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Field Sampling Plan for the Pre-Remediation Sampling of the Central Facilities Area-04 Pond

INEEL
Home of Science and Engineering Solutions
Idaho National Engineering and Environmental Laboratory

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Prepared for the
U.S. Department of Energy
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ABSTRACT

This field sampling plan outlines the collection and analysis of samples in support of the Central Facilities Area-04 mercury pond pre-remediation sampling. The selected remedy for the pond is defined in the *Final Comprehensive Record of Decision for Central Facilities Area Operable Unit 4-13* as excavation, treatment by stabilization, and disposal of the mercury-contaminated soils at the Idaho National Engineering and Environmental Laboratory.

There are three purposes for this sampling effort. First, although significant data exist defining the expected mercury concentrations in the contaminated soils, additional data are required to further refine the vertical extent of contamination to provide better direction for the remediation excavation effort. Second, additional data are need to determine the final treatment and/or disposal options for contaminated soils excavated from the pond. Third, sampling will determine whether the assumptions used in calculating the preliminary remediation goals are valid.

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ACRONYMS

ARAR	applicable or relevant and appropriate requirement
CEL	Chemical Engineering Laboratory
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFA	Central Facilities Area
CFR	Code of Federal Regulations
COC	chain-of-custody
CSA	CERCLA storage area
CWSU	CERCLA waste storage unit
DOE-ID	Department of Energy Idaho Operations Office
DQO	data quality objective
DR	decision rule
DS	decision statement
EPA	Environmental Protection Agency
ER	environmental restoration
FFA/CO	Federal Facility Agreement and Consent Order
FSP	field sampling plan
FTL	field team leader
GDE	guide
GFPC	gas flow proportional counting
HASP	health and safety plan
HDPE	high-density polyethylene
ICDF	INEEL CERCLA Disposal Facility
ID	identification
INEEL	Idaho National Engineering and Environmental Laboratory
MCP	management control procedure

OU	operable unit
PQL	practical quantitation limit
PSQ	principal study question
QA	quality assurance
QA/QC	quality assurance/quality control
QAPjP	quality assurance project plan
QC	quality control
RadCon	radiological control
RCRA	Resource Conservation and Recovery Act
RI/FS	remedial investigation/feasibility study
RMA	radioactive materials area
ROD	Record of Decision
RRWAC	reusable property, recyclable materials, and waste acceptance criteria
SAP	sampling and analysis plan
TCLP	toxicity characteristic leaching procedure
TPR	technical procedure
TSCA	Toxic Substances Control Act
WAG	waste area group
WGS	Waste Generator Services
WROC	Waste Reduction Operations Complex

Field Sampling Plan for the Pre-Remediation Sampling of the Central Facilities Area-04 Pond

1. OVERVIEW

This field sampling plan (FSP) is part of the sampling and analysis plan for the Central Facilities Area pond (CFA-04). The sampling and analysis plan for the Idaho National Engineering and Environmental Laboratory (INEEL) Waste Area Group (WAG) 4 pre-remediation sampling of the CFA-04 pond is comprised of two parts:

1. The FSP describing the sampling activities

2. The quality assurance project plan (QAPjP).

These plans have been prepared pursuant to the *National Oil and Hazardous Substances Contingency Plan* (Environmental Protection Agency [EPA] 1990), guidance from the EPA on the preparation of sampling and analysis plans (SAPs), and in accordance with Management Control Procedure (MCP)-241, "Preparation of Characterization Plans." The FSP describes the field sampling activities that will be performed, while the QAPjP details the processes and programs that will be used to ensure that the data generated are suitable for their intended uses. The FSP develops the data quality objectives (DQOs) upon which the collection of samples will be based. The governing QAPjP for this sampling effort will be the *Quality Assurance Project Plan for Waste Area Groups 1, 2, 3, 4, 5, 6, 7, 10 and Inactive Sites* (Department of Energy Idaho Operations Office [DOE-ID] 2000a). This document is incorporated herein by reference. Work control processes will follow formal practices as per communicated agreement between the appropriate site area director and the Environmental Restoration (ER) WAG 4 project manager and/or their designee(s).

1.1 Field Sampling Plan and Other Documentation

The purpose of this FSP is to guide the collection and analysis of samples required to further define the areal and vertical extent of the contamination at CFA-04 in accordance with the *Final Comprehensive Record of Decision for Central Facilities Area Operable Unit 4-13* (DOE-ID 2000b), hereinafter referred to as the Record of Decision (ROD). Sampling will be conducted to further refine the contaminant boundaries to enable the project to direct the remediation efforts while minimizing the generation of waste soils requiring disposal.

In addition, a health and safety plan (HASP) has been prepared for this project. The HASP, *Health and Safety Plan for the CFA-04 Mercury Pond Sampling and Remedial Action* (INEEL 2002), covers the activities associated with the remediation of the site, including the pre-remediation sampling. The *Interface Agreement Between the Environmental Restoration Program, Waste Area Groups 4, 5, 10, and D&D&D and the Central Facilities Area* (INEEL 1999) addresses activities related to the WAG 4 ROD (DOE-ID 2000b) and remedial design/remedial action as carried out within CFA under the purview of the CFA site area director.

1.2 Project Organization and Responsibility

The organizational structure for this work reflects the resources and expertise required to plan and perform the work, while minimizing risks to worker health and safety. The HASP (INEEL 2002) provides the job titles of the individuals who will be filling the key managerial roles and lines of responsibility and communication.

2. SITE BACKGROUND

2.1 Site Description

Located 51 km (32 mi) west of Idaho Falls, Idaho, the INEEL is a government-owned/contractor-operated facility managed by the DOE-ID (Figure 2-1). Occupying 2,305 km^2 (890 mi^2) of the northeastern portion of the Eastern Snake River Plain, the INEEL encompasses portions of five Idaho counties: (1) Butte, (2) Jefferson, (3) Bonneville, (4) Clark, and (5) Bingham.

The CFA has been used since 1949 to house many of the support services for all of the operations at the INEEL, including laboratories, security, fire protection, medical facilities, communication systems, warehouses, a cafeteria, vehicle and equipment pools, the bus system, and laundry facilities. The *Federal Facility Agreement and Consent Order* (FFA/CO) (DOE-ID 1991) identified 52 potential release sites at CFA, which were designated as WAG 4. The types of Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) sites at WAG 4 include landfills, underground storage tanks, aboveground storage tanks, dry wells, disposal ponds, soil contamination sites, and a sewage plant. Each of these sites was placed into one of 13 operable units within the WAG, based on similarity of contaminants, environmental release pathways, and/or investigations.

The CFA-04 pond is a shallow, unlined surface depression that was originally a borrow pit for construction activities at the CFA (Figure 2-2). It is approximately 46 × 152 m (150 × 500 ft) and roughly 2 to 2.4 m (7 to 8 ft) deep. Basalt outcrops are present within and immediately adjacent to the pond. It received laboratory wastes from the Chemical Engineering Laboratory (CEL) in Building CFA-674 between 1953 and 1969. The CEL was used to conduct calcine experiments on simulated nuclear wastes. The calcining process was later used on actual nuclear wastes at the INEEL to change them from a liquid to a solid and to effect an overall volume reduction. The CEL experiments used mercury to dissolve simulated aluminum fuel cladding as well as radioisotope tracers in the calcining process. The primary waste streams discharged to the pond from the CEL included approximately 76.5 m^3 (100 yd^3) of mercury-contaminated calcine that contained low-level radioactive wastes and liquid effluent from the laboratory experiments. In addition, there is approximately 382 m^3 (500 yd^3) of rubble consisting of laboratory bottles, asphalt and asbestos roofing materials, reinforced concrete, and construction and demolition debris. The pond received run-off from the CFA site periodically between 1953 and 1995.

2.2 Nature and Extent of Contamination

The CFA-04 pond was identified as a Track 2 investigation site in the FFA/CO (DOE-ID 1991). Visual inspections in 1994 revealed the presence of calcine on the bermed areas around the periphery of the pond. Following surface and subsurface soil data collection from the calcine and the pond berm in early and mid-1994, a time-critical removal action in September 1994 excavated approximately 218 m^3 (285 yd^3) of calcine and calcine-contaminated soil and a small amount of asbestos from the bermed area. The soil was remediated at a portable retort set up northeast of the pond. Verification soil sampling conducted after the removal action showed that with the exception of one location having a mercury concentration of 233 mg/kg, the bermed areas had residual mercury concentrations less than the final remediation goal of 8.4 mg/kg (DOE-ID 2000c).

The ROD (DOE-ID 2000b) originally established a final remediation goal of 0.5 mg/kg for mercury contamination at CFA-04. This was an ecological goal based on ten times the average background concentration for composite samples. It was determined that a re-evaluation of the final remediation goal for mercury was warranted for both human and ecological receptors after new information recently became available from EPA sources. Based on this new information, hazard quotients were recalculated for the existing concentration of mercury at the CFA-04 pond. For the future residential exposure scenario, the recalculated hazard quotient is 7.56 as compared to 80 from the ROD

(DOE-ID 2000b). For the ecological risk assessment, the recalculated values are < 1 to 210 as compared to < 1 to 30,000 from the ROD (DOE-ID 2000b). Based upon this new information, the recalculated remediation goals for ecological and human health are 8.4 mg/kg and 9.4 mg/kg, respectively. The recalculated remediation goals for both human health and ecological receptors are consistent with the remedial action objectives for the CFA-04 pond. This information will be presented in more detail in an Explanation of Significant Differences that is currently being prepared.

During the 1995 Track 2 investigation, additional soil samples were collected from the pond inlet area, as well as a deeper area of the pond near the inlet where laboratory effluent may have collected. The results of the 1994 and 1995 soil investigations revealed that concentrations of the following constituents exceeded background concentrations for the INEEL: aluminum, arsenic, barium, cadmium, calcium, chromium, cobalt, lead, magnesium, mercury, nickel, Cs-137, Pa-234m, Sr-90, Th-234, U-234, U-235, and U-238. Aroclor-1254 was also detected at low levels. Preliminary risk screening indicated that the following constituents detected at the pond posed potential human health risks: aroclor-1254, arsenic, mercury, Cs-137, U-234, U-235, and U-238. The range of detected concentrations of these analytes is presented in Table 2-1. Based upon these data, the site was recommended for further characterization in the Operable Unit (OU) 4-13 Remedial Investigation/Feasibility Study (RI/FS) (INEEL 1996a).

Table 2-1. Range of detected concentrations.

Analyte	Range of Detected Concentrations
Arsenic	3.1 to 22.4 mg/kg
Mercury	0.12 to 439 mg/kg
Cs-137	0.0742 to 2 pCi/g
U-234	0.651 to 22.6 pCi/g
U-235	0.0225 to 1.6 pCi/g
U-238	0.73 to 35 pCi/g

Additional soil samples were collected for the OU 4-13 RI/FS during 1997 and 1998 at four areas along the length of the pipe connecting the CEL to the pond, in the area northeast of the pond known as the windblown area, and from the pond bottom. Data from these investigations confirmed the presence of mercury in these areas at concentrations up to 439 mg/kg (DOE-ID 1992). Four of the 88 samples exceeded the mercury Resource Conservation and Recovery Act (RCRA) characteristic hazardous waste level of 0.2 mg/L. Three of the four samples were in close proximity to one another in the pond and the fourth was an isolated occurrence in the windblown area and was eliminated. A contour line was drawn around the three closely spaced samples and the area was estimated. The depth of the soil in the pond was conservatively estimated to be 2.4 m (8 ft) in the pond bottom and 0.15 m (0.5 ft) in the windblown area, indicating that approximately 612 m^3 (800 yd^3) of soil is potentially characteristic waste per RCRA and is subject to land disposal restrictions upon excavation.

The only contaminant that poses an unacceptable risk to human health and the environment is mercury. Mercury-contaminated soil is present in the pond bottom, around the pond periphery in the berms, along the pipe connecting the CEL to the pond, and in the area northeast of the pond as a result of windblown contamination, an area encompassing approximately 91 × 183 m (300 × 600 ft). The OU 4-13 RI/FS conservatively estimated the volume of mercury-contaminated soil to be approximately 6,338 m^3 (8,290 yd^3), based on the dimensions of the pond bottoms, windblown area, and pipeline at depths of 2.4 m (8 ft), 0.15 m (0.5 ft), and 1.8 m (6 ft), respectively. This volume was calculated using the extent of contamination based upon the original final remediation goal of 0.50 mg/kg for total mercury as stated in the ROD (DOE-ID 2000b). The final volume may differ based upon the revised final remediation goal of 8.4 mg/kg and actual conditions encountered in the field.

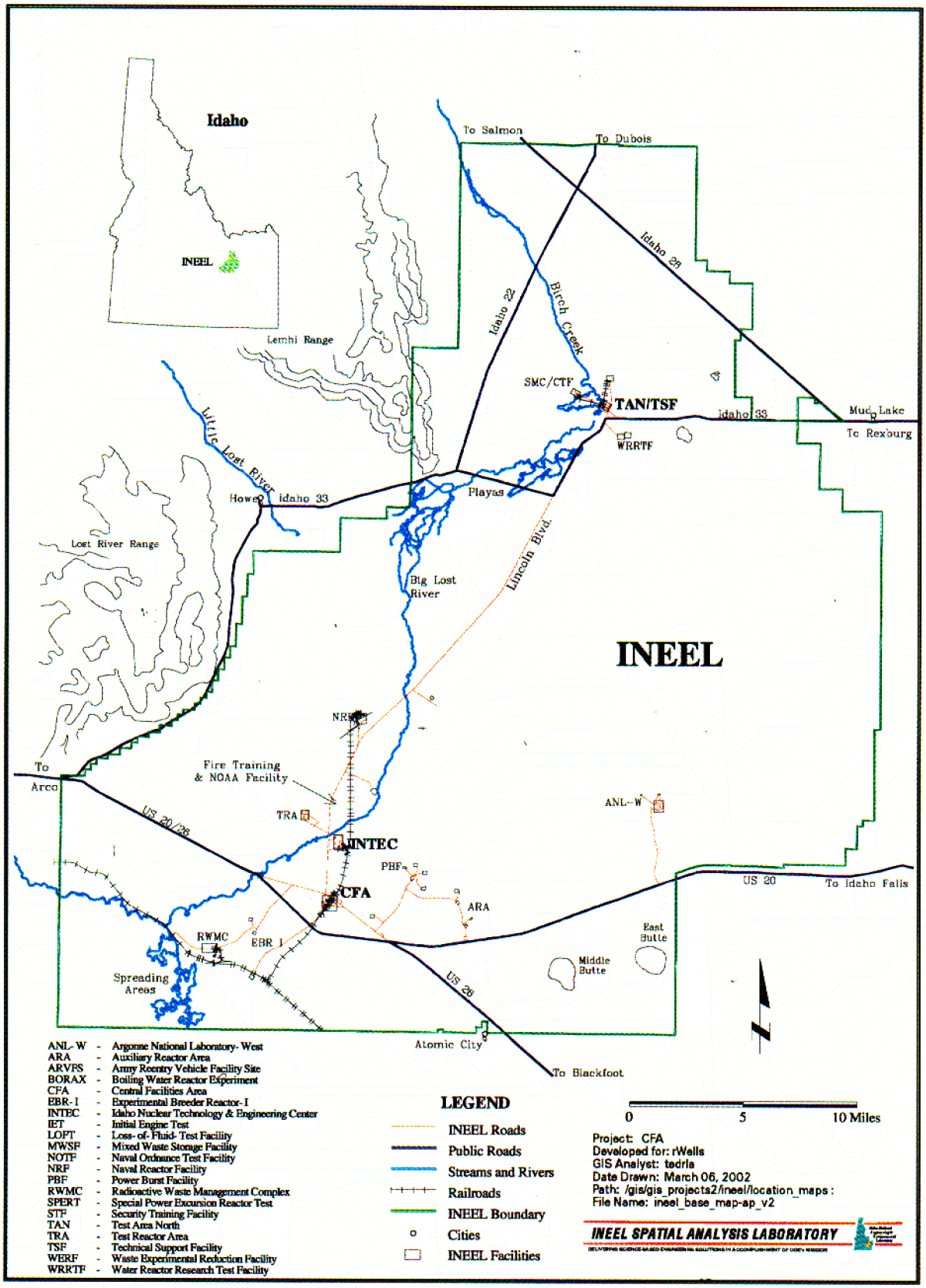

Figure 2-1. Idaho National Engineering and Environmental Laboratory.

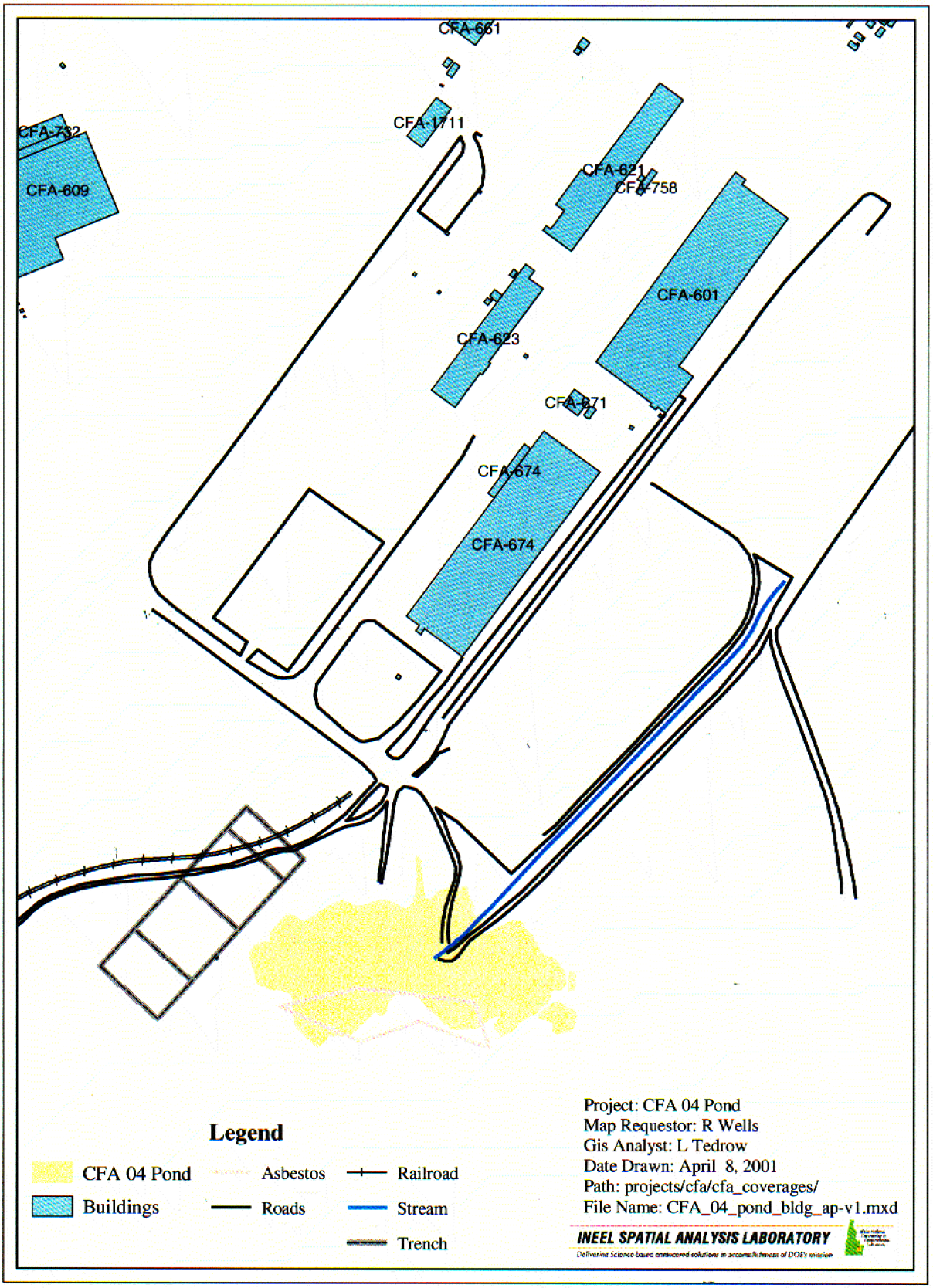

Figure 2-2. CFA-04 pond.

2.3 Project Description

Significant data have previously been collected defining much of the areal and vertical extent of mercury contamination in the CFA-04 pond (refer to Appendix A). Particularly, adequate information is available detailing the contamination levels in the pond surficial soils, much of the bermed area, and the surficial soils in the windblown area. However, data gaps still exist in the definition of the vertical extent of contamination in the pond area and the bermed area along the southern edges of the pond. To aid in the excavation of the soils during the remedial action in an effort to minimize the volume of contaminated soils requiring disposal, additional sampling is required for mercury analysis.

Chromium and silver have been detected in soil samples collected from the pond at maximum concentrations of 237 mg/kg and 121 mg/kg, respectively. Applying the 20X rule of dilution to the total metal results provides a conservative estimate of 11.8 mg/L and 6.0 mg/L, respectively, both of which exceed the characteristic limits of 5.0 mg/L for both chromium and silver. Therefore, it is necessary to determine whether any of the soils to be remediated for mercury contamination are characteristic for either chromium or silver as this will affect the final disposal pathway.

Likewise, there are some soils that exceed background concentrations for radionuclides. Of specific concern are those areas of the pond where mercury concentrations exceed the 260 mg/kg regulatory limit requiring treatment of the contaminated soils by retort (40 CFR 268.40). It must be determined whether those soils that potentially exceed this limit also contain radionuclides with concentrations exceeding background as this will also affect the final disposal pathway.

As it is the intent of the CFA-04 project to dispose of the contaminated soils at the INEEL CERCLA Disposal Facility (ICDF), data are required to support the waste acceptance criteria for that facility. The data generated from this sampling effort will be used to define a three-dimensional representation of the contamination zones within the CFA-04 pond that will ultimately be used to direct the excavation of the soils during the remedial action. This three-dimensional representation will describe the vertical extent of contamination within each zone allowing for the project to determine the required excavation depth within the areal boundary of a zone.

3. SAMPLING OBJECTIVES

Data needs and DQOs for conducting the proposed sampling at CFA-04 are defined in the following sections. Data needs have been determined through the evaluation of existing data and the projection of data requirements anticipated for the analysis of samples collected during the CFA-04 pre-remediation sampling effort.

3.1 Data Quality Objectives

The DQOs were developed following the seven-step process outlined in the *Guidance for the Data Quality Objectives Process* (EPA 1994). The DQOs developed in these sections provide the basis for the sampling to be performed. Section 4 provides a summary of the sampling locations, frequencies, and analytical requirements. The following team members contributed to this DQO process:

Stephen G. Wilkinson	WAG 4 Project Manager
Christine M. Hiaring	WAG 4 Deputy Project Manager
Douglas H. Preussner	WAG 4 Project Engineer
Deborah W. Wagoner	WAG 4 Technical Task Leader
Richard P. Wells	Advisory Scientist

3.1.1 Problem Statement

The objective of DQO Step 1 is to use relevant information to clearly and concisely state the problem to be resolved. There are two basic parts to the problem. First, the areal and vertical extent of the mercury contamination in the CFA-04 pond need to be refined to allow for better direction of the excavation effort during remediation of the site. Second, additional data are required to determine the final disposition paths for the soils to be excavated. The problem statements associated with this DQO process step are:

- Problem Statement 1—Extent of contamination: Refine the definition of the vertical extent of contamination to provide better direction for the remediation excavation effort.
- Problem Statement 2—Disposition pathways: Obtain data necessary to determine the final treatment and/or disposal of contaminated soils excavated from the CFA-04 pond.
- Problem Statement 3—Risk-based concentrations: Determine whether the assumptions used in calculating the preliminary remediation goals are valid.

3.1.2 Decision Identification

The goal of DQO Step 2 is to define the questions that the study will attempt to resolve and to identify the alternative actions that may be taken based on the outcome of the study. Alternative actions are those actions resulting from the resolution of the stated principal study questions (PSQs). The types of alternative actions considered depend on the answers to the PSQs. The PSQs and their corresponding alternative actions will then be joined to form decision statements. The PSQs, alternative actions, and resulting decision statements (DSs) for CFA-04 pre-remediation sampling are provided in Table 3-1.

Table 3-1. Summary of DQO Step 2 information.

PSQ #1—What are the vertical boundaries of the pond where the mercury concentrations exceed the final remediation goal of 8.4 mg/kg?			
Alternative Action	Error Associated with Incorrect Action	Consequences of Error	Severity of Consequences
The vertical contamination boundaries are properly defined delineating the extent of mercury contamination exceeding the remediation goal of 8.4 mg/kg.	Vertical contamination boundaries are erroneously determined to be smaller than should be.	Contaminated soils exceeding the remediation goal of 8.4 mg/kg lie outside the defined boundaries with soils exceeding the remediation goal remaining at the site following excavation.	Moderate
The vertical contamination boundaries are not properly defined delineating a larger extent of mercury contamination exceeding the remediation goal of 8.4 mg/kg.	Vertical contamination boundaries are erroneously determined to be larger than should be.	Contaminated soils exceeding the remediation goal of 8.4 mg/kg are well within the defined boundaries with soils not exceeding the remediation goals being excavated for disposal.	Moderate
DS #1—Verify and refine the vertical extent of mercury contamination in the CFA-04 pond.			
PSQ #2a—Do the soils exceed the TCLP[a] limits for mercury, chromium, or silver?			
Alternative Action	Error Associated with Incorrect Action	Consequences of Error	Severity of Consequences
Soils to be excavated are identified as being characteristic for mercury, chromium, or silver and stabilized for disposal in the ICDF.	Soils to be excavated are erroneously identified as being characteristic.	Soils are unnecessarily stabilized prior to disposal.	Moderate
Soils to be excavated are not identified as being characteristic for mercury, chromium, or silver and are direct-disposed in the ICDF.	Soils to be excavated are erroneously identified as not being characteristic.	Soils are inappropriately disposed of in the ICDF.	High
DS #2a—Based upon the analytical data, determine whether any of the key contaminants are RCRA-characteristic.			
PSQ #2b—Do the soils that exceed 260-mg/kg total mercury contain elevated concentrations of radionuclides?			

Table 3-1. (continued).

Alternative Action	Error Associated with Incorrect Action	Consequences	Severity of Consequences
Soils that exceed 260-mg/kg total mercury and are to be excavated are identified as containing elevated concentrations of radionuclides.	Soils exceeding 260-mg/kg total mercury and are to be excavated are erroneously identified as containing elevated concentrations of radionuclides.	Alternative disposal options are evaluated for treatment of the waste stream.	Moderate
Soils that exceed 260-mg/kg total mercury and are to be excavated are identified as not containing elevated concentrations of radionuclides.	Soils exceeding 260-mg/kg total mercury and are to be excavated are erroneously identified as not containing elevated concentrations of radionuclides.	Soils are sent to an off-Site retort treatment facility not licensed for radiologically contaminated materials.	High
DS #2b—Based upon the analytical data, determine whether any soils that are greater than 260-mg/kg total mercury also contain elevated levels of radionuclides.			
PSQ #3—What are the methyl mercury concentrations in the contaminated soils?			
Alternative Action	Error Associated with Incorrect Action	Consequences	Severity of Consequences
Methyl mercury concentrations are determined to be less than or equal to the concentration used in calculating the risk associated with the final remediation goal.	The methyl mercury concentrations are erroneously determined to be less than or equal to that used in determining the final remediation goal.	Risk associated with soils remaining at the site exceeds the final remediation goal.	High
Methyl mercury concentrations are determined to be greater than the concentration used in calculating the risk associated with the final remediation goal.	The methyl mercury concentrations are erroneously determined to be greater than that used in determining the final remediation goal.	The final remediation goal is recalculated requiring the excavation of soils that do not pose an unacceptable risk.	Moderate
DS #3—Based on the analytical data, determine whether the methyl mercury concentrations validate the assumptions used in calculating the risk-based concentrations.			

a. TCLP = toxicity characteristic leaching procedure

3.1.3 Identify Inputs to the Decision

The purpose of DQO Step 3 is to identify the type of data needed to resolve each of the decision statements identified in DQO Step 2. These data may already exist or may be derived from computational or surveying/sampling and analysis methods. Analytical performance requirements (e.g., practical quantitation limits [PQLs], precision, and accuracy) are also provided in this step for any new data that will be collected.

3.1.3.1 Information Required to Resolve Decision Statements. Table 3-2 specifies the information (data) required to resolve each of the decision statements identified in Section 3.1.2 and identifies whether these data already exist. For the data that are identified as existing, the source references for the data have been provided with a qualitative assessment as to whether the data are of sufficient quality to resolve the corresponding decision statement. The qualitative assessment of the existing data was based on the evaluation of the corresponding quality control (QC) data (e.g., spikes, duplicates, and blanks), detection limits, data collection methods, etc.

Table 3-2. Required information and reference sources.

DS #	Measurement Variable	Required Data	Do Data Exist?	Source Reference	Sufficient Quality?	Additional Information Required?
1	Mercury concentrations	Laboratory measurements of contaminant	Yes	RI/FS	No	Yes
2a	TCLP metal concentrations	Laboratory measurements of potential contaminants	Yes	RI/FS	No	Yes
2b	Radionuclide concentrations	Laboratory measurements of potential contaminants	Yes	RI/FS	No	Yes
3	Methyl mercury concentrations	Laboratory measurements of potential contaminant	No	—	No	Yes

3.1.3.2 Basis for Setting the Action Level. The action level is the threshold value that provides the criterion for choosing between alternative actions. For Decision Statement 1, the contaminant of concern is mercury. For Decision Statement 2a, the potential contaminants are mercury, chromium, and silver. For Decision Statement 2b, the potential contaminants are Cs-137, Pa-234m, Sr-90, Th-234, U-234, U-235, and U-238. For Decision Statement 3, the potential contaminant is methyl mercury. For Decision Statement 1, the basis for setting the action level is the final remediation goal of 8.4 mg/kg. For Decision Statement 2a, the basis is the maximum concentration of contaminants for the toxicity characteristic, as defined in 40 Code of Federal Regulations (CFR) 261.24, Table 1. For Decision Statement 2b, the bases for setting the action levels are the background concentrations at the INEEL, as found in the *Background Dose Equivalent Rates and Surficial Soil Metal and Radionuclide Concentrations for the Idaho National Engineering Laboratory* (INEEL 1996b). For Decision Statement 3, the basis for setting the action level is the risk-based concentration assuming 0.5% methylation of available mercury. The numerical values for the action levels are provided in DQO Step 5.

3.1.3.3 Computational and Survey/Analytical Methods. Table 3-3 identifies the decision statements where existing data either do not exist or are of insufficient quality to resolve the decision statements. For these decision statements, Table 3-3 presents computational and surveying/sampling methods that could be used to obtain the required data. For Decision Statements 1, 2b, and 3, analytical data will be collected to determine the total concentrations of contaminants. For Decision Statement 2a, analytical data will be collected following the prescribed extraction methodology for the toxicity characteristic. For Decision Statement 3, additional statistical analyses will be used to determine the correlation of the methyl mercury data set to the total mercury data obtained from the same samples, thereby allowing a direct comparison of methyl mercury to total mercury concentrations.

Table 3-3. Information required to resolve the decision statements.

DS #	Measurement Variable	Required Data	Computational Methods	Survey/Analytical Methods
1	Mercury	Total mercury concentrations in soils	Determine spatial mercury concentrations	Analytical laboratory determination of mercury concentrations in soils
2a	Mercury, chromium, and silver	TCLP metal concentrations in soils	Compare TCLP metal concentrations to the regulatory levels	Analytical laboratory determination of TCLP metal concentrations in soils
2b	Cs-137, Pa-234m, Sr-90, Th-234, U-234, U-235, and U-238	Radionuclide concentrations in soils	Compare radionuclide concentrations to background levels	Analytical laboratory determination of radionuclide concentrations in soils
3	Methyl mercury	Methyl mercury concentrations in soils	Determine methyl mercury concentrations	Analytical laboratory determination of methyl mercury concentrations in soils

3.1.3.4 Analytical Performance Requirements. Table 3-4 defines the analytical performance requirements for the data that need to be collected to resolve each of the decision statements. These performance requirements include PQL, precision, and accuracy requirements for each of the contaminants.

3.1.4 Study Boundaries

The primary objective of DQO Step 4 is to identify the population of interest, define the spatial and temporal boundaries that apply to each decision statement, define the scale of decision-making, and identify any practical constraints (hindrances or obstacles) that must be taken into consideration in the sampling design. Implementing this step ensures that the sampling design will result in the collection of data that accurately reflect the true condition of the site under investigation.

3.1.4.1 Geographic Boundaries. Limiting the geographic boundaries of the study area ensures that the investigation does not expand beyond the original scope of the task. This study will focus on the CFA-04 pond at WAG 4. Based upon a review of the existing data, the collections of samples from selected sites in this area will satisfy the decision statements defined for DQOs.

Table 3-4. Analytical performance requirements.

DS #	Analyte List	Survey/ Analytical Method	Preliminary Action Level	PQL	Precision Requirement	Accuracy Requirement
1	Mercury	SW-846	8.4 mg/kg	0.04 mg/kg	± 30%	70–130%
2a	TCLP mercury TCLP chromium TCLP silver	SW-846	0.2 mg/L 5.0 mg/L 5.0 mg/L	0.2 μg/L 10 μg/L 10 μg/L	± 20%	80–120%
2b	Cs-137 Pa-234m Sr-90 Th-234 U-234 U-235 U-238	Gamma Spec Gamma Spec GFPC[a] Gamma Spec Alpha Spec Alpha Spec Alpha Spec	0.44 pCi/g 1.04 pCi/g[b] 0.26 pCi/g 1.04 pCi/g[b] 1.03 pCi/g 0.048 pCi/g[c] 1.04 pCi/g	0.1 pCi/g d 0.1 pCi/g d 0.05 pCi/g 0.05 pCi/g 0.05 pCi/g	± 30%	70–130%
3	Methyl mercury	SW-846 (modified)	0.042 mg/kg	0.04 mg/kg	± 30%	70–130%

a. GFPC = gas-flow proportional counting.

b. The action level was determined based upon the assumption that Pa-234m and Th-234 would be in secular equilibrium with U-238.

c. The action level was calculated based upon the naturally-occurring isotopic ratio of U-235 to U-238 and the average concentration of U-238 in INEEL soils.

d. Based on Cs-137, all other gamma-emitting isotopes have a detection limit commensurate with their photon yield and energy as related to the Cs-137 detection limit.

3.1.4.2 Temporal Boundaries. The temporal boundary refers to the time frame to which each decision statement applies (e.g., number of years) and when (e.g., season, time of day, weather conditions) the data should optimally be collected. Temporal boundaries are important when contaminant concentration changes over time are significant. There is no temporal component to the CFA-04 pond pre-remediation sampling, although it could be argued that sampling during the hotter summer months or those months during which soil moisture levels are higher could adversely affect the analytical results. Sampling will be conducted in late spring/early summer allowing for soils to dry following the spring run-off and prior to the hotter months of summer.

3.1.4.3 Scale of Decision-Making. The scale of decision-making is defined by joining the population of interest and the geographic and temporal boundaries of the area under investigation. For the CFA-04 pre-remediation sampling, the scale of decision-making is the same as the geographic boundary defined in Section 3.1.4.1.

3.1.4.4 Practical Constraints. Practical constraints may include physical barriers, difficult sample matrices, high radiation areas, or any other condition that will need to be taken into consideration in the design and scheduling of the sampling program. For the CFA-04 pre-remediation sampling, there are no practical constraints to be considered.

3.1.5 Develop a Decision Rule

The purpose of DQO Step 5 is initially to define the statistical parameter of interest (mean, 95% upper confidence level, etc.) that will be used for comparison against the action level. Table 3-5 summarizes the decision rules (DRs) for the two decision statements provided in Section 3.1.2. These DRs summarize the attributes the decision-maker needs to know about the sample population and how this knowledge will guide the selection of a course of action to solve the problem.

Table 3-5. Decision rules.

DS #	DR #	Decision Rule
1	1	**If** the mercury concentrations for soil samples collected in the pond exceed the final remediation goal of 8.4 mg/kg, **then** soils will be excavated. Otherwise, the soils will be left in place.
2a	2a	**If** the TCLP concentrations for any of the three contaminants exceed the RCRA toxicity characteristic levels defined in 40 CFR 261.24, **then** the contaminated soils will require stabilization prior to disposal. Otherwise, the soils will be directly disposed of at the ICDF without stabilization.
2b	2b	**If** the concentrations of any of the radionuclides exceed the INEEL background concentrations, **then** an alternative disposal option will be identified for those soils requiring treatment by retort. Otherwise, the soils will be disposed of at the ICDF.
3	3	**If** the methyl mercury concentrations of soil samples collected in the pond exceed the assumed concentrations used in the risk estimates, **then** the final remediation goal for mercury will need to be recalculated. Otherwise, a final remediation goal of 8.4 mg/kg will be used.

3.1.6 Decision Error Limits

Because analytical data can only estimate the true condition of the site under investigation, decisions that are made based on measurement data could potentially be in error (i.e., decision error). For this reason, the primary objective of DQO Step 6 is to determine which decision statements (if any) require a statistically-based sample design. The purpose of determining the decision error limits is to specify the decision-maker's tolerable limits on decision errors, which are used to establish performance goals for the data collection design.

Tolerable error limits assist in the development of sampling designs to ensure that the spatial variability and sampling frequency are within specified limits. However, the sampling design for the CFA-04 pre-remediation sampling is determined by sample locations and concentrations of the historical sampling events. The selection of the collection locations for the pre-remediation sampling is based on professional judgment rather than statistics. Therefore, error limits are not used in determination of sampling locations or frequency.

The decision statements defined herein will be resolved using a non-statistical design. Therefore, there is no need to define the "gray region" or the tolerable limits on the decision error, since these only apply to statistical designs.

3.1.7 Optimize the Design

The objective of DQO Step 7 is to present alternative data collection designs that meet the minimum data quality requirements, as specified in DQO Steps 1 through 6. A selection process is then used to identify the most resource-effective data collection design that satisfies all of the data quality requirements.

For the CFA-04 mercury pond, sampling will occur within zones established throughout the area. The objective is to obtain analytical results that are representative of the average contaminant concentrations in each zone. Therefore, four core samples will be collected within each zone with subsamples of each core composited to provide analytical samples that are representative of specified depths. This will allow for a determination of average contamination by depth in a zone and provide a concentration gradient for the zone. Ultimately, the information obtained for each of the zones will be used to delineate the depth and areas for excavation in a three-dimensional fashion allowing for treatment and disposal of the soils based upon these analytical data. More specifically, soils will be excavated to below the deepest interval that is greater than the final remediation goal. The excavated soil waste characteristics will be determined by averaging the composited zone results for each applicable 30-cm (1-ft) interval.

The operational details, rationale, and approach for the final selected sampling design are provided in Table 3-6.

Table 3-6. Operational details of sampling.

Pre-Remediation Sampling Phase	
Media	Soils
Method of Analysis	Laboratory analyses
Sampling Method	Collect four continuous core samples within specified zones and composite analytical samples representing each 30-cm (1-ft) interval within the zone.
Implementation Design	Divide the CFA-04 pond into 13 zones. The size of each zone is based on historical mercury analytical data. Divide each zone into four quadrants obtaining a continuous core sample from each quadrant. Composite the samples from the cores that are representative of each 30-cm (1-ft) interval of the cores. Submit the composite samples for the specified analyses.
Rationale	Dividing the pond into zones based on historical analytical data will allow for decisions to be made regarding waste disposition for soils within discrete zones. Submission of composite samples will reduce analytical costs.

3.2 QA Objectives for Measurement

The quality assurance (QA) objectives for measurement will meet or surpass the minimum requirements for data quality indicators established in the QAPjP (DOE-ID 2000a). This reference provides minimum requirements for the following measurement quality indicators: precision, accuracy, representativeness, completeness, and comparability. Precision, accuracy, and completeness will be calculated per the QAPjP (DOE-ID 2000a).

3.2.1 Precision

Precision is a measure of the reproducibility of measurements under a given set of conditions. In the field, precision is affected by sample collection procedures and by the natural heterogeneity encountered in the environment. Overall precision (field and laboratory) can be evaluated by the use of duplicate samples collected in the field. Greater precision is typically required for analytes with very low action levels that are close to background concentrations.

Laboratory precision will be based upon the use of laboratory-generated duplicate samples or matrix spike/matrix spike duplicate samples. Evaluation of laboratory precision will be performed during the method data validation process.

Field precision will be based upon the analysis of collected field duplicate or split samples. For samples collected for laboratory analyses, a field duplicate will be collected at a minimum frequency of 1 in 20 environmental samples.

3.2.2 Accuracy

Accuracy is a measure of bias in a measurement system. Laboratory accuracy is demonstrated using laboratory control samples, blind QC samples, and matrix spikes. Evaluation of laboratory accuracy will be performed during the method data validation process. Sample handling, field contamination, and the sample matrix in the field affect overall accuracy. To assess false positive or high-biased sample results, the results from field blanks and equipment rinsates will be evaluated.

3.2.3 Representativeness

Representativeness is a qualitative parameter that expresses the degree to which the sampling and analysis data accurately and precisely represent the characteristic of a population parameter being measured at a given sampling point or for a process or environmental condition. Representativeness will be evaluated by determining whether measurements are made and physical samples are collected in such a manner that the resulting data appropriately measure the media and phenomenon measured or studied. The comparison of all field and laboratory analytical data sets obtained throughout this remedial action will be used to ensure representativeness.

3.2.4 Detection Limits

Detection limits will meet or exceed the risk-based or decision-based concentrations for the contaminants of concern. Detection limits will be as specified in the Sampling and Analysis Management (formerly the Sample Management Office) laboratory Master Task Agreement statements of work, task order statements of work, and as described in the QAPjP (DOE-ID 2000a).

3.2.5 Completeness

Completeness is a measure of the quantity of usable data collected during the field sampling activities. The QAPjP (DOE-ID 2000a) requires that an overall completeness goal of 90% be achieved for non-critical samples. If critical parameters or samples are identified, a 100% completeness goal is specified. Critical data points are those sample locations or parameters for which valid data must be obtained in order for the sampling event to be considered complete.

The end use of the data generated as a result of this sampling activity serves three purposes as discussed in Section 3.1.1. Because one of the primary purposes of the data is to determine the final disposition of the soils, the data will be considered critical with a completeness goal of 100%.

3.2.6 Comparability

Comparability is a qualitative characteristic that refers to the confidence with which one data set can be compared to another. At a minimum, comparable data must be obtained using unbiased sampling designs. If sampling designs are not unbiased, the reasons for selecting another design should be well documented. Data comparability will be assessed through the comparison of all data sets collected during this study using the following parameters:

- Data sets will contain the same variables of interest
- Units will be expressed in common metrics
- Similar analytical procedures and QA will be used to collect data
- Time of measurements of variables will be similar
- Measuring devices will have similar detection limits
- Samples within data sets will be selected in a similar manner
- Number of observations will be of the same order of magnitude.

3.3 Data Validation

Method data validation is the process whereby analytical data are reviewed against set criteria to ensure that the results conform to the requirements of the analytical method and any other specified requirements. All of the laboratory-generated analytical data will be reviewed per INEEL Guide (GDE)-7003, "Levels of Analytical Method Data Validation." A cursory review of the laboratory data will be performed to ensure that contractual requirements have been met.

Field-generated data will not be validated. Quality of the field-generated data will be ensured through adherence to established operating procedures and use of equipment calibration, as appropriate.