosphate, REDOX, PUREX/URP, Z Plant Complex, Sr/Cs Operations	LA-UR-96-3860; WHC-SD-WM-ER-133; RadDecay Version 3
Strontium-90	Bismuth phosphate, REDOX, PUREX/URP, Z Plant Complex, Sr/Cs Operations	ES/ER/TM-33/R2
Technetium-99	Bismuth phosphate, REDOX, PUREX/URP, Z Plant Complex, Sr/Cs Operations	HW-10475, Sections A, B, and C; WHC-MR-0270; ES/ER/TM-33/R2
Thorium-232	Bismuth phosphate, REDOX, PUREX/URP, Z Plant Complex, Sr/Cs Operations	HW-10475, Sections A, B, and C; HNF-1744
Uranium-234	Bismuth phosphate, REDOX, PUREX/URP, Z Plant Complex, Sr/Cs Operations	HW-10475, Sections A, B, and C; ES/ER/TM-33/R2
Uranium-235	Bismuth phosphate, REDOX, PUREX/URP, Z Plant Complex, Sr/Cs Operations	HW-10475, Sections A, B, and C
Uranium-238	Bismuth phosphate, REDOX, PUREX/URP, Z Plant Complex, Sr/Cs Operations	HW-10475, Sections A, B, and C; ES/ER/TM-33/R2
Metals		
Aluminum	Bismuth phosphate, REDOX, PUREX/URP, Sr/Cs Operations, Z Plant Complex	HW-10475, Sections A, B, and C, HW-18700; HW-31000-DEL; ISO-100, DOE/RL-91-52
Antimony	REDOX	HW-18700
Arsenic, Total all valence states	Z Plant Complex	FH-0002791
Arsenic (III)	N/A-included in total	WAC 173-340-900, Table 749-3
Arsenic (V)	N/A-included in total	WAC 173-340-900, Table 749-3
Barium	REDOX, Sr/Cs Operations	HW-18700; ISO-100
Beryllium	REDOX, PUREX/URP	HW-18700; HW-31000-DEL;
Bismuth	Bismuth phosphate, Sr/Cs Operations	HW-10475
Cadmium	Bismuth phosphate	HW-10475, Section A,
Chromium	Bismuth phosphate, Sr/Cs Operations	HW-10475, Section C; WHC-MR-0132; ISO-100
Chromium (VI)	Bismuth phosphate, Sr/Cs Operations	HW-10475, Section C; WHC-MR-0132; ISO-100
Cobalt	Scavenging Operations	LA-UR-96-3860; WHC-SD-WM-ER-133
Copper	Bismuth phosphate, REDOX, Sr/Cs Operations	HW-10475, Section A, HW-18700; ISO-100
Lead	Bismuth phosphate, Sr/Cs Operations	HW-10475, Sections A, B, and C, ISO-100
Lithium	Z Plant Complex	DOE/RL-91-52
Manganese	Bismuth phosphate, REDOX, PUREX/URP, Z Plant Complex	HW-10475, Sections A, B, and C, HW-18700; HW-31000-DEL; DOE/RL-91-52
Mercury (inorganic)	Bismuth phosphate, REDOX, PUREX/URP	LA-UR-96-3860; HW-10475, Sections A, B, and C, HW-18700; HW-31000-DEL
Molybdenum	Bismuth phosphate	HW-10475, Sections A, B, and C
Nickel	Bismuth phosphate	LA-UR-96-3860; WHC-SD-WM-ER-133
Selenium	Z Plant Complex	FH-0002791

Table A-4. Central Plateau Contaminants of Potential Concern. (5 Pages)

Contaminant	Chemical Process	Reference
Metals (cont)		
Silver	Bismuth phosphate, REDOX, PUREX/URP, Sr/Cs Operations, Z Plant Complex	HW-10475, Section C; HW-18700; HW-31000-DEL; ISO-100, FH-0002791
Strontium	Bismuth phosphate, REDOX, PUREX/URP, Sr/Cs Operations	HW-10475, Section C; HW-18700; HW-31000-DEL; ISO-100, FH-0002791
Tin	Bismuth phosphate, REDOX, PUREX/URP	HW-10475, Section C; HW-18700; HW-31000-DEL
Uranium	Bismuth phosphate, REDOX, PUREX/URP	HW-10475, Section C; HW-18700; HW-31000-DEL
Vanadium	Bismuth phosphate	HW-10475, Sections A, B, and C
Zinc	Bismuth phosphate	HW-10475, Sections A, B, and C
General Inorganics		
Ammonia/Ammonium	Bismuth phosphate, REDOX, PUREX/URP, Sr/Cs Operations	HW-10475, Section C; HW-18700; HW-31000-DEL; ISO-100
Chloride	Bismuth phosphate, REDOX, PUREX/URP, Sr/Cs Operations, Z Plant Complex	HW-10475, Section C; HW-18700; HW-31000-DEL; ISO-100, FH-0002791
Cyanide	Scavenging Operations	LA-UR-96-3860; WHC-SD-WM-ER-133
Fluoride	Bismuth phosphate, REDOX, PUREX/URP, Sr/Cs Operations, Z Plant Complex	HW-10475, Section C; HW-18700; HW-31000-DEL; ISO-100, WHC-SD-WM-ER-133; CCN 092732
Iodine	Z Plant Complex	DOE/RL-91-52
Nitrate/Nitrite	Bismuth phosphate, REDOX, PUREX/URP, Sr/Cs Operations, Z Plant Complex	HW-10475, Section C; HW-18700; HW-31000-DEL; ISO-100, FH-0002791
Phosphate	Bismuth phosphate, REDOX, PUREX/URP, Sr/Cs Operations, Z Plant Complex	HW-10475, Section C; HW-18700; HW-31000-DEL; ISO-100, FH-0002791
Sulfate/Sulfite	Bismuth phosphate, REDOX, PUREX/URP, Sr/Cs Operations, Z Plant Complex	HW-10475, Section C; HW-18700; HW-31000-DEL; ISO-100, FH-0002791
Organics		
1,1-dichloroethane (DCA)	Z Plant Complex	WHC-SD-EN-TI-248
1,1-dichloroethene	Z Plant Complex	WHC-SD-EN-TI-248
1,1,1-trichloroethane (TCA)	Z Plant Complex	WHC-SD-EN-TI-248
1,1,2-trichloroethane	Z Plant Complex	WHC-SD-EN-TI-248
1,1,2,2-tetrachloroethane	Z Plant Complex	WHC-SD-EN-TI-248
1,2-dichlorobenzene	Z Plant Complex	WHC-SD-EN-TI-248
1,2-dichloroethane (DCA)	Z Plant Complex	WHC-SD-EN-TI-248
1,3-dichlorobenzene	Z Plant Complex	WHC-SD-EN-TI-248
2,4-dinitrotoluene	Z Plant Complex	WHC-SD-EN-TI-248
2-butanone (Methyl Ethyl Ketone/MEK)	PUREX/URP, Z Plant Complex	WHC-EP-0342, Addendum 14; Addendum 12; Addendum 19; WHC-SD-EN-TI-248

Table A-4. Central Plateau Contaminants of Potential Concern. (5 Pages)

Contaminant	Chemical Process	Reference
Organics (cont)		
2-hexanone	Z Plant Complex	WHC-SD-EN-TI-248
2-methylphenol (o-cresol)	Misc equipment oils and lubricants	CP-13196
4-methylphenol (p-cresol)	Misc equipment oils and lubricants	CP-13196
Benzene	Z Plant Complex	WHC-SD-EN-TI-248
Butanol	PUREX/URP	WHC-EP-0342, Addendum 14; Addendum 12; Addendum 19
Carbon Tetrachloride	Z Plant Complex	WHC-SD-EN-TI-248
Chlorobenzene	Z Plant Complex	WHC-SD-EN-TI-248
Chloroform	Z Plant Complex	WHC-SD-EN-TI-248
Cis-1,2-dichloroethylene	Z Plant Complex	WHC-SD-EN-TI-248
Dichloromethane (Methylene Chloride)	Z Plant Complex	WHC-SD-EN-TI-248
Ethyl Benzene	Z Plant Complex	WHC-SD-EN-TI-248
Methyl Isobutyl Ketone (MIBK/Hexone)	REDOX, Z Plant Complex	HW-18700; WHC-SD-EN-TI-248
Naphthalene	PUREX/URP, Z Plant Complex	WHC-EP-0342, Addendum 14; Addendum 12; Addendum 19; WHC-SD-EN-TI-248
n-butyl Benzene	Z Plant Complex	WHC-SD-EN-TI-248
Tetrachloroethylene (PCE)	Z Plant Complex	WHC-SD-EN-TI-248
Toluene	PUREX/URP, Z Plant Complex	WHC-EP-0342, Addendum 14; Addendum 12; Addendum 19; WHC-SD-EN-TI-248
Total Organic Carbon	REDOX, PUREX/URP, Sr/Cs Operations, Z Plant Complex	HW-18700; HW-31000-DEL; ISO-100, DOE/RL-91-52
Trans-1,2-dichloroethylene	Z Plant Complex	WHC-SD-EN-TI-248
Trichloroethylene (TCE)	Z Plant Complex	WHC-SD-EN-TI-248
Xylene	PUREX/URP, Z Plant Complex	WHC-EP-0342, Addendum 14; Addendum 12; Addendum 19; WHC-SD-EN-TI-248
Semivolatile Organics		
Normal paraffin hydrocarbons	PUREX/URP, Sr/Cs Operations	WHC-SD-WM-ER-133; HW-31000-DEL; ISO-100
Phenol	Z Plant Complex	WHC-SD-EN-TI-248
Polychlorinated Biphenyls (PCB)	Bismuth phosphate, Z Plant Complex	HW-10475, Sections A, B, and C; CCN 092732
Petroleum		
Gasoline Range Organics	PUREX/URP, Z Plant Complex	WHC-EP-0342, Addendum 14; Addendum 12; Addendum 19; WHC-SD-EN-TI-248
Diesel Range Organics	PUREX/URP, Z Plant Complex	WHC-EP-0342, Addendum 14; Addendum 12; Addendum 19; WHC-SD-EN-TI-248

Table A-4. Central Plateau Contaminants of Potential Concern. (5 Pages)

Contaminant	Chemical Process	Reference

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WHC-EP-0342, 1990, Addendum 14, *PUREX Plant Ammonia Scrubber Condensate Stream-Specific Report*, Westinghouse Hanford Company, Richland, Washington.

WHC-EP-0342, 1990, Addendum 19, *UO_3 Plant Process Condensate Stream-Specific Report*, Westinghouse Hanford Company, Richland, Washington.

WHC-MR-0132, 1990, *A History of the 200 Area Tank Farms*, Westinghouse Hanford Company, Richland, Washington.

WHC-MR-0270, 1991, *200-BP-5 Operable Unit Technical Baseline Report*, Westinghouse Hanford Company, Richland, Washington.

WHC-SD-EN-TI-248, 1994, *Conceptual Model of the Carbon Tetrachloride Contamination in the 200 West Area at the Hanford Site*, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

WHC-SD-WM-ER-133, 1991, *An Assessment of the Inventories of the Ferrocyanide Watchlist Tanks*, Westinghouse Hanford Company, Richland, Washington.

N/A = not applicable.
PUREX = Plutonium-Uranium Extraction (Plant or process).
REDOX = Reduction-Oxidation (Plant or process).
URP = Uranium Recovery Process.

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APPENDIX B

CONTAMINANTS OF POTENTIAL ECOLOGICAL CONCERN

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TABLES

Table B-1. Key to the Terminology in Table B-2 ..... B-1

Table B-2. Screening of Contaminants of Potential Concern for Contaminants of Potential Ecological Concern Identification B-3

Table B-3. Screening of Noncontaminants of Potential Concern with Empirical Data for Contaminant of Potential Ecological Concern Identification B-19

Table B-4. Contaminants of Potential Ecological Concern and Additional Analytes for the Central Plateau B-33

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APPENDIX B

CONTAMINANTS OF POTENTIAL ECOLOGICAL CONCERN

Table B-1 provides a key to the terminology found in Table B-2. Table B-2 provides the refinement of contaminants of potential ecological concern.

Table B-1. Key to the Terminology in Table B-2. (2 Pages)

Column	Definition
Analyte	Specific chemical
COPEC Designation Justification	COPEC means kept on list or justification to remove as COPEC
Method Class	Analytical category: GENCHEM = general chemistry GENORG = general organic chemical HERB = herbicide [a] METALMULT = metal from analysis for multiple metals PEST/PCB = pesticide or polychlorinated biphenyl [a] RAD = radionuclide SVOA = semivolatile organic analyte [b] VOA = volatile organic analyte [b]
Samples	Number of samples collected
# NDs	Number of nondetect samples (minimum, median, maximum)
Detects	Number of detected samples (median)
Max Detect	Maximum detected value
Units	Unit of concentration measured in soil (mg/kg or pCi/g)
Top Depth (ft) of Max Detect	Top interval marking where the maximum detected concentration was collected
Bottom Depth (ft) of Max Detect	Bottom interval marking where the maximum detected concentration was collected
Mean Site	Sitewide average of all detected values
BV	Background concentration
# Detects >BV	Number of detected values above background concentrations
# ND >BV	Number of nondetected values above background concentrations
Plant	Plant soil-screening value
# D >Plant	Number of detected values above soil-screening value for plants
Biota	Soil biota soil-screening value
# D >Biota	Number of detected values above soil-screening value for soil biota
Shrew	Wildlife soil-screening value based on shrew (mammalian insectivore)
# D >Shrew	Number of detected values above soil-screening value for shrew
Vole	Wildlife soil-screening value based on vole (mammalian herbivore)

Table B-1. Key to the Terminology in Table B-2. (2 Pages)

Column	Definition
# D >Vole	Number of detected values above soil-screening value for vole
Robin	Wildlife soil-screening value based on robin (avian insectivore)
# D >Robin	Number of detected values above soil-screening value for robin
BCG Plant	Biota concentration guideline (pCi/g) for plants (see DOE-STD-1153-2002, *A Graded Approach for Evaluating Radiation Doses to Aquatic and Terrestrial Biota*)
# D >BCG Plant	Number of detected values above biota concentration guideline for plants
BCG Wildlife	Biota concentration guideline (pCi/g) for wildlife
# D >BCG Wildlife	Number of detected values above biota concentration guideline for wildlife
FD >BV	Frequency of detected values exceeding background out of all samples
FD >SSV	Frequency of detected values exceeding soil-screening values or biota concentration guidelines out of all samples
FD	Detection frequency

Highlighted rows signify contaminants of potential ecological concern.

[a] The sample size for each of the 19 sampled **pesticides** (PEST/PCB) was typically 57 samples, and only two chemicals were detected at least twice. Dichlorodiphenyltrichloroethane (DDT) had 3 detected values, and heptaclor was detected 2 times; neither chemical exceeded the available soil-screening values. The data on **herbicides** was more limited. There were no detected herbicides, but the sample size was typically 4 or 5 samples.

[b] No **semivolatile** contaminants of concern exceed soil-screening values, nor do **volatile** contaminants of concern exceed soil-screening values. Some volatile contaminants of concern do not have soil-screening values. Volatile chemicals are not expected to persist on the Central Plateau and, for the unique situations where volatiles may persist (e.g., the large volumes of carbon tetrachloride used on site and contaminating subsurface aquifers), a qualitative evaluation will be performed.

Table B-3 presents the screening of the non-COPCs to assure that none of these constituents should be added back to the COPEC list. The column headers are the same as Table B-2. Table B-4 provides the final list of COPECs.

Table B-2. Screening of Contaminants of Potential Concern for Contaminants of Potential Ecological Concern Identification. (8 Pages)

Analyte	COPEC Designation Justification	Method Class	Samples	# NDs	Min ND	Median ND	Max ND	Detects	Median Detect	Max Detect	Units	Top Depth (ft) of Max Detect	Bottom Depth (ft) of Max Detect	Mean Site	BV	# Detects >BV	# ND >BV	Plant	#D> Plant	Biota	#D> Biota	Shrew	#D> Shrew	Vole	#D> Vole	Robin	#D> Robin	BCG Plant	#D>BCG Plant	BCG Wild-life	#D> BCG Wild-life	FD>BV	FD>SSV	FD
Radionuclides																																		
Americium-241	COPEC	RAD	408	337	-0.49	5.60 E-02	8.50 E+02	71	0.395	649	pCi/g	7.5	10	7.89 E+00	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	21600	0	3.89 E+03	0	NA	0	0.17402
Antimony-125	Not significant contributor to dose based on SOF	RAD	23	22	-0.023	8.90 E-02	9.00 E+02	1	1.67	1.67	pCi/g	4	5	3.93 E+01	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	34100	0	3.52 E+03	0	NA	0	0.04348
Carbon-14	Not significant contributor to dose based on SOF	RAD	28	26	-1.8	5.83 E-01	9.51 E+01	2	9.25	12.2	pCi/g	1	1	4.52 E+00	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.90 E+07	0	NA	0	0.07143
Cesium-134	Not significant contributor to dose based on SOF	RAD	120	119	- 0.0062	4.00 E-02	1.00 E+02	1	0.05	0.05	pCi/g	0	0	8.93 E-01	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1000	0	1.13 E+01	0	NA	0	0.00833
Cesium-137	COPEC	RAD	310	95	0.008	2.70 E-02	2.80 E-01	215	1.67	529000	pCi/g	12.5	15	2.83 E+03	1.05	123	0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1090	7	2.08 E+01	40	0.396774	0.129032	0.69355
Cobalt-60	COPEC	RAD	310	301	-0.008	3.00 E-02	8.90 E+01	9	0.1	1700	pCi/g	12.5	15	5.85 E+00	0.0084 2	9	292	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	13900	0	6.92 E+02	1	0.029032	0.003226	0.02903
Europium-152	Not significant contributor to dose based on SOF	RAD	249	248	-0.37	7.60 E-02	8.50 E+02	1	1.1	1.1	pCi/g	4.4	5.4	5.23 E+00	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	7340	0	1.52 E+03	0	NA	0	0.00402
Europium-154	Not significant contributor to dose based on SOF	RAD	249	232	- 0.0547	9.60 E-02	2.80 E+02	17	0.538	3.37	pCi/g	14	15	1.48 E+00	0.0334	17	223	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	12400	0	1.29 E+03	0	0.068273	0	0.06827
Europium-155	Not significant contributor to dose based on SOF	RAD	249	244	0.0093	9.05 E-02	5.80 E+02	5	0.602	2.04	pCi/g	12	13	3.30 E+00	0.0539	5	211	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	151000	0	1.58 E+04	0	0.02008	0	0.02008
Hydrogen-3 (tritium)	Not significant contributor to dose based on SOF	RAD	26	18	-0.753	-7.00 E-03	4.70 E+00	8	5.6695	44	pCi/g	3	5.5	3.10 E+00	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	166000 0	0	1.74 E+05	0	NA	0	0.30769
Neptunium-237	Not significant contributor to dose based on SOF	RAD	112	103	-0.543	4.00 E-03	3.61 E+00	9	0.05003 333	0.28	pCi/g	6.5	6.5	6.10 E-02	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	2700	0	1.90 E+03	0	NA	0	0.08036
Nickel-63	Not significant contributor to dose based on SOF	RAD	19	17	-45.4	0.00 E+00	1.01 E+00	2	1137.5	2110	pCi/g	12.5	15	1.17 E+02	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	2.20 E+07	0	NA	0	0.10526
Plutonium-238	Not significant contributor to dose based on SOF	RAD	270	229	-0.376	7.67 E-03	7.81 E+00	41	0.06	39.2	pCi/g	10	12.5	5.27 E-01	0.0037 8	41	131	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	110000	0	5.40 E+03	0	0.151852	0	0.15185
Plutonium-239/240	COPEC	RAD	270	194	-0.059	1.00 E-02	3.48 E-01	76	0.245	2230	pCi/g	10	12.5	1.96 E+01	0.0248	59	27	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	12700	0	6.11 E+03	0	0.218519	0	0.28148
Radium-226	COPEC	RAD	304	39	0.043	6.00 E-01	4.10 E+02	265	0.606	15.2	pCi/g	0	0	2.71 E+00	0.815	63	13	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	246	0	5.06 E+01	0	0.207237	0	0.87171
Radium-228	COPEC	RAD	218	17	0.09	3.00 E-01	4.70 E+02	201	0.735	2.6	pCi/g	6.5	6.5	3.31 E+00	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	261	0	4.39 E+01	0	NA	0	0.92202
Strontium-90	COPEC	RAD	309	124	-11	3.00 E-02	5.00 E-01	185	0.829	974000	pCi/g	12.5	15	3.22 E+03	0.178	165	6	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	2230	3	2.25 E+01	19	0.533981	0.061489	0.59871
Technetium-99	Not significant contributor to dose based on SOF	RAD	116	82	-28.2	6.50 E-01	7.00 E+01	34	1	8.8	pCi/g	6.5	6.5	2.93 E+00	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	9610	0	4.49 E+03	0	NA	0	0.2931
Thorium-232	Not significant contributor to dose based on SOF	RAD	404	46	-9.48	2.83 E-01	4.70 E+02	358	0.5935	5.969	pCi/g	9.5	10.5	2.00 E+00	1.32	4	7	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	4440	0	1.51 E+03	0	0.009901	0	0.88614
Uranium-233/234	Not significant contributor to dose based on SOF	RAD	39	5	0.676	2.45 E+00	3.17 E+01	34	0.6295	85	pCi/g	6.5	6.5	4.02 E+00	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	52200	0	4.83 E+03	0	NA	0	0.87179
Uranium-234	Not significant contributor to dose based on SOF	RAD	16	1	0.0545	5.45 E-02	5.45 E-02	15	0.84	5.17	pCi/g	8	9	1.04 E+00	1.1	4	0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	51600	0	5.13 E+03	0	0.25	0	0.9375
Uranium-235	Not significant contributor to dose based on SOF	RAD	250	229	-0.109	1.20 E-01	7.40 E+02	21	0.0415	0.439	pCi/g	4	5	4.54 E+00	0.109	4	126	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	27400	0	2.77 E+03	0	0.016	0	0.084
Uranium-238	COPEC	RAD	256	209	-0.656	3.50 E+00	1.00 E+04	47	0.652	88	pCi/g	6.5	6.5	5.14 E+01	1.06	8	206	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	15800	0	1.58 E+03	0	0.03125	0	0.18359

Table B-2. Screening of Contaminants of Potential Concern for Contaminants of Potential Ecological Concern Identification. (8 Pages)

Analyte	COPEC Designation Justification	Method Class	Samples	# NDs	Min ND	Median ND	Max ND	Detects	Median Detect	Max Detect	Units	Top Depth (ft) of Max Detect	Bottom Depth (ft) of Max Detect	Mean Site	BV	# Detects >BV	# ND >BV	Plant	#D> Plant	Biota	#D> Biota	Shrew	#D> Shrew	Vole	#D> Vole	Robin	#D> Robin	BCG Plant	#D>BCG Plant	BCG Wild-life	#D> BCG Wild-life	FD>BV	FD>SSV	FD
Metals																																		
Aluminum	Considered nontoxic to terrestrial wildlife, BPJ	METALMULT	94	0	NA	NA	NA	94	4.52 E+03	14300	mg/kg	6.5	6.5	5.15 E+03	13000	1	0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.010638	NA	1
Antimony	COPEC	METALMULT	192	163	0.16	0.26	11.1	29	3.00 E-01	13.5	mg/kg	9	10	2.47 E+00	NA	NA	NA	5.00 E+00	2	78	0	0.05772	29	0.846262	29	NA	NA	NA	NA	NA	NA	NA	0.151042	0.15104
Arsenic	COPEC	METALMULT	280	2	2.42	10.86	19.3	278	2.70 E+00	33.8	mg/kg	5.5	6.5	3.62 E+00	20	1	0	1.00 E+01	10	60	0	7.118644	22	42.91045	0	1.50 E+02	0	NA	NA	NA	NA	0.003571	0.078571	0.99286
Barium	COPEC	METALMULT	282	0	NA	NA	NA	282	7.25 E+01	331	mg/kg	6.5	6.5	7.38 E+01	144	1	0	5.00 E+02	0	330	1	508.7719	0	603.8078	19	1.22 E+03	0	NA	NA	NA	NA	0.003546	0.067376	1
Beryllium	No detects above background	METALMULT	276	14	0.01	0.295	2.97	262	3.20 E-01	1.2	mg/kg	9	10	3.69 E-01	1.62	0	1	1.00 E+01	0	40	0	0.509861	40	47.9638	0	NA	NA	NA	NA	NA	NA	0	0.144928	0.94928
Bismuth	COPEC	METALMULT	24	14	0.29	0.58	9.7	10	1.38 E+00	233	mg/kg	12.5	15	1.51 E+01	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.41667
Boron	COPEC	METALMULT	24	2	0.58	2.835	5.09	22	1.50 E+00	23.8	mg/kg	7.5	10	3.24 E+00	NA	NA	NA	NA	NA	NA	NA	26.93603	0	85.8764	0	5.65 E+00	3	NA	NA	NA	NA	NA	0.125	0.91667
Cadmium	COPEC	METALMULT	291	141	0.02	0.04	1.3	150	1.95 E-01	28	mg/kg	4	5	7.57 E-01	0.81	36	23	4.00 E+00	8	20	1	14.43001	4	288.4615	0	3.87 E+01	0	NA	NA	NA	NA	0.123711	0.027491	0.51546
Chromium	COPEC	METALMULT	291	5	0.56	4.7	6.8	286	8.00 E+00	815	mg/kg	0	1.5	1.24 E+01	21.4	13	0	4.20 E+01	3	42	3	306.7538	1	2884.287	2	6.73 E+01	3	NA	NA	NA	NA	0.044674	0.010309	0.98282
Chromium (VI)	COPEC	METALSING	196	175	0.08	0.42	11.7	21	1.09 E+00	14.1	mg/kg	1.5	3	7.06 E-01	NA	NA	NA	3.50 E-01	20	0.2	21	28.58388	0	319.6102	1	5.12 E+01	0	NA	NA	NA	NA	NA	0.107143	0.10714
Cobalt	No detects above background	METALMULT	81	6	7.1	8.7	10.3	75	7.80 E+00	13.2	mg/kg	9	10	8.23 E+00	16.9	0	0	2.00 E+01	0	NA	NA	7.022607	50	514.0845	0	1.47 E+01	0	NA	NA	NA	NA	0	0.617284	0.92593
Copper	COPEC	METALMULT	289	5	4.95	15.5	16	284	1.36 E+01	244	mg/kg	0	1.5	1.69 E+01	24.1	18	0	1.00 E+02	3	50	8	217.284	1	2366.197	0	5.31 E+02	0	NA	NA	NA	NA	0.062284	0.027682	0.9827
Lead	COPEC	METALMULT	289	3	1.26	11.9	19.3	286	4.40 E+00	582.5	mg/kg	8	9	1.23 E+01	11.7	30	2	5.00 E+01	9	500	1	125.1956	5	2132.083	0	1.18 E+02	5	NA	NA	NA	NA	0.103806	0.031142	0.98962
Manganese	No detects above SSV	METALMULT	100	0	NA	NA	NA	100	2.67 E+02	641	mg/kg	12.5	15	2.85 E+02	550	1	0	1.10 E+03	0	NA	NA	8946.237	0	5504.905	0	1.10 E+04	0	NA	NA	NA	NA	0.01	0	1
Mercury	COPEC	METALSING	278	211	0	0.02	0.99	67	1.00 E-01	9.1	mg/kg	8	9	1.71 E-01	0.6	13	1	3.00 E-01	17	0.1	32	9.485904	0	62.64188	0	5.50 E+00	1	NA	NA	NA	NA	0.046763	0.115108	0.24101
Molybdenum	COPEC	METALMULT	23	6	0.11	0.775	9.7	17	5.30 E-01	3.2	mg/kg	4	5	1.40 E+00	NA	NA	NA	2.00 E+00	1	NA	NA	27.46667	0	7.238154	0	4.82 E+02	0	NA	NA	NA	NA	NA	0.043478	0.73913
Nickel	COPEC	METALMULT	285	1	3.76	3.76	3.76	284	8.90 E+00	131	mg/kg	6.5	6.5	9.55 E+00	21	3	0	3.00 E+01	2	200	0	976.6667	0	5919.401	0	1.01 E+03	0	NA	NA	NA	NA	0.010526	0.007018	0.99649
Selenium	COPEC	METALMULT	306	220	0.15	0.38	19.3	86	5.80 E-01	4.7	mg/kg	11	13.5	5.26 E-01	NA	NA	NA	1.00 E+00	8	70	0	0.306295	78	55.29027	0	8.68 E-01	18	NA	NA	NA	NA	NA	0.254902	0.28105
Silver	COPEC	METALMULT	289	231	0.01	0.1	2.12	58	1.15 E+00	42	mg/kg	4	5	1.11 E+00	1.33	27	37	2.00 E+00	16	NA	NA	18.27802	4	141.8969	0	1.05 E+01	4	NA	NA	NA	NA	0.093426	0.055363	0.20069
Thallium	COPEC	METALMULT	200	110	0.29	0.42	1.6	90	7.05 E-01	1.7	mg/kg	14	15	6.03 E-01	NA	NA	NA	1.00 E+00	14	NA	NA	0.00683	90	0.775109	90	NA	NA	NA	NA	NA	NA	NA	0.45	0.45
Tin	COPEC	METALMULT	4	4	3.5	3.95	9.7	0	NA	NA	mg/kg	NA	NA	5.28 E+00	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0

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Analyte	COPEC Designation Justification	Method Class	Samples	# NDs	Min ND	Median ND	Max ND	Detects	Median Detect	Max Detect	Units	Top Depth (ft) of Max Detect	Bottom Depth (ft) of Max Detect	Mean Site	BV	# Detects >BV	# ND >BV	Plant	#D> Plant	Biota	#D> Biota	Shrew	#D> Shrew	Vole	#D> Vole	Robin	#D> Robin	BCG Plant	#D>BCG Plant	BCG Wild-life	#D> BCG Wild-life	FD>BV	FD>SSV	FD
Metals (cont)																																		
Uranium	COPEC	METALMULT	74	51	0.3	0.54	8	23	1.70 E+00	270	mg/kg	6.5	6.5	4.70 E+00	NA	NA	NA	5.00 E+00	1	NA	NA	5.868206	1	576.6958	1	1.51 E+02	1	NA	NA	NA	NA	NA	0.013514	0.31081
Uranium	Identified as a COPEC as a metal based on mass, contribution of uranium isotopes to SOF was evaluated	RAD	170	0	NA	NA	NA	170	0.60225	56.9	mg/kg	12.5	15	1.29 E+00	NA	NA	NA	5	4	NA	NA	5.868206	4	576.6958	0	150.9744	0	NA	NA	NA	NA	NA	0.023529	1
Vanadium	COPEC	METALMULT	277	1	23.3	23.3	23.3	276	5.14 E+01	101	mg/kg	12.5	15	4.95 E+01	93.9	2	0	2.00 E+00	276	NA	NA	2.020202	276	218.0119	276	2.13 E+00	276	NA	NA	NA	NA	0.00722	0.99639	0.99639
Zinc	COPEC	METALMULT	277	2	20.1	21	21.9	275	4.50 E+01	645	mg/kg	6.5	6.5	5.19 E+01	72.1	25	0	8.60 E+01	19	200	5	973.7625	0	14207.53	0	3.59 E+02	2	NA	NA	NA	NA	0.090253	0.068592	0.99278
General Inorganics																																		
Ammonia	Considered nontoxic to terrestrial wildlife, BPJ	GENCHEM	185	148	0.146	1.7	28.3	37	5.35 E+00	91.9	mg/kg	14	15	5.54 E+00	15.1	13	2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.07027	NA	0.2
Ammonium ion	Considered nontoxic to terrestrial wildlife, BPJ	METALMULT	2	1	0.258	0.258	0.258	1	2.85 E-01	0.285	mg/kg	11	13.5	2.72 E-01	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.5
Chloride	Considered nontoxic to terrestrial wildlife, BPJ	GENCHEM	180	19	0.11	1.3	1.33	161	4.00 E+00	226	mg/kg	4	5	9.34 E+00	182	1	0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.005556	NA	0.89444
Cyanide	COPEC	GENCHEM	297	292	0.13	0.53	1.33	5	4.50 E-01	4.09333	mg/kg	8	9	6.24 E-01	NA	NA	NA	NA	NA	NA	NA	299.3464	0	212.7594	0	3.10 E-01	4	NA	NA	NA	NA	NA	0.013468	0.01684
Fluoride	Considered nontoxic to terrestrial wildlife, BPJ	GENCHEM	183	150	0.4	2.6	19.2	33	2.06 E+00	7.4	mg/kg	14.5	15.5	2.43 E+00	3.7	5	6	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.027322	NA	0.18033
Nitrate	Considered nontoxic to terrestrial wildlife, BPJ	GENCHEM	205	19	0.4	1.2	2.5	186	3.02 E+01	927	mg/kg	4	5	6.03 E+01	93.4	41	0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.2	NA	0.90732
Nitrite	Considered nontoxic to terrestrial wildlife, BPJ	GENCHEM	176	170	0.069	1.3	9.62	6	1.26 E+00	1.741	mg/kg	9.5	10.5	1.40 E+00	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.03409
Nitrogen in nitrite and nitrate	Considered nontoxic to terrestrial wildlife, BPJ	GENCHEM	198	10	0.038	0.2035	2.49	188	8.35 E+00	230	mg/kg	5	6	1.67 E+01	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.94949
Phosphate	Considered nontoxic to terrestrial wildlife, BPJ	GENCHEM	199	120	0.37	1.3	9.6	79	2.40 E+00	19	mg/kg	12.5	15	2.06 E+00	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.39698
Sulfate	Considered nontoxic to terrestrial wildlife, BPJ	GENCHEM	216	4	1.28	3.145	63.8	212	2.82 E+01	3640	mg/kg	14	15	1.44 E+02	469	14	0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.064815	NA	0.98148
Sulfide	Considered nontoxic to terrestrial wildlife, BPJ	GENCHEM	161	115	0.63	21.1	61.2	46	4.20 E+00	59	mg/kg	5	6	1.62 E+01	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.28571
Organics																																		
Benzene	No detects above SSV	VOA	229	224	0.0019	0.005	0.017	5	5.00 E-03	0.008	mg/kg	5	6	5.69 E-03	NA	NA	NA	NA	NA	NA	NA	71.00337	0	26.86369	0	NA	NA	NA	NA	NA	NA	NA	0	0.02183
4-(2,4-Dichlorophenoxy)-butanoic acid	No detects and <50 samples; eliminated as COPEC because not one of the herbicides currently used at waste sites; characterization of soils for herbicides will continue at waste sites, facilities, and tank farms	HERB	4	4	0.17	0.17	0.18	0	NA	NA	mg/kg	NA	NA	1.73 E-01	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0
1-Butanol	Less than 2 detects and <50 samples; detection limits are below SSV of surrogate, 2-butanone	VOA	3	3	0.1	0.22	0.24	0	NA	NA	mg/kg	NA	NA	1.87 E-01	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0
2-Butanone (same as Methyl Ethyl Ketone)	No detects above SSV	VOA	229	210	0.0019	0.01	0.024	19	6.00 E-03	0.11333	mg/kg	8	9	1.09 E-02	NA	NA	NA	NA	NA	NA	NA	5662.67	0	471.462	0	NA	NA	NA	NA	NA	NA	NA	0	0.08297

Table B-2. Screening of Contaminants of Potential Concern for Contaminants of Potential Ecological Concern Identification. (8 Pages)

Analyte	COPEC Designation Justification	Method Class	Samples	# NDs	Min ND	Median ND	Max ND	Detects	Median Detect	Max Detect	Units	Top Depth (ft) of Max Detect	Bottom Depth (ft) of Max Detect	Mean Site	BV	# Detects >BV	# ND >BV	Plant	#D> Plant	Biota	#D> Biota	Shrew	#D> Shrew	Vole	#D> Vole	Robin	#D> Robin	BCG Plant	#D>BCG Plant	BCG Wild-life	#D> BCG Wild-life	FD>BV	FD>SSV	FD
Organics (cont)																																		
2-secButyl-4,6-dinitrophenol(DNBP)	No detects and <50 samples; eliminated as COPEC because not one of the herbicides currently used at waste sites; characterization of soils for herbicides will continue at waste sites, facilities, and tank farms	HERB	4	4	0.017	0.017	0.018	0	NA	NA	mg/kg	NA	NA	1.73 E-02	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0
Carbon tetrachloride*	No detects above SSV	VOA	229	227	0.0019	0.005	0.017	2	5.00 E-03	0.005	mg/kg	3	6	5.68 E-03	NA	NA	NA	NA	NA	NA	NA	15.06591	0	41.98289	0	NA	NA	NA	NA	NA	NA	NA	0	0.00873
Chlorobenzene	No detects above SSV	VOA	229	227	0.0019	0.005	0.017	2	5.00 E-03	0.005	mg/kg	3	6	5.70 E-03	NA	NA	NA	NA	NA	40	0	148.9758	0	115.7854	0	NA	NA	NA	NA	NA	NA	NA	0	0.00873
Chloroform	>2 detects, no SSV, below SSV of surrogate, tetrachloroethene	VOA	229	226	0.0019	0.005	0.011	3	5.00 E-03	0.005	mg/kg	3	6	5.64 E-03	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.0131
Dalapon	No detects and <50 samples; eliminated as COPEC because not one of the herbicides currently used at waste sites; characterization of soils for herbicides will continue at waste sites, facilities, and tank farms	HERB	4	4	0.17	0.17	0.18	0	NA	NA	mg/kg	NA	NA	1.73 E-01	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0
Dicamba	No detects and <50 samples; eliminated as COPEC because not one of the herbicides currently used at waste sites; characterization of soils for herbicides will continue at waste sites, facilities, and tank farms	HERB	4	4	0.069	0.069	0.07	0	NA	NA	mg/kg	NA	NA	6.93 E-02	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0
1,2-Dichlorobenzene	Less than 2 detects	VOA	234	234	0.2493	0.35	5.6	0	NA	NA	mg/kg	NA	NA	4.03 E-01	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0
1,3-Dichlorobenzene	Less than 2 detects	VOA	234	234	0.2483	0.35	5.6	0	NA	NA	mg/kg	NA	NA	4.03 E-01	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0
1,1-Dichloroethane	2 detects, no SSV, below SSV of surrogate, methylene chloride	VOA	229	227	0.0019	0.005	0.017	2	5.00 E-03	0.005	mg/kg	3	6	5.70 E-03	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.00873
1,2-Dichloroethane	>2 detects, no SSV, below SSV of surrogate, methylene chloride	VOA	229	226	0.0019	0.005	0.017	3	5.00 E-03	0.013	mg/kg	4	5	5.72 E-03	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.0131
1,1-Dichloroethene	2 detects, no SSV, below SSV of surrogate, methylene chloride	VOA	229	227	0.0019	0.005	0.017	2	5.00 E-03	0.005	mg/kg	3	6	5.71 E-03	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.00873
1,2-Dichloroethene (Total)	2 detects, no SSV, below SSV of surrogate, methylene chloride	VOA	229	227	0.0019	0.005	0.017	2	5.00 E-03	0.005	mg/kg	3	6	5.71 E-03	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.00873
2,4-Dichlorophenoxy-acetic acid	No detects and <50 samples; eliminated as COPEC because not one of the herbicides currently used at waste sites; characterization of soils for herbicides will continue at waste sites, facilities, and tank farms	HERB	5	5	0.035	0.035	0.036	0	NA	NA	mg/kg	NA	NA	3.52 E-02	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0

Table B-2. Screening of Contaminants of Potential Concern for Contaminants of Potential Ecological Concern Identification. (8 Pages)

Analyte	COPEC Designation Justification	Method Class	Samples	# NDs	Min ND	Median ND	Max ND	Detects	Median Detect	Max Detect	Units	Top Depth (ft) of Max Detect	Bottom Depth (ft) of Max Detect	Mean Site	BV	# Detects >BV	# ND >BV	Plant	#D> Plant	Biota	#D> Biota	Shrew	#D> Shrew	Vole	#D> Vole	Robin	#D> Robin	BCG Plant	#D>BCG Plant	BCG Wild-life	#D> BCG Wild-life	FD>BV	FD>SSV	FD
Organics (cont)																																		
Dichloroprop	No detects and <50 samples; eliminated as COPEC because not one of the herbicides currently used at waste sites; characterization of soils for herbicides will continue at waste sites, facilities, and tank farms	HERB	4	4	0.17	0.17	0.18	0	NA	NA	mg/kg	NA	NA	1.73 E-01	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0
2,4-Dinitrotoluene	Less than 2 detects	VOA	235	235	0.069	0.35	5.6	0	NA	NA	mg/kg	NA	NA	4.00 E-01	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0
Ethylbenzene	2 detects, no SSV, below SSV of surrogate, benzene	VOA	229	227	0.0019	0.005	0.017	2	5.00 E-03	0.005	mg/kg	3	6	5.71 E-03	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.00873
2-Hexanone (same as 4-methyl-2-pentanone)	>2 detects, no SSV, below SSV of surrogate, 2-butanone	VOA	229	227	0.0019	0.01	0.024	2	1.00 E-02	0.01	mg/kg	3	6	1.08 E-02	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.00873
4-Methyl-2-Pentanone (same as 2-hexanone)	>2 detects, no SSV, below SSV of surrogate, 2-butanone	VOA	229	226	0.0019	0.01	0.024	3	1.00 E-02	0.01	mg/kg	3	6	1.07 E-02	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.0131
2-Methylphenol (cresol, o-)	Less than 2 detects	VOA	234	234	0.07	0.35	5.6	0	NA	NA	mg/kg	NA	NA	4.02 E-01	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0
3+4 Methylphenol (cresol, m+p)	No detects and <50 samples (typically reported as 4-Methylphenol (cresol, p-) that has no detects in 233 samples	VOA	1	1	0.12	0.12	0.12	0	NA	NA	mg/kg	NA	NA	1.20 E-01	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0
4-Methylphenol-(cresol, p-)	Less than 2 detects	VOA	233	233	0.2547	0.35	5.6	0	NA	NA	mg/kg	NA	NA	4.03 E-01	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0
Naphthalene	Less than 2 detects	VOA/SVOA	234	234	0.259	0.35	5.6	0	NA	NA	mg/kg	NA	NA	4.03 E-01	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0
1,1,2,2-Tetrachloroethane	2 detects, no SSV, below SSV of surrogate, methylene chloride	VOA	229	227	0.0019	0.005	0.017	2	5.00 E-03	0.005	mg/kg	3	6	5.71 E-03	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.00873
Tetrachloroethene	No detects above SSV	VOA	229	224	0.0019	0.005	0.017	5	5.00 E-03	0.006	mg/kg	4	5	5.67 E-03	NA	NA	NA	1.00 E+01	0	NA	NA	5.079365	0	3.281109	0	NA	NA	NA	NA	NA	NA	NA	NA	0	0.02183
Toluene	No detects above SSV	VOA	229	207	0.0019	0.005	0.011	22	2.50 E-03	0.017	mg/kg	6.5	6.5	5.45 E-03	NA	NA	NA	NA	NA	NA	NA	65.28562	0	45.72635	0	NA	NA	NA	NA	NA	NA	NA	NA	0	0.09607
1,1,1-Trichloroethane	>2 detects, no SSV, below SSV of surrogate, methylene chloride	VOA	229	226	0.0019	0.005	0.017	3	5.00 E-03	0.005	mg/kg	3	6	5.66 E-03	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.0131
1,1,2-Trichloroethane	2 detects, no SSV, below SSV of surrogate, methylene chloride	VOA	229	227	0.0019	0.005	0.017	2	5.00 E-03	0.005	mg/kg	3	6	5.71 E-03	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.00873
Trichloroethene	2 detects, no SSV, below SSV of surrogate, methylene chloride	VOA	229	227	0.0019	0.005	0.017	2	5.00 E-03	0.005	mg/kg	3	6	5.70 E-03	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.00873
2-(2,4,5-Trichlorophenoxy) propionic acid	No detects and <50 samples; eliminated as COPEC because not one of the herbicides currently used at waste sites; characterization of soils for herbicides will continue at waste sites, facilities, and tank farms	HERB	5	5	0.017	0.017	0.018	0	NA	NA	mg/kg	NA	NA	1.74 E-02	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0

Table B-2. Screening of Contaminants of Potential Concern for Contaminants of Potential Ecological Concern Identification. (8 Pages)

Analyte	COPEC Designation Justification	Method Class	Samples	# NDs	Min ND	Median ND	Max ND	Detects	Median Detect	Max Detect	Units	Top Depth (ft) of Max Detect	Bottom Depth (ft) of Max Detect	Mean Site	BV	# Detects >BV	# ND >BV	Plant	#D> Plant	Biota	#D> Biota	Shrew	#D> Shrew	Vole	#D> Vole	Robin	#D> Robin	BCG Plant	#D>BCG Plant	BCG Wild-life	#D> BCG Wild-life	FD>BV	FD>SSV	FD
Organics (cont)																																		
2,4,5-Trichlorophenoxy-acetic acid	No detects and <50 samples; eliminated as COPEC because not one of the herbicides currently used at waste sites; characterization of soils for herbicides will continue at waste sites, facilities, and tank farms	HERB	5	5	0.017	0.017	0.018	0	NA	NA	mg/kg	NA	NA	1.74 E-02	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0
Xylenes (total)	No detects above SSV	VOA	229	225	0.0019	0.005	0.017	4	3.50 E-03	0.005	mg/kg	3	6	5.68 E-03	NA	NA	NA	NA	NA	NA	NA	5.017921	0	5.441824	0	4.86 E+02	0	NA	NA	NA	NA	NA	0	0.01747
Semivolatile Organics																																		
Aroclor-1016	Less than 2 detects, additional analyte to be measured with PCBs	PEST/PCB	227	227	0.0189	0.036	56.3	0	NA	NA	mg/kg	NA	NA	3.81 E-01	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0
Aroclor-1221	Less than 2 detects, additional analyte to be measured with PCBs	PEST/PCB	227	227	0.033	0.072	344	0	NA	NA	mg/kg	NA	NA	1.74 E+00	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0
Aroclor-1232	Less than 2 detects, additional analyte to be measured with PCBs	PEST/PCB	227	227	0.0189	0.036	317	0	NA	NA	mg/kg	NA	NA	1.53 E+00	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0
Aroclor-1242	Less than 2 detects, additional analyte to be measured with PCBs	PEST/PCB	227	227	0.0189	0.036	179	0	NA	NA	mg/kg	NA	NA	9.21 E-01	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0
Aroclor-1248	Less than 2 detects, additional analyte to be measured with PCBs	PEST/PCB	227	227	0.0189	0.036	18.3	0	NA	NA	mg/kg	NA	NA	2.13 E-01	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0
Aroclor-1254	COPEC	PEST/PCB	227	217	0.0207	0.036	7.4	10	7.20 E-01	52	mg/kg	7.5	10	4.55 E-01	NA	NA	NA	1.60 E+02	0	NA	NA	0.398175	5	15.95404	1	1.33 E-01	6	NA	NA	NA	NA	NA	0.026432	0.04405
Aroclor-1260	COPEC	PEST/PCB	229	217	0.0207	0.036	2.6	12	8.05 E-01	77.6	mg/kg	7.5	10	6.92 E-01	NA	NA	NA	NA	NA	NA	NA	8.993157	3	378.388	0	2.85 E+00	4	NA	NA	NA	NA	NA	0.017467	0.0524
Aroclor-1262	Less than 2 detects, additional analyte to be measured with PCBs	PEST/PCB	2	2	0.034	0.042	0.05	0	NA	NA	mg/kg	NA	NA	4.20 E-02	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0
Aroclor-1268	Less than 2 detects, not routinely part of EPA method 8082	PEST/PCB	2	2	0.034	0.042	0.05	0	NA	NA	mg/kg	NA	NA	4.20 E-02	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0
Petroleum																																		
High boiling hydrocarbons	Less than 2 detects	GENORG	8	7	0.026	0.028	34	1	1.80 E+02	180	mg/kg	8	9	3.33 E+01	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.125
Kerosene	Less than 2 detects	GENORG	11	11	5	5	10	0	NA	NA	mg/kg	NA	NA	5.91 E+00	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0
Total petroleum hydrocarbon- diesel range	Less than 2 detects	GENORG	163	162	2.5	4.7	132	1	3.10 E+01	31	mg/kg	0	1.5	9.35 E+00	NA	NA	NA	NA	NA	200	0	6000	0	6000	0	6000	0	NA	NA	NA	NA	NA	0	0.00613
Total petroleum hydrocarbon - gasoline range	Less than 2 detects	GENORG	4	4	0.03	0.045	0.25	0	NA	NA	mg/kg	NA	NA	9.25 E-02	NA	NA	NA	NA	NA	100	0	5000	0	5000	0	5000	0	NA	NA	NA	NA	NA	0	0
Total petroleum hydrocarbon - kerosene range	Less than 2 detects	GENORG	61	60	3.9	12.5	33	1	4.40 E+02	440	mg/kg	4	6.5	2.02 E+01	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.01639
Total petroleum hydrocarbon - motor oil (high boiling)	No soil screening value but highest detect almost 10X less than comparable wildlife SSV	GENORG	22	15	0.0146	45	1100	7	3.90 E+01	760	mg/kg	4	5	1.24 E+02	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.31818

Table B-2. Screening of Contaminants of Potential Concern for Contaminants of Potential Ecological Concern Identification. (8 Pages)

Analyte	COPEC Designation Justification	Method Class	Samples	# NDs	Min ND	Median ND	Max ND	Detects	Median Detect	Max Detect	Units	Top Depth (ft) of Max Detect	Bottom Depth (ft) of Max Detect	Mean Site	BV	# Detects >BV	# ND >BV	Plant	#D> Plant	Biota	#D> Biota	Shrew	#D> Shrew	Vole	#D> Vole	Robin	#D> Robin	BCG Plant	#D>BCG Plant	BCG Wild-life	#D> BCG Wild-life	FD>BV	FD>SSV	FD
Pesticides																																		
Aldrin	Less than 2 detects, additional analyte to be measured with chlorinated pesticides	PEST/PCB	57	57	0.0017	0.016	0.083	0	NA	NA	mg/kg	NA	NA	1.61 E-02	NA	NA	NA	NA	NA	NA	NA	2.039434	0	166.2543	0	1.12 E-01	0	NA	NA	NA	NA	NA	0	0
Alpha-BHC	Less than 2 detects, additional analyte to be measured with chlorinated pesticides	PEST/PCB	57	57	0.0017	0.016	0.083	0	NA	NA	mg/kg	NA	NA	1.61 E-02	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0
alpha-Chlordane	Less than 2 detects, additional analyte to be measured with chlorinated pesticides	PEST/PCB	57	56	0.0017	0.16	0.83	1	1.60 E-01	0.16	mg/kg	3	6	1.59 E-01	NA	NA	NA	2.20 E+00	0	1	0	2.718543	0	735.5917	0	5.52 E+00	0	NA	NA	NA	NA	NA	0	0.01754
beta-1,2,3,4,5,6-Hexachlorocyclohexane (beta-BHC)	Less than 2 detects	PEST/PCB	57	57	0.0017	0.016	0.083	0	NA	NA	mg/kg	NA	NA	1.61 E-02	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0
Delta-BHC	Less than 2 detects, additional analyte to be measured with chlorinated pesticides	PEST/PCB	57	57	0.0017	0.016	0.083	0	NA	NA	mg/kg	NA	NA	1.61 E-02	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0
Dichlorodiphenyldichloroethane (DDD)	Less than 2 detects, additional analyte to be measured with chlorinated pesticides	PEST/PCB	57	57	0.0033	0.032	0.17	0	NA	NA	mg/kg	NA	NA	2.94 E-02	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0
Dichlorodiphenyldichloroethylene (DDE)	Less than 2 detects, additional analyte to be measured with chlorinated pesticides	PEST/PCB	57	57	0.0033	0.032	0.17	0	NA	NA	mg/kg	NA	NA	2.94 E-02	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0
Dichlorodiphenyltrichloroethane (DDT)	3 detects, all < SSV, additional analyte to be measured with chlorinated pesticides	PEST/PCB	57	54	0.0033	0.032	0.17	3	1.10 E-02	0.034	mg/kg	3	6	2.79 E-02	NA	NA	NA	3.70 E+00	0	NA	NA	0.447792	0	116.8122	0	2.06 E-01	0	NA	NA	NA	NA	NA	0	0.05263
Dieldrin	Less than 2 detects, additional analyte to be measured with chlorinated pesticides	PEST/PCB	57	57	0.0033	0.032	0.17	0	NA	NA	mg/kg	NA	NA	2.94 E-02	NA	NA	NA	1.00 E+01	0	NA	NA	0.067854	0	19.95891	0	1.40 E+00	0	NA	NA	NA	NA	NA	0	0
Endosulfan I	Less than 2 detects, additional analyte to be measured with chlorinated pesticides	PEST/PCB	57	57	0.0017	0.016	0.083	0	NA	NA	mg/kg	NA	NA	1.64 E-02	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0
Endosulfan II	Less than 2 detects, additional analyte to be measured with chlorinated pesticides	PEST/PCB	57	57	0.0033	0.032	0.17	0	NA	NA	mg/kg	NA	NA	2.94 E-02	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0
Endosulfan sulfate	Less than 2 detects, additional analyte to be measured with chlorinated pesticides	PEST/PCB	57	57	0.0033	0.032	0.17	0	NA	NA	mg/kg	NA	NA	2.94 E-02	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0
Endrin	Less than 2 detects, additional analyte to be measured with chlorinated pesticides	PEST/PCB	57	57	0.0033	0.032	0.17	0	NA	NA	mg/kg	NA	NA	2.94 E-02	NA	NA	NA	3.40 E-03	0	NA	NA	1.343155	0	42.07348	0	2.44 E-01	0	NA	NA	NA	NA	NA	0	0
Endrin aldehyde	Less than 2 detects, additional analyte to be measured with chlorinated pesticides	PEST/PCB	6	6	0.0033	0.0034	0.0056	0	NA	NA	mg/kg	NA	NA	3.78 E-03	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0
Endrin ketone	Less than 2 detects, additional analyte to be measured with chlorinated pesticides	PEST/PCB	56	56	0.0034	0.032	0.17	0	NA	NA	mg/kg	NA	NA	2.99 E-02	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0
Gamma-BHC (Lindane)	Less than 2 detects, additional analyte to be measured with chlorinated pesticides	PEST/PCB	57	56	0.0017	0.016	0.083	1	1.70 E-02	0.017	mg/kg	3	6	1.61 E-02	NA	NA	NA	1.00 E-01	0	NA	NA	0.006148	1	0.05749	0	6.31 E+00	0	NA	NA	NA	NA	NA	0.017544	0.01754

Table B-2. Screening of Contaminants of Potential Concern for Contaminants of Potential Ecological Concern Identification. (8 Pages)

Analyte	COPEC Designation Justification	Method Class	Samples	# NDs	Min ND	Median ND	Max ND	Detects	Median Detect	Max Detect	Units	Top Depth (ft) of Max Detect	Bottom Depth (ft) of Max Detect	Mean Site	BV	# Detects >BV	# ND >BV	Plant	#D> Plant	Biota	#D> Biota	Shrew	#D> Shrew	Vole	#D> Vole	Robin	#D> Robin	BCG Plant	#D>BCG Plant	BCG Wild-life	#D> BCG Wild-life	FD>BV	FD>SSV	FD
Pesticides (cont)																																		
gamma-Chlordane	Less than 2 detects, additional analyte to be measured with chlorinated pesticides	PEST/PCB	57	57	0.0017	0.16	0.83	0	NA	NA	mg/kg	NA	NA	1.59 E-01	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0
Heptachlor	2 detects, all < SSV, additional analyte to be measured with chlorinated pesticides	PEST/PCB	57	55	0.0017	0.016	0.083	2	1.65 E-02	0.017	mg/kg	3	6	1.61 E-02	NA	NA	NA	4.00 E-01	0	NA	NA	1.1628	0	132.8863	0	4.02 E-01	0	NA	NA	NA	NA	NA	0	0.03509
Heptachlor epoxide	Less than 2 detects, additional analyte to be measured with chlorinated pesticides	PEST/PCB	57	57	0.0017	0.016	0.083	0	NA	NA	mg/kg	NA	NA	1.61 E-02	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0
Isodrin	Less than 2 detects, additional analyte to be measured with chlorinated pesticides	PEST/PCB	1	1	0.0033	0.0033	0.003 3	0	NA	NA	mg/kg	NA	NA	3.30 E-03	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0
Kepone	Less than 2 detects, additional analyte to be measured with chlorinated pesticides	PEST/PCB	1	1	0.017	0.017	0.017	0	NA	NA	mg/kg	NA	NA	1.70 E-02	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0
Methoxychlor	Less than 2 detects, additional analyte to be measured with chlorinated pesticides	PEST/PCB	57	57	0.0016	0.16	0.83	0	NA	NA	mg/kg	NA	NA	1.61 E-01	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0
Toxaphene	Less than 2 detects, additional analyte to be measured with chlorinated pesticides	PEST/PCB	57	57	0.15	0.32	1.7	0	NA	NA	mg/kg	NA	NA	3.10 E-01	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0

Highlighted rows signify contaminants of potential ecological concern.

* Note: Carbon tetrachloride was kept as a COPEC based on its presence in groundwater at Hanford and the potential for its existence in soil gas as a result of the groundwater.

Aroclor is an expired trademark.

BPJ = best professional judgment.
COPC = contaminant of potential concern.
COPEC = contaminant of potential ecological concern.
EPA = U.S. Environmental Protection Agency.
NA = not available.
PCB = polychlorinated biphenyl.
SOF = sum of fractions.
SSV = soil-screening value.
VOA/SVOA = constituents that may be determined either by volatile or semivolatile methods

Table B-3. Screening of Noncontaminants of Potential Concern with Empirical Data for Contaminant of Potential Ecological Concern Identification. (7 Pages)

Analyte	COPEC Designation Justification	Method Class	Samples	# NDs	Min ND	Median ND	Max ND	Detects	Median Detect	Max Detect	Units	Top Depth (ft) of Max Detect	Bottom Depth (ft) of Max Detect	Mean Site	BV	# Detects >BV	# ND >BV	Plant	#D> Plant	Biota	#D> Biota	Shrew	#D> Shrew	Vole	#D> Vole	Robin	#D> Robin	BCG Plant	#D>BCG Plant	BCG Wild-life	#D> BCG Wild-life	FD>BV	FD>SSV	FD
Radionuclides																																		
Actinium-228	Not a COPC	RAD	1	0	NA	NA	NA	1	0.429	0.429	pCi/g	9	11.5	4.29 E-01	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1
Barium-133	Not a COPC	RAD	15	15	0.017	3.90 E-02	3.00 E-01	0	NA	NA	pCi/g	NA	NA	5.66 E-02	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0
Barium-140	Not a COPC	RAD	86	48	-0.028	6.00 E+00	4.00 E+02	38	100	5000	pCi/g	0	0	2.01 E+02	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	5870	0	7.32 E+00	37	NA	0.430233	0.44186
Beryllium-7	Not a COPC	RAD	86	85	0.071	1.00 E+00	4.00 E+01	1	2	2	pCi/g	0	0	2.95 E+00	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.01163
Bismuth-212	Not a COPC	RAD	1	0	NA	NA	NA	1	0.282	0.282	pCi/g	9	11.5	2.82 E-01	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1
Bismuth-214	Not a COPC	RAD	1	0	NA	NA	NA	1	0.392	0.392	pCi/g	9	11.5	3.92 E-01	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1
Cerium-141	Not a COPC	RAD	86	85	0.016	7.00 E-01	2.00 E+01	1	0.7	0.7	pCi/g	0	0	1.37 E+00	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	76200	0	7.90 E+03	0	NA	0	0.01163
Cerium-144	Not a COPC	RAD	98	97	-0.071	3.00 E-01	1.00 E+01	1	0.3	0.3	pCi/g	0	0	5.21 E-01	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	13900	0	1.44 E+03	0	NA	0	0.0102
Cobalt-58	Not a COPC	RAD	97	96	-0.0033	8.00 E-02	1.00 E+00	1	0.1	0.1	pCi/g	0	0	1.01 E-01	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	15600	0	1.80 E+03	0	NA	0	0.01031
Curium-242	Not a COPC	RAD	20	20	-0.0418	0.00 E+00	3.10 E-01	0	NA	NA	pCi/g	NA	NA	1.89 E-02	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	4160	0	2.05 E+03	0	NA	0	0
Curium-243/244	Not a COPC	RAD	15	15	-0.0406	0.00 E+00	2.58 E-01	0	NA	NA	pCi/g	NA	NA	2.47 E-02	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	4130	0	4.06 E+03	0	NA	0	0
Curium-244	Not a COPC	RAD	17	16	-0.041	6.20 E-04	4.33 E-01	1	0.064	0.064	pCi/g	4.4	5.4	2.75 E-02	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	4130	0	4.06 E+03	0	NA	0	0.05882
Gross alpha	Not a COPC	RAD	180	38	0.292	2.68 E+00	5.00 E+00	142	6.75	777	pCi/g	4	6.5	1.34 E+01	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.78889
Gross beta	Not a COPC	RAD	180	3	-2.03	3.50 E+00	6.03 E+00	177	30	10000	pCi/g	8	10.5	1.18 E+02	22.96	105	0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.583333	NA	0.98333
Iodine-129	Not a COPC	RAD	15	15	-0.51	-5.71 E-02	5.10 E-01	0	NA	NA	pCi/g	NA	NA	-9.46 E-02	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	177000	0	5.67 E+03	0	NA	0	0
Iodine-131	Not a COPC	RAD	69	68	0.014	1.00 E+03	1.00 E+05	1	1000	1000	pCi/g	0	0	1.00 E+04	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	24100	0	8.62 E+02	1	NA	0.014493	0.01449
Iron-59	Not a COPC	RAD	97	96	0.0058	4.00 E-01	5.00 E+00	1	0.5	0.5	pCi/g	0	0	4.81 E-01	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.01031
Lead-212	Not a COPC	RAD	1	0	NA	NA	NA	1	0.445	0.445	pCi/g	9	11.5	4.45 E-01	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1
Lead-214	Not a COPC	RAD	1	0	NA	NA	NA	1	0.432	0.432	pCi/g	9	11.5	4.32 E-01	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1
Manganes E-54	Not a COPC	RAD	97	95	-0.0045	4.00 E-02	5.00 E-01	2	0.0525	0.065	pCi/g	0	0	5.45 E-02	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.02062
Niobium-94	Not a COPC	RAD	16	16	-0.0009	5.45 E-02	5.00 E-01	0	NA	NA	pCi/g	NA	NA	1.13 E-01	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0
Plutonium-241	Not a COPC	RAD	3	3	-0.235	9.99 E-01	3.22 E+01	0	NA	NA	pCi/g	NA	NA	1.10 E+01	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0
Potassium-40	Not a COPC	RAD	304	4	0.76	9.00 E+01	3.30 E+03	300	12.25	155	pCi/g	2.5	5	2.41 E+01	16.6	15	3	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.049342	NA	0.98684
Radium-224	Not a COPC	RAD	3	0	NA	NA	NA	3	0.69	0.91	pCi/g	4	6.5	7.47 E-01	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1

Table B-3. Screening of Noncontaminants of Potential Concern with Empirical Data for Contaminant of Potential Ecological Concern Identification. (7 Pages)

Analyte	COPEC Designation Justification	Method Class	Samples	# NDs	Min ND	Median ND	Max ND	Detects	Median Detect	Max Detect	Units	Top Depth (ft) of Max Detect	Bottom Depth (ft) of Max Detect	Mean Site	BV	# Detects >BV	# ND >BV	Plant	#D> Plant	Biota	#D> Biota	Shrew	#D> Shrew	Vole	#D> Vole	Robin	#D> Robin	BCG Plant	#D>BCG Plant	BCG Wild-life	#D> BCG Wild-life	FD>BV	FD>SSV	FD
Radionuclides (cont)																																		
Ruthenium-103	Not a COPC	RAD	98	97	0	3.00 E-01	9.00 E+00	1	0.3	0.3	pCi/g	0	0	6.31 E-01	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.0102
Ruthenium-106	Not a COPC	RAD	103	102	-0.0945	3.00 E-01	3.00 E+01	1	0.4	0.4	pCi/g	0	0	9.18 E-01	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.00971
Selenium-79	Not a COPC	RAD	15	13	-23.7	-4.42 E-01	8.10 E+01	2	1.4335	2	pCi/g	6.5	6.5	3.40 E+00	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.13333
Sodium-22	Not a COPC	RAD	28	28	-0.0079	4.90 E-02	9.00 E-01	0	NA	NA	pCi/g	NA	NA	9.76 E-02	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	8900	0	NA	NA	NA	0	0
Thallium-208	Not a COPC	RAD	1	0	NA	NA	NA	1	0.136	0.136	pCi/g	9	11.5	1.36 E-01	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1
Thorium-228	Not a COPC	RAD	489	64	-0.171	2.96 E-01	3.70 E+02	425	0.6155	9.35	pCi/g	2.5	5	1.79 E+00	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	810	0	NA	NA	NA	0	0.86912
Thorium-230	Not a COPC	RAD	190	37	-22.1	1.69 E-01	3.22 E+00	153	0.523	7.6	pCi/g	10	12.5	4.46 E-01	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	27000	0	NA	NA	NA	0	0.80526
Thorium-234	Not a COPC	RAD	27	27	0.25	6.00 E-01	8.00 E+00	0	NA	NA	pCi/g	NA	NA	8.94 E-01	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0
Tin-113	Not a COPC	RAD	12	12	-0.0022	1.00 E-01	6.00 E+00	0	NA	NA	pCi/g	NA	NA	7.91 E-01	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0
Tin-126	Not a COPC	RAD	17	17	0.035	8.80 E-02	3.70 E+02	0	NA	NA	pCi/g	NA	NA	2.19 E+01	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0
Zinc-65	Not a COPC	RAD	87	86	0.0091	9.00 E-02	1.00 E+00	1	0.1	0.1	pCi/g	0	0	1.03 E-01	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	25000	0	4.13 E+02	0	NA	0	0.01149
Zirconium-95	Not a COPC	RAD	86	85	0.0041	1.00 E-01	1.00 E+00	1	0.1	0.1	pCi/g	0	0	1.29 E-01	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	11400	0	1.17 E+03	0	NA	0	0.01163
Metals																																		
Calcium	Micronutrient	METALMULT	94	0	NA	NA	NA	94	6.86 E+03	57000	mg/kg	6.5	6.5	7.76 E+03	19700	2	0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.021277	NA	1
Iron	Micronutrient	METALMULT	94	0	NA	NA	NA	94	1.45 E+04	37900	mg/kg	12.5	15	1.66 E+04	35000	1	0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.010638	NA	1
Magnesium	Micronutrient	METALMULT	95	0	NA	NA	NA	95	3.43 E+03	8240	mg/kg	6.5	6.5	3.71 E+03	7620	1	0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.010526	NA	1
Potassium	Micronutrient	METALMULT	94	4	466	950	1000	90	9.75 E+02	11600	mg/kg	3.2	5.7	1.15 E+03	2440	1	0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.010638	NA	0.95745
Sodium	Micronutrient	METALMULT	94	6	104.8	132.5	586	88	1.97 E+02	898	mg/kg	12.5	15	2.38 E+02	878	1	0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.010638	NA	0.93617
Titanium	No detects above background	METALMULT	12	0	NA	NA	NA	12	1.46 E+03	2420	mg/kg	9	10	1.57 E+03	2950	0	0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0	NA	1
General Inorganics																																		
Bromide	Not a COPC	GENCHEM	2	2	1	1.625	2.25	0	NA	NA	mg/kg	NA	NA	1.63 E+00	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0
Free cyanide	Not a COPC	GENCHEM	3	2	0.05	0.05	0.05	1	2.00 E+00	2	mg/kg	3	6	7.00 E-01	NA	NA	NA	NA	NA	NA	NA	299.3464	0	212.7594	0	3.10 E-01	1	NA	NA	NA	NA	NA	0.333333	0.33333
Hydrazine	Not a COPC	GENCHEM	24	23	0.91	1.1	1.5	1	1.94 E+00	1.94286	mg/kg	7	8	1.12 E+00	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.04167

Table B-3. Screening of Noncontaminants of Potential Concern with Empirical Data for Contaminant of Potential Ecological Concern Identification. (7 Pages)

Analyte	COPEC Designation Justification	Method Class	Samples	# NDs	Min ND	Median ND	Max ND	Detects	Median Detect	Max Detect	Units	Top Depth (ft) of Max Detect	Bottom Depth (ft) of Max Detect	Mean Site	BV	# Detects >BV	# ND >BV	Plant	#D> Plant	Biota	#D> Biota	Shrew	#D> Shrew	Vole	#D> Vole	Robin	#D> Robin	BCG Plant	#D>BCG Plant	BCG Wild-life	#D> BCG Wild-life	FD>BV	FD>SSV	FD
Organics																																		
Acetone	Not a COPC	VOA	229	141	0.0019	0.011	0.046	88	6.67 E-03	0.19	mg/kg	6.5	6.5	1.37 E-02	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.38428
Bromodichloro-methane	Not a COPC	VOA	229	227	0.0019	0.005	0.017	2	5.00 E-03	0.005	mg/kg	3	6	5.70 E-03	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.00873
Bromoform	Not a COPC	VOA	229	227	0.0019	0.005	0.017	2	5.00 E-03	0.005	mg/kg	3	6	5.71 E-03	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.00873
Bromomethane	Not a COPC	VOA	229	227	0.0019	0.01	0.017	2	1.00 E-02	0.01	mg/kg	3	6	1.05 E-02	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.00873
Carbon disulfide	Not a COPC	VOA	229	225	0.0019	0.005	0.011	4	5.00 E-03	0.007	mg/kg	6.5	6.5	5.65 E-03	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.01747
Chloroethane	Not a COPC	VOA	229	227	0.0019	0.01	0.017	2	1.00 E-02	0.01	mg/kg	3	6	1.05 E-02	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.00873
Chloromethane	Not a COPC	VOA	229	225	0.0019	0.01	0.017	4	8.00 E-03	0.01	mg/kg	3	6	1.04 E-02	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.01747
Cyclohexanone	Less than 2 detects, not a COPC	VOA	3	3	0.05	0.05633 33	0.06	0	NA	NA	mg/kg	NA	NA	5.54 E-02	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0
Dibromochloro-methane	Not a COPC	VOA	229	227	0.0019	0.005	0.017	2	5.00 E-03	0.005	mg/kg	3	6	5.71 E-03	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.00873
1,2-Dichloropropane	Not a COPC	VOA	229	227	0.0019	0.005	0.017	2	5.00 E-03	0.005	mg/kg	3	6	5.70 E-03	NA	NA	NA	NA	NA	700	0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0	0.00873
cis-1,3-Dichloropropene	Not a COPC	VOA	229	227	0.0019	0.005	0.017	2	5.00 E-03	0.005	mg/kg	3	6	5.71 E-03	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.00873
trans-1,3-Dichloropropene	Not a COPC	VOA	229	227	0.0019	0.005	0.017	2	5.00 E-03	0.005	mg/kg	3	6	5.71 E-03	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.00873
1-Propanol	Less than 2 detects, not a COPC	VOA	158	158	3	5.5	34.33 333	0	NA	NA	mg/kg	NA	NA	1.11 E+01	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0
Diethyl ether	Less than 2 detects, not a COPC	VOA	2	2	0.011	0.0115	0.012	0	NA	NA	mg/kg	NA	NA	1.15 E-02	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0
Ethanol	Less than 2 detects, not a COPC	VOA	158	158	3	5.5	30	0	NA	NA	mg/kg	NA	NA	1.08 E+01	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0
Ethylene glycol	Less than 2 detects, not a COPC	VOA	1	1	5	5	5	0	NA	NA	mg/kg	NA	NA	5.00 E+00	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0
Hexane	Less than 2 detects, not a COPC	VOA	1	0	NA	NA	NA	1	1.04 E-02	0.01039	mg/kg	4	6	1.04 E-02	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1
Isobutyl alcohol	Not a COPC	VOA	3	0	NA	NA	NA	3	1.10 E+02	110	mg/kg	2.5	3.5	1.10 E+02	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1
Methanol	Less than 2 detects, not a COPC	VOA	2	2	28	29	30	0	NA	NA	mg/kg	NA	NA	2.90 E+01	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0
Methylene chloride	Not a COPC	VOA	229	66	0.0019	0.008	0.03	163	1.00 E-02	0.078	mg/kg	4	5	1.16 E-02	NA	NA	NA	1.60 E+03	0	NA	NA	17.44966	0	2.74519	0	NA	NA	NA	NA	NA	NA	NA	0	0.71179
Styrene	Not a COPC	VOA	229	227	0.0019	0.005	0.017	2	5.00 E-03	0.005	mg/kg	3	6	5.71 E-03	NA	NA	NA	3.00 E+02	0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0	0.00873
Tetrahydrofuran	Less than 2 detects, not a COPC	VOA	1	1	0.0031	0.0031	0.003 1	0	NA	NA	mg/kg	NA	NA	3.10 E-03	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0
Trichloromonofluoro methane	Less than 2 detects, not a COPC	VOA	3	3	0.006	0.006	0.006	0	NA	NA	mg/kg	NA	NA	6.00 E-03	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0

Table B-3. Screening of Noncontaminants of Potential Concern with Empirical Data for Contaminant of Potential Ecological Concern Identification. (7 Pages)

Analyte	COPEC Designation Justification	Method Class	Samples	# NDs	Min ND	Median ND	Max ND	Detects	Median Detect	Max Detect	Units	Top Depth (ft) of Max Detect	Bottom Depth (ft) of Max Detect	Mean Site	BV	# Detects >BV	# ND >BV	Plant	#D> Plant	Biota	#D> Biota	Shrew	#D> Shrew	Vole	#D> Vole	Robin	#D> Robin	BCG Plant	#D>BCG Plant	BCG Wild-life	#D> BCG Wild-life	FD>BV	FD>SSV	FD
Organics (cont)																																		
1,2,4-Trimethylbenzene	Less than 2 detects, not a COPC	VOA	3	3	0.0041	0.006	0.006	0	NA	NA	mg/kg	NA	NA	5.38 E-03	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0
Vinyl acetate	Not a COPC	VOA	53	51	0.01	0.01	0.013	2	1.00 E-02	0.01	mg/kg	3	6	1.02 E-02	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.03774
Vinyl chloride	Not a COPC	VOA	229	227	0.0019	0.01	0.017	2	1.00 E-02	0.01	mg/kg	3	6	1.04 E-02	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.00873
Semivolatile Organics																																		
Acenaphthene	Not a COPC	SVOA	235	232	0.069	0.35	5.6	3	6.10 E-02	0.26533	mg/kg	5	6	3.96 E-01	NA	NA	NA	2.00 E+01	0	NA	NA	154.0154	0	338.1969	0	NA	NA	NA	NA	NA	NA	NA	0	0.01277
Acenaphthylene	No detects above SSV, not a COPC	SVOA	234	234	0.083	0.35	5.6	0	NA	NA	mg/kg	NA	NA	4.02 E-01	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0
Anthracene	No detects above SSV, not a COPC	SVOA	234	232	0.07	0.35	5.6	2	2.06 E-01	0.26267	mg/kg	5	6	3.99 E-01	NA	NA	NA	NA	NA	NA	NA	204.8131	0	820.1427	0	NA	NA	NA	NA	NA	NA	NA	0	0.00855
Benzo(a)anthracene	No detects above SSV, not a COPC	SVOA	234	227	0.07	0.35	5.6	7	6.40 E-02	0.55	mg/kg	0	1.5	3.85 E-01	NA	NA	NA	NA	NA	NA	NA	3.777778	0	3.480041	0	NA	NA	NA	NA	NA	NA	NA	0	0.02991
Benzo(a)pyrene	No detects above SSV, not a COPC	SVOA	234	227	0.07	0.35	5.6	7	9.03 E-02	0.6	mg/kg	0	1.5	3.85 E-01	NA	NA	NA	NA	NA	NA	NA	11.75309	0	80.07039	0	NA	NA	NA	NA	NA	NA	NA	0	0.02991
Benzo(b)fluoranthene	No detects above SSV, not a COPC	SVOA	234	227	0.07	0.35	5.6	7	9.47 E-02	0.53	mg/kg	0	1.5	3.85 E-01	NA	NA	NA	NA	NA	NA	NA	40.40404	0	116.6283	0	NA	NA	NA	NA	NA	NA	NA	0	0.02991
Benzo(ghi)perylene	No detects above SSV, not a COPC	SVOA	234	229	0.07	0.35	5.6	5	7.47 E-02	0.66	mg/kg	0	1.5	3.97 E-01	NA	NA	NA	NA	NA	NA	NA	11.55235	0	289.7734	0	NA	NA	NA	NA	NA	NA	NA	0	0.02137
Benzo(k)fluoranthene	No detects above SSV, not a COPC	SVOA	234	229	0.07	0.35	5.6	5	1.07 E-01	0.45	mg/kg	0	1.5	3.97 E-01	NA	NA	NA	NA	NA	NA	NA	64	0	209.9309	0	NA	NA	NA	NA	NA	NA	NA	0	0.02137
Benzoic acid	No detects above SSV	SVOA	51	47	1.6	1.7	1.9	4	6.35 E-02	0.07	mg/kg	9	11.5	1.60 E+00	NA	NA	NA	NA	NA	NA	NA	11.11111	0	3.243462	0	NA	NA	NA	NA	NA	NA	NA	0	0.07843
Benzyl alcohol	Less than 2 detects, not a COPC	SVOA	51	51	0.33	0.34	0.38	0	NA	NA	mg/kg	NA	NA	3.45 E-01	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0
Bis(2-chloro-1-methylethyl)ether	Less than 2 detects, not a COPC	SVOA	230	230	0.2597	0.35	5.6	0	NA	NA	mg/kg	NA	NA	4.04 E-01	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0
Bis(2-Chloroethoxy)-methane	Less than 2 detects, not a COPC	SVOA	234	234	0.12	0.35	5.6	0	NA	NA	mg/kg	NA	NA	4.02 E-01	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0
Bis(2-chloroethyl)-ether	Less than 2 detects, not a COPC	SVOA	234	234	0.255	0.35	5.6	0	NA	NA	mg/kg	NA	NA	4.03 E-01	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0
Bis(2-chloroisopropyl)	Less than 2 detects, not a COPC	SVOA	4	4	0.34	0.34	0.35	0	NA	NA	mg/kg	NA	NA	3.43 E-01	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0
Bis(2-ethylhexyl) phthalate	Not a COPC	SVOA	234	175	0.075	0.35	5.6	59	5.70 E-02	6.2	mg/kg	4	5	3.56 E-01	NA	NA	NA	NA	NA	NA	NA	27.38496	0	1024.98	0	3.24 E+00	1	NA	NA	NA	NA	NA	0.004274	0.25214
4-Bromophenyl phenyl-ether	Less than 2 detects, not a COPC	SVOA	234	234	0.07	0.35	5.6	0	NA	NA	mg/kg	NA	NA	4.02 E-01	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0
2,6-di-tert-Butyl-p-benzoquinon	Less than 2 detects, not a COPC	SVOA	1	0	NA	NA	NA	1	1.20 E-02	0.01202	mg/kg	6	8	1.20 E-02	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1
Butylbenzylphthalate	Not a COPC	SVOA	234	225	0.07	0.35	5.6	9	2.90 E-01	1.8	mg/kg	6	8	3.97 E-01	NA	NA	NA	NA	NA	NA	NA	315.4762	0	1654.527	0	NA	NA	NA	NA	NA	NA	NA	0	0.03846
Carbazole	Not a COPC	SVOA	183	181	0.083	0.35	5.6	2	1.78 E-01	0.25933	mg/kg	5	6	4.13 E-01	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.01093
4-Chloro-3-methylphenol	Less than 2 detects, not a COPC	SVOA	235	234	0.069	0.35	5.6	1	2.70 E-02	0.027	mg/kg	10	12.5	3.99 E-01	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.00426
4-Chloroaniline	Less than 2 detects, not a COPC	SVOA	234	234	0.097	0.35	5.6	0	NA	NA	mg/kg	NA	NA	4.02 E-01	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0

Table B-3. Screening of Noncontaminants of Potential Concern with Empirical Data for Contaminant of Potential Ecological Concern Identification. (7 Pages)

Analyte	COPEC Designation Justification	Method Class	Samples	# NDs	Min ND	Median ND	Max ND	Detects	Median Detect	Max Detect	Units	Top Depth (ft) of Max Detect	Bottom Depth (ft) of Max Detect	Mean Site	BV	# Detects >BV	# ND >BV	Plant	#D> Plant	Biota	#D> Biota	Shrew	#D> Shrew	Vole	#D> Vole	Robin	#D> Robin	BCG Plant	#D>BCG Plant	BCG Wild-life	#D> BCG Wild-life	FD>BV	FD>SSV	FD
Semivolatile Organics(cont)																																		
2-Chloronaphthalene	Less than 2 detects, not a COPC	SVOA	234	231	0.07	0.35	5.6	3	6.50 E-02	0.074	mg/kg	3	6	4.04 E-01	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.01282
2-Chlorophenol	Less than 2 detects, not a COPC	SVOA	235	234	0.15	0.35	5.6	1	3.10 E-02	0.031	mg/kg	10	12.5	4.00 E-01	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.00426
4-Chlorophenyl phenyl-ether	Less than 2 detects, not a COPC	SVOA	234	234	0.07	0.35	5.6	0	NA	NA	mg/kg	NA	NA	4.02 E-01	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0
Chrysene	Not a COPC	SVOA	234	225	0.07	0.35	5.6	9	6.20 E-02	0.68	mg/kg	0	1.5	3.84 E-01	NA	NA	NA	NA	NA	NA	NA	2.905983	0	3.480041	0	NA	NA	NA	NA	NA	NA	NA	0	0.03846
Decane	Less than 2 detects, not a COPC	SVOA	1	1	0.25	0.25	0.25	0	NA	NA	mg/kg	NA	NA	2.50 E-01	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0
Diacetone alcohol	Not a COPC	SVOA	3	0	NA	NA	NA	3	6.50 E+01	76	mg/kg	10	12.5	4.70 E+01	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1
Dibenz[a,h]-anthracene	Not a COPC	SVOA	234	232	0.07	0.35	5.6	2	1.77 E-01	0.244	mg/kg	8	9	3.99 E-01	NA	NA	NA	NA	NA	NA	NA	13.43434	0	53.25752	0	NA	NA	NA	NA	NA	NA	NA	0	0.00855
Dibenzofuran	Less than 2 detects, not a COPC	SVOA	234	234	0.07	0.35	5.6	0	NA	NA	mg/kg	NA	NA	4.02 E-01	NA	NA	NA	6.10 E+00	0	NA	NA	NA	NA	NA	NA	1.93 E-06	0	NA	NA	NA	NA	NA	0	0
1,4-Dichlorobenzene	Less than 2 detects, not a COPC	SVOA	235	234	0.2473	0.35	5.6	1	2.00 E-02	0.02	mg/kg	10	12.5	4.01 E-01	NA	NA	NA	NA	NA	20	0	5.817336	0	7.857311	0	NA	NA	NA	NA	NA	NA	NA	0	0.00426
3,3'-Dichlorobenzidine	Less than 2 detects, not a COPC	SVOA	234	234	0.083	0.36	5.6	0	NA	NA	mg/kg	NA	NA	5.14 E-01	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0
2,4-Dichlorophenol	Less than 2 detects, not a COPC	SVOA	234	234	0.083	0.35	5.6	0	NA	NA	mg/kg	NA	NA	4.02 E-01	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0
Diethylphthalate	Not a COPC	SVOA	235	224	0.27	0.35	5.6	11	6.60 E-02	0.36	mg/kg	11	13.5	3.91 E-01	NA	NA	NA	1.00 E+02	0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0	0.04681
2,4-Dimethylphenol	Less than 2 detects, not a COPC	SVOA	234	234	0.07	0.35	5.6	0	NA	NA	mg/kg	NA	NA	4.02 E-01	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0
Dimethyl phthalate	Less than 2 detects, not a COPC	SVOA	234	234	0.07	0.35	5.6	0	NA	NA	mg/kg	NA	NA	4.02 E-01	NA	NA	NA	NA	NA	200	0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0	0
Di-n-butylphthalate	Not a COPC	SVOA	234	194	0.062	0.35	5.6	40	1.20 E-01	3.3	mg/kg	0	2.5	4.66 E-01	NA	NA	NA	2.00 E+02	0	NA	NA	2731.906	0	11557.2	0	5.51 E-01	15	NA	NA	NA	NA	NA	0.064103	0.17094
Di-n-octylphthalate	Less than 2 detects, not a COPC	SVOA	234	233	0.07	0.35	5.6	1	2.30 E-02	0.023	mg/kg	12.5	15	4.00 E-01	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.00427
4,6-Dinitro-2-methylphenol	Less than 2 detects, not a COPC	SVOA	234	234	0.5997	0.9	14	0	NA	NA	mg/kg	NA	NA	1.22 E+00	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0
2,4-Dinitrophenol	Less than 2 detects, not a COPC	SVOA	234	234	0.6093	0.9	14	0	NA	NA	mg/kg	NA	NA	1.22 E+00	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0
2,6-Dinitrotoluene	Less than 2 detects, not a COPC	SVOA	234	234	0.07	0.35	5.6	0	NA	NA	mg/kg	NA	NA	4.02 E-01	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0
Fluoranthene	Not a COPC	SVOA	234	226	0.07	0.35	5.6	8	1.58 E-01	1.5	mg/kg	0	1.5	3.91 E-01	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.03419
Fluorene	Not a COPC	SVOA	234	232	0.07	0.35	5.6	2	1.60 E-01	0.26	mg/kg	5	6	3.98 E-01	NA	NA	NA	NA	NA	30	0	265.8161	0	771.9147	0	NA	NA	NA	NA	NA	NA	NA	0	0.00855
Hexachlorobenzene	Less than 2 detects, not a COPC	SVOA	234	234	0.07	0.35	5.6	0	NA	NA	mg/kg	NA	NA	4.02 E-01	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0
Hexachlorobutadiene	Less than 2 detects, not a COPC	SVOA	234	234	0.259	0.35	5.6	0	NA	NA	mg/kg	NA	NA	4.03 E-01	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0
Hexachlorocyclo-pentadiene	Less than 2 detects, not a COPC	SVOA	234	234	0.2447	0.35	5.6	0	NA	NA	mg/kg	NA	NA	4.41 E-01	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0

Table B-3. Screening of Noncontaminants of Potential Concern with Empirical Data for Contaminant of Potential Ecological Concern Identification. (7 Pages)

Analyte	COPEC Designation Justification	Method Class	Samples	# NDs	Min ND	Median ND	Max ND	Detects	Median Detect	Max Detect	Units	Top Depth (ft) of Max Detect	Bottom Depth (ft) of Max Detect	Mean Site	BV	# Detects >BV	# ND >BV	Plant	#D> Plant	Biota	#D> Biota	Shrew	#D> Shrew	Vole	#D> Vole	Robin	#D> Robin	BCG Plant	#D>BCG Plant	BCG Wild-life	#D> BCG Wild-life	FD>BV	FD>SSV	FD
Semivolatile Organics(cont)																																		
Hexachloroethane	Less than 2 detects, not a COPC	SVOA	234	234	0.247	0.35	5.6	0	NA	NA	mg/kg	NA	NA	4.03 E-01	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0
Hexadecanoic acid (9CI)	Less than 2 detects, not a COPC	SVOA	2	0	NA	NA	NA	2	2.20 E-01	0.25	mg/kg	3	5.5	2.20 E-01	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1
Indeno(1,2,3-cd)pyrene	No detects above SSV	SVOA	234	229	0.07	0.35	5.6	5	6.67 E-02	0.4	mg/kg	0	1.5	3.96 E-01	NA	NA	NA	NA	NA	NA	NA	64	0	281.217	0	NA	NA	NA	NA	NA	NA	NA	0	0.02137
Isophorone	Less than 2 detects, not a COPC	SVOA	234	234	0.07	0.35	5.6	0	NA	NA	mg/kg	NA	NA	4.02 E-01	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0
Mesityl oxide	Less than 2 detects, not a COPC	SVOA	1	0	NA	NA	NA	1	3.90 E-01	0.39	mg/kg	9	11.5	3.90 E-01	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1
2-Methylnaphthalene	Less than 2 detects, not a COPC	SVOA	234	234	0.19	0.35	5.6	0	NA	NA	mg/kg	NA	NA	4.02 E-01	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0
N-Butyl benzenesulfonamide	Less than 2 detects, not a COPC	SVOA	1	0	NA	NA	NA	1	4.40 E+00	4.4	mg/kg	9	11.5	4.40 E+00	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1
Nitrobenzene	Less than 2 detects, not a COPC	SVOA	234	234	0.2573	0.35	5.6	0	NA	NA	mg/kg	NA	NA	4.03 E-01	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0
2-Nitroaniline	Less than 2 detects, not a COPC	SVOA	234	234	0.07	0.9	14	0	NA	NA	mg/kg	NA	NA	1.21 E+00	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0
3-Nitroaniline	Less than 2 detects, not a COPC	SVOA	234	234	0.07	0.9	14	0	NA	NA	mg/kg	NA	NA	1.21 E+00	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0
4-Nitroaniline	Less than 2 detects, not a COPC	SVOA	234	234	0.26	0.9	14	0	NA	NA	mg/kg	NA	NA	1.21 E+00	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0
2-Nitrophenol	Less than 2 detects, not a COPC	SVOA	235	235	0.18	0.35	5.6	0	NA	NA	mg/kg	NA	NA	4.01 E-01	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0
4-Nitrophenol	No detects above SSV	SVOA	234	232	0.6147	0.9	14	2	1.70 E+00	1.7	mg/kg	2	4.5	1.22 E+00	NA	NA	NA	NA	NA	7	0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0	0.00855
N-Nitrosodi-n-dipropylamine	Less than 2 detects, not a COPC	SVOA	235	235	0.069	0.35	5.6	0	NA	NA	mg/kg	NA	NA	4.00 E-01	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0
N-Nitrosodiphenylamine	Less than 2 detects, not a COPC	SVOA	234	234	0.07	0.35	5.6	0	NA	NA	mg/kg	NA	NA	4.02 E-01	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0
Octathiocane	Less than 2 detects, not a COPC	SVOA	1	1	0.0204	0.02038	0.02038	0	NA	NA	mg/kg	NA	NA	2.04 E-02	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0
Pentachlorophenol	No detects above SSV	SVOA	235	232	0.31	0.9	910.3	3	1.50 E-01	0.15	mg/kg	3	5.5	5.06 E+00	NA	NA	NA	3.00 E+00	0	6	0	4.508547	0	187.9226	0	5.68 E+00	0	NA	NA	NA	NA	NA	0	0.01277
17-Pentatriacontene	Less than 2 detects, not a COPC	SVOA	1	0	NA	NA	NA	1	1.90 E-01	0.19	mg/kg	3	5.5	1.90 E-01	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1
Phenanthrene	No detects above SSV	SVOA	234	227	0.07	0.35	5.6	7	1.50 E-01	0.93	mg/kg	0	1.5	3.88 E-01	NA	NA	NA	NA	NA	NA	NA	10.52739	0	42.15534	0	NA	NA	NA	NA	NA	NA	NA	0	0.02991
Phenol	Not a COPC	SVOA	235	228	0.1	0.35	5.6	7	2.80 E-02	0.12	mg/kg	9	11.5	3.89 E-01	NA	NA	NA	7.00 E+01	0	30	0	174.2919	0	34.47483	0	NA	NA	NA	NA	NA	NA	NA	0	0.02979
Pyrene	No detects above SSV	SVOA	235	225	0.069	0.35	5.6	10	9.55 E-02	1.6	mg/kg	0	1.5	3.87 E-01	NA	NA	NA	NA	NA	NA	NA	14.43001	0	97.15026	0	NA	NA	NA	NA	NA	NA	NA	0	0.04255
Tributyl phosphate	Not a COPC	SVOA	73	71	0.069	0.35	0.77	2	4.27 E-01	0.54321	mg/kg	4	6.5	3.77 E-01	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.0274
1,2,4-Trichlorobenzene	Less than 2 detects, not a COPC	SVOA	235	235	0.258	0.35	5.6	0	NA	NA	mg/kg	NA	NA	4.02 E-01	NA	NA	NA	NA	NA	20	0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0	0
2,4,5-Trichlorophenol	Less than 2 detects, not a COPC	SVOA	234	234	0.076	0.89	14	0	NA	NA	mg/kg	NA	NA	1.16 E+00	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0

Table B-3. Screening of Non-COPCs with Empirical Data for COPEC Identification. (7 Pages)

Analyte	COPEC Designation Justification	Method Class	Samples	# NDs	Min ND	Median ND	Max ND	Detects	Median Detect	Max Detect	Units	Top Depth (ft) of Max Detect	Bottom Depth (ft) of Max Detect	Mean Site	BV	# Detects >BV	# ND >BV	Plant	#D> Plant	Biota	#D> Biota	Shrew	#D> Shrew	Vole	#D> Vole	Robin	#D> Robin	BCG Plant	#D>BCG Plant	BCG Wild-life	#D> BCG Wild-life	FD>BV	FD>SSV	FD
Semivolatile Organics(cont)																																		
2,4,6-Trichlorophenol	Less than 2 detects, not a COPC	SVOA	234	234	0.07	0.35	5.6	0	NA	NA	mg/kg	NA	NA	4.08 E-01	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0

Highlighted rows signify contaminants of potential ecological concern.

Aroclor is an expired trademark.

4-digit EPA Methods are found in SW-846, *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, as amended.*

BPJ = best professional judgment.
COPC = contaminant of potential concern.
COPEC = contaminant of potential ecological concern.
EPA = U.S. Environmental Protection Agency.
NA = not available.
PCB = polychlorinated biphenyl.
SOF = sum of fractions.
SSV = soil-screening value.

Table B-4. Contaminants of Potential Ecological Concern and Additional Analytes for the Central Plateau.

Radioactive Constituents		
Americium-241	Plutonium-239/240	Strontium-90
Cesium-137	Radium-226	Uranium-238
Cobalt-60	Radium-228	
Chemical Constituents – Metals		
Antimony	Chromium (VI)	Selenium
Arsenic	Copper	Silver
Barium	Cyanide	Thallium
Bismuth	Lead	Tin
Boron	Mercury	Uranium
Cadmium	Molybdenum	Vanadium
Chromium	Nickel	Zinc
Chemical Constituents - Organics		
Aroclor-1254[a]	Aroclor-1260	Carbon tetrachloride
Pesticides[b]		

[a] Aroclor is an expired trademark.

[b] Pesticides are included in the study design as additional analytes, because they can be analyzed by EPA Method 8082/8081A (SW-846, *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, as amended*, for little additional cost.

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