

## RCRA CLOSURES AT ROCKY FLATS PLANT A PROGRAMMATIC PERSPECTIVE AND CASE STUDY

Randy T. Ogg and Bruce D. Peterman  
EG&G Rocky Flats, Inc  
Golden, Colorado

### ABSTRACT

The Interagency Agreement (IAG) integrates a unique mechanism for remediating hazardous waste sites at the Rocky Flats Plant (RFP), which include utilizing RCRA and CERCLA technical/regulatory processes.

Pursuant to the IAG signed by the Department of Energy (DOE), Environmental Protection Agency (EPA), and the Colorado Department of Health (CDH) on January 22, 1991, sixteen operable units (OUs) were defined for characterization and remediation at RFP (1). Of the sixteen OUs, six are classified as Resource Conservation and Recovery Act (RCRA) closure units. The six RCRA interim status closure units are: Solar Evaporation Ponds-OU 4, Present Landfill-OU 7, Original Process Waste Lines-OU 9, Other Outside Closures-OU 10, West Spray Field-OU 11, and Inside Building Closures-OU 15. The IAG will function as a technical/regulatory mechanism for managing/complying with all aspects of the RCRA interim status closure units at RFP.

### INTRODUCTION

The Rocky Flats Plant (RFP) is a Government-owned, contractor-operated facility, part of the nationwide nuclear weapons complex which began operations in 1952. Operations at the plant consist of fabrication of nuclear weapons components from plutonium, uranium, and other nonradioactive metals. The plant is managed and operated by EG&G Rocky Flats, Inc. (EG&G), a contractor to the Department of Energy (DOE).

RFP is located in northern Jefferson County, Colorado, approximately 16 miles northwest of Denver along the eastern edge of the southern Rocky Mountain region immediately east of the Colorado Front Range (2). The RFP consists of approximately 6,550 acres of federal land, 400 acres being the Protected Area and 6,150 acres being other industrial areas and the Buffer Zone (Fig. 1).

Pursuant to the RFP Interagency Agreement (IAG) signed by DOE, the Environmental Protection Agency (EPA), and Colorado Department of Health (CDH) on January 22, 1991, sixteen operable units (OUs) were defined for characterization and remediation at RFP. Of the sixteen OUs, six are interim status Resource Conservation and Recovery Act (RCRA) closure units. In accordance with the IAG, the interim status RCRA closure units external to buildings (OUs 4, 7, 9, 10 and 11) will be assessed/remediated in two phases. Phase I addresses the sources and soils and Phase II addresses ground water, surface water, air, the environment and biota. The IAG requires RFP to integrate applicable RCRA and Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) requirements for all environmental related activities associated with the IAG, including RCRA closure units.

### INTERAGENCY AGREEMENT

Rocky Flats IAG, signed by DOE, EPA and CDH on January 22, 1991, will function as a technical/regulatory mechanism for managing/complying with all aspects of RCRA interim status closure units at RFP. The IAG dictates the regulatory framework for ensuring compliance and managing RCRA closure units, which include RCRA 40 CFR Part 265/Colorado Hazardous Waste Act (CHWA) regulations (6

CCR 1007-3 ) Part 265 Subpart G Closure and Post-Closure (Part 264), Part 265 Subpart F Ground Water Monitoring, corrective action requirements of sections 3004(u) and (v) of RCRA, and CERCLA and the National Contingency Plan (NCP) (1). Although the state of Colorado/CDH has primacy for all RCRA closure units at RFP, the IAG requires applicable CERCLA regulations/guidance to be integrated as part of the closure process, including Applicable or Relevant and Appropriate Requirements (ARARs), Baseline Risk Assessments (BRA), and Environmental Evaluations (EE).

### RESOURCE CONSERVATION AND RECOVERY ACT CLOSURE UNITS

#### Operable Unit 4-Solar Evaporation Ponds

RFP has operated the Solar Evaporation Ponds (SEPs), located in the Protected Area (PA), for the disposal of miscellaneous wastes since 1953 however, process wastes have not been placed in the ponds since mid-1986. They have been used primarily to store and treat (by evaporation) low-level radioactive waste, hazardous waste, sanitary waste and non-hazardous wastes. The SEPs consists of five impoundments identified as ponds 207-A, 207-B North, Center, and South, and pond 207-C, with a total capacity of 10.7 million gallons and a surface area of approximately 6 acres (2).

An Interceptor Trench (french drain) System (ITS) was installed down-gradient of the SEPs to collect and pump back contaminated ground water as a result of leakage from the SEPs. The primary purpose of this system is to prevent contaminants from entering into North Walnut Creek via ground water flow. Since the SEPs are currently under closure, additional measures are being implemented to manage the contaminated ground water.

In accordance with 6 CCR 1007-3 Part 265.93(d), ground water monitoring is required and being conducted at the SEPs. Currently, there are 62 wells that are monitored in the SEPs area (3). There are 29 alluvial wells, 14 screened in the Rocky Flats alluvium, 9 in colluvium, and 6 in valley fill alluvium (3). Bedrock wells total 33 (3). Sixteen wells are screened in weathered claystone, 7 in weathered sandstone, and 10 in unweathered sandstone (3). Ground water sampling data and hydrogeologic investigations have indicated that the

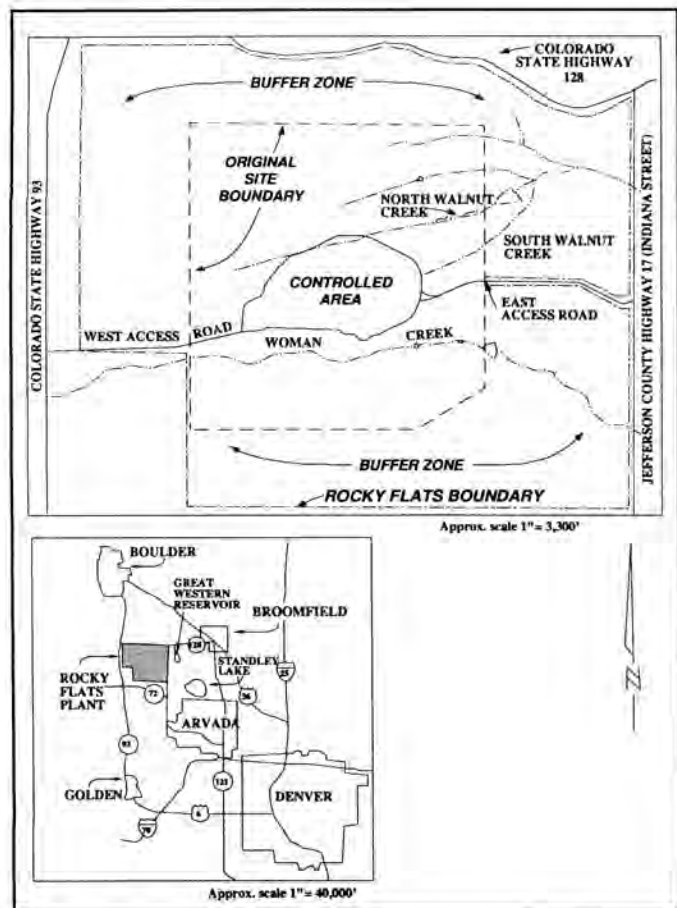


Fig. 1. Rocky Flats location maps.

SEPs have contaminated alluvial ground water. Down-gradient contaminants from the SEPs include: some major ions, nitrates, uranium, tritium, and some metals. Volatile organic contamination is limited and may not be a result of the SEPs. Ground water in shallow bedrock in hydraulic connection with the alluvium has also been impacted by the SEPs based on ground water sampling data.

#### Operable Unit 7-Present Landfill

The Present Landfill-Operable Unit 7 is located north of the plant complex on the western end of an unnamed tributary of North Walnut Creek and is comprised of Individual Hazardous Substance Site (IHSS) 114 (landfill) and Inactive Hazardous Waste Storage Area-IHSS 203 (4). The landfill became operational in August 1968 and was originally constructed to provide for disposal of RFP's nonradioactive and nonhazardous solid wastes. In September 1973, tritium was detected in leachate from the landfill (4). During the mid-1980's, extensive investigations were conducted on the waste streams being disposed into the landfill, and consequently, hazardous wastes/hazardous constituents were identified (4). Because records indicate that hazardous waste was disposed at the landfill, it was designated a RCRA Subtitle C regulated unit in 1986.

A RCRA ground water monitoring program has been implemented at the Present Landfill in accordance with 6 CCR 1007-3 Part 265 Subpart F 265.90(d).

#### Operable Unit 9-Original Process Waste Lines

The Original Process Waste Lines (OPWL)-Operable Unit 9 consists of a system of underground pipelines and associated tanks constructed to transport and temporarily store process wastes. The OPWL system became operational in 1952 with numerous additions to the system through 1975 (5). The OPWL was replaced during the 1975-1983 time period by the new process waste system (5). The OPWL transported and/or stored various aqueous process wastes containing low-level radioactive materials, nitrates, caustics and acids. Other liquids were also introduced into the system, including pickling liquor from foundry operations, medical decontamination fluids, miscellaneous laboratory liquids and laundry effluent (5).

Pipe sections of OPWL have an approximate length of 35,000 feet. Approximately 13,000 feet of the pipes are located beneath buildings and a similar amount are located within areas where other utility lines are interwoven with the system (5). At several locations, active and inactive utility lines have been placed in the same trenches adjacent to the OPWL, which has resulted in congestion of numerous underground lines at several locations.

#### Operable Unit 10-Other Outside Closures

Other Outside Closures (OOC)-Operable Unit 10 is comprised of sixteen individual hazardous substance sites (IHSS) at various locations of RFP. In general, OOC consists of a variety of IHSSs, including: radioactive/hazardous waste storage tanks, cargo container storage facilities, acid dumpsters/sumps, and mixed/hazardous waste drum storage units (6). The two substantial IHSS in OU 10 include the 750 and 904 pads which are being utilized to store pondcrete and saltcrete.

#### Operable Unit 11-West Spray Field

The West Spray Field (WSF)-Operable Unit 11 is undeveloped land within the Buffer Zone located on the west side of the Plant and consists of approximately 105 acres.

The WSF operated from April 1982 through October 1985 (7). During operations, excess liquids from the Solar Evaporation Ponds (SEPs) were pumped to the WSF for spray application. The total combined area of direct application is approximately 14 acres. Liquids applied in the WSF were derived from SEPs 207-B North and 207-B Center. Approximately 66,000,000 gallons of waste-water were applied at the WSF during operation (7). Of this quantity, approximately 9,000,000 gallons were taken from Pond 207-B North, and 57,000,000 gallons were taken from Pond 207-B Center (7).

The contents in Pond 207-B North during operation of the WSF generally consisted of ground water collected in the Interceptor Trench System (ITS) located downgradient of the SEPs. The liquid collected in Pond 207-B North is characterized typically by high nitrate concentrations, elevated gross alpha, gross beta, uranium, and trace levels of volatile organic compounds (VOC's). The liquid contained in Pond 207-C Center consisted of treated sanitary effluent from RFP sanitary waste-water treatment plant (7). The sanitary effluent was characterized by elevated nitrates, gross alpha and gross beta (7).

The WSF is subject to RCRA ground water monitoring requirements in accordance with 6 CCR 1007-3 Part 265 Subpart F. Twenty alluvial wells and three bedrock wells are sampled quarterly at the WSF to comply with CHWA ground water regulations (3).

#### **Operable Unit 15-Inside Building Closures**

Inside Building Closures (IBC)-Operable Unit 15 is comprised of eight RCRA interim status closure units. IBC units consists primarily of mixed and/or hazardous waste drum storage areas. These units contained a variety of wastes including: oils, coolants, solvents, low-level radioactive wastes, waste paints and metals. RCRA closure plans have been developed for these units, and in addition, an RFI/RI work plan will be prepared to evaluate the sub-surface environmental media adjacent to the IBC units.

### **INTERAGENCY AGREEMENT RCRA CLOSURE PROCESS**

#### **Phase I**

For RCRA interim status closure units external to buildings (OUs 4, 7, 9, 10, and 11), the regulatory process entails two phases. The first step in Phase I requires the development of "Phase I RFI/RI Work Plans" which are designed to characterize the sources and soils of each interim status unit and provide the information necessary to determine the risk associated with the source of contamination at each closure unit (1). The second step requires the implementation of the approved Phase I RFI/RI Work Plan in accordance with the IAG schedule and, subsequent data validation. Following data validation, a "Phase I RFI/RI Report" is generated which is used by the regulatory agencies to identify additional work/investigations to be performed, if applicable, and provide information to support a "draft Baseline Risk Assessment" (1). Subsequent to approval by the regulatory agencies for the Phase I RFI/RI Reports, a "draft Proposed Phase I Interim Measure/Interim Remedial Action (IM/IRA) Decision Documents" will be prepared for regulatory review. The draft proposed Phase I IM/IRA Decision Documents will be designed to provide the information required to recommend an alternative consistent with the State of Colorado hazardous waste closure regulations (1). The draft Proposed Phase I IM/IRA Decision Document will address all hazardous substance source areas with risk levels greater than  $1 \times 10^{-6}$  evaluated at the source, and require the remediation of all source areas exhibiting risk levels greater than  $1 \times 10^{-6}$  evaluated at the source. Subsequent steps to the approved IM/IRA Decision Document include, engineering design work plans (title I and II), IM/IRA Implementation Documents, and construction activities (1).

#### **Phase II**

The first step in Phase II requires the development of "Phase II RFI/RI Work Plans" which will be designed to evaluate (nature and extent of contamination) the subsequent impact of each interim status closure unit on surface water, ground water, air, and biota. The second step, as with Phase I, requires the implementation of the approved Phase II RFI/RI Work Plans in accordance with the IAG schedule and, subsequent data validation. Following data validation, a Phase II RFI/RI Report is generated which evaluates the IM/IRA

implemented at each source, as appropriate, and will include draft comprehensive Baseline Risk Assessments (1). The draft comprehensive Baseline Risk Assessments will evaluate risk associated with both the sources and the resultant environmental contamination. The draft Phase II RFI/RI Reports will be used by the regulatory agencies to evaluate the need for conducting additional field work/investigations and provide the information to be used to support the draft "Phase II Corrective Measure Study/Feasibility Study (CMS/FS) Reports" (1). The draft Phase II CMS/FS Reports will evaluate corrective/remedial measures to address both the sources and contamination resulting from the sources, and consequently, a "Phase II Corrective and Remedial Action Proposed Plan" will be developed (1). Following approval of the Phase II Corrective and Remedial Action Plan, a "Phase II Corrective Action Decision/Final Action Decision" document, "Phase II Corrective/Remedial Design" document, and "Phase II Corrective/Remedial Action" plan will be prepared (1).

### **OPERABLE UNIT NUMBER 4 (Case Study)**

#### **Abstract**

Operable Unit Number 4 (OU 4), the Solar Evaporation Ponds (SEPs), is one of 16 Operable Units listed in the IAG signed by EPA, CDH, and the DOE (1). The SEPs were once used to store and treat (by evaporation) the majority of the Rocky Flats Plant's liquid process waste. These ponds were used from 1952 through mid-1986 and received low-level radioactive waste, hazardous waste, sanitary waste, and non-hazardous wastes. The SEPs consist of five separate surface impoundments with a total capacity of 10.7 million gallons and a surface area of approximately 6 acres (2). The SEPs have leaked over the years and as a result a Interceptor Trench (french drain) System (ITS) was installed downgradient of the SEPs to prevent discharge of contaminated ground water to North Walnut Creek. The ITS collects approximately 4 million gallons of water per year and the water is currently pumped back into the SEPs for storage and treatment.

The SEPs are RCRA interim status regulated units that are presently undergoing RCRA partial closure and Phase I RFI/RI activities. The RCRA partial closure activities consist of an accelerated clean up schedule for the SEPs which includes removal of remaining pond liquids and solidification of pond sludges. The Agreement in Principle (AIP) signed by DOE and the state of Colorado is the primary regulatory driver for the accelerated clean up (8). For accelerated activities to proceed, contaminated ground water and surface water collected by the ITS and transferred to the SEPs needs to be terminated. Thus, an Interim Measure/Interim Remedial Action document (9) was prepared in September, 1991 to address alternate storage and treatment of contaminated waters collected by the ITS. The Phase I RFI/RI activities are specified in the IAG to "characterize the source/soils of each interim status unit which shall provide the information necessary to determine the risk associated with the source of contamination" (1). The Draft Final Phase I RFI/RI Work Plan for OU 4 has been submitted to the regulatory agencies for review and work is scheduled to begin in February 1992 (2).

## INTRODUCTION

Operable Unit Number 4 (OU 4), the Solar Evaporation Ponds (SEPs) were identified as RCRA regulated units in the summer of 1986 during RCRA Part B permitting activities for the RFP. Shortly thereafter, a RCRA Closure Plan was developed for SEPs (10). The Closure Plan was revised in 1987 and 1988, in accordance with regulatory agency comments.

On June 28, 1989, the DOE and the state of Colorado entered into the Agreement in Principle (AIP). The AIP identified certain contaminated sites at RFP that would require special and accelerated remedial actions. The AIP in part specifies that DOE will expedite cleanup of the SEPs in order to further prevent harmful contaminants from impacting soil and ground water (8).

On January 22, 1991, the DOE, EPA, and the CDH entered into the Interagency Agreement (IAG). The IAG program (1) establishes the work and schedule requirements for all Operable Units (OUs) at RFP. The IAG requires general compliance with both RCRA and CERCLA, thus a combined RCRA Facility Investigation (RFI)/Remedial Investigation (RI) approach is utilized for the SEPs. Individual hazardous substance sites (IHSS) identified in the IAG are grouped into Operable Units (OUs) for investigatory purposes. OU 4 consists of only IHSS number 101 (Fig. 2). The scheduled tasks defined within the IAG supersede all previous closure activities at the RFP. CDH is the lead agency for this investigation because it has RCRA authorization and the SEPs were initially identified as a RCRA facility.

A IM/IRA Decision Document was developed in September 1991 for RCRA partial closure activities for the SEPs. This IM/IRA provides an alternative means of storage for ground water collected by the ITS, identifies a treatment method for the contaminated ground water, and enables accelerated clean out of the SEPs according to the AIP signed by the DOE and the State of Colorado.

The first Draft Phase I RFI/RI Work Plan was submitted to the regulatory agencies in June 1990 and comments were received from EPA and CDH in September 1991. A draft final of the work plan incorporated agency comments and was submitted to the agencies on November 26, 1991. The agencies

completed review on January 6, 1991 and the work plan should be approved by February 5, 1992.

## BACKGROUND

There are five surface impoundments which comprise the Solar Evaporation Ponds which were designed to store and treat (by evaporation) the majority of the RFP's liquid process waste (Fig. 2). These ponds are presently inactive and undergoing RCRA closure. The ponds were used from 1953 though mid-1986 to store radioactive wastes from industrial operations at the plant. The wastes typically consisted of treated acidic wastes (e.g. nitric, hydrochloric, and sulfuric acid) sodium nitrate, plating solutions (cyanide and hexavalent chromium), and sanitary effluent. Solvents and organic compounds have not been routinely discharged to the ponds as it was believed that these compounds would promote algal growth and diminish solar evaporation (10).

The OU 4 area consists of one unnamed original pond and five surface impoundments identified as ponds 207-A, 207-B (North, Center, South), and 207-C with a total capacity of 10.7 million gallons and a surface area of approximately 6 acres (Fig. 2). The original pond was constructed in 1953 and used continuously through 1956, when regular use was discontinued. The original pond has since been covered and several buildings and the 207-C pond were built over the area. Pond 207-A was placed in service in August 1956 and is 3 acres in size. The pond was most recently cleaned out in 1985 and the remaining liquid (approximately 1 million gallons) and sediment is the result of precipitation and wind blown particulates. Ponds 207-B North, Center, and South were placed in service in June 1960. Each pond is approximately 1 acre in size. The 207-B ponds continue to be used for storage and treatment of intercepted ground water and surface water collected by the ITS. Pond 207-C was placed in service in December 1970 to provide additional storage capacity and to allow transfer and storage of liquids from the other ponds in order to perform routine pond repair work.

In response to nitrate contamination discovered in North Walnut Creek, a series of trenches and sumps were installed north of the SEPs from the period of 1971 to 1974. The trenches and sumps collected seepage and ground water and returned the water to the SEPs. Operations continued until 1980 when the trenches were replaced by a more extensive french drain system or Interceptor Trench System (ITS). The ITS is currently in use. Water entering the ITS gravity feeds to a central pump house where the water is collected and then pumped back into the 207-B North pond.

Since the detection of nitrate contamination downgradient of the SEPs, several previous investigations have been conducted around the solar pond area. These investigations included geotechnical, hydrogeologic, and surface water characterization. Geotechnical investigations were performed in the 1970's and focused on landslide risk potentials and foundation siting (2). Fifteen 15 soil borings were drilled for the geotechnical evaluations and information about ground water elevations were collected. Hydrogeologic information was collected in 1975 from drilling 31 soil borings. Samples from the borings were used to identify key contaminants from the solar ponds (2). The closure plan for the SEPs was developed in 1986 and included information regarding past uses, waste inventory, and treatment and disposal techniques. The plan was revised in 1987 and again in 1988 (10).

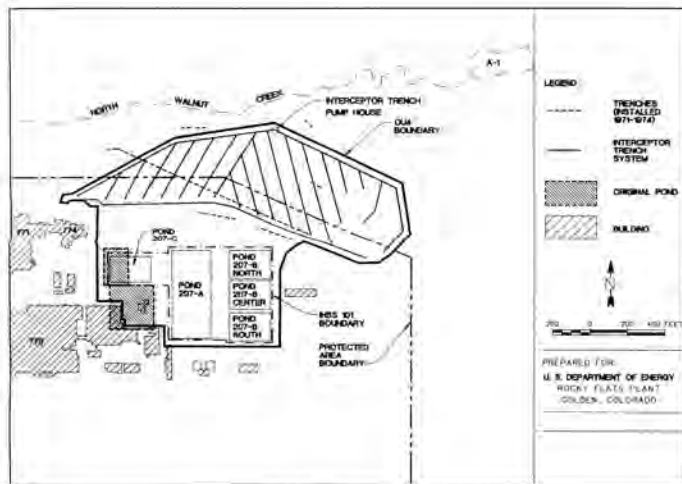


Fig. 2. Major features in the solar evaporation pond area.

Since 1986, several monitoring well installation programs have been implemented to meet RCRA ground water compliance standards. Currently, there are 62 wells that are monitored in the SEPs area. Sampling and analysis of the wells are reported in annual RCRA ground water monitoring reports (3). The results of these previous investigations were evaluated to determine data gaps and the need for additional requirements for the Phase I RFI/RI project.

#### INTERIM MEASURE/INTERIM REMEDIAL ACTION

The SEPs have leaked over the years and as a result the ITS was installed downgradient of the SEPs to collect and pump contaminated ground water back into the SEPs. The ITS was constructed to prevent contaminated ground water from migrating into North Walnut Creek (Fig. 2). The ITS collects ground water and surface runoff at a rate of approximately 4 million gallons per year and recycles the collected water back into the SEPs.

The Interim Measure/Interim Remedial Action (IM/IRA) Decision Document dated September 1991 is intended to facilitate implementation of the SEPs RCRA partial closure actions per the AIP (8). The objectives of this IM/IRA are to cease the addition of intercepted water to the SEPs and remove excess liquids from the SEPs as expeditiously as possible in order to proceed with closure of the ponds consistent with State and federal laws, the IAG, and the AIP (9).

The major components of the IM/IRA selected remedy include three 500,000 gallon modular tanks to contain and transfer water collected by the ITS, and three portable flash evaporators to treat excess liquids within the SEPs and ITS collected water (9).

Implementation of the IM/IRA activities are scheduled for March 1992 contingent upon EPA and CDH approval.

#### PHASE I RFI/RI WORK PLAN

OU 4 is one of several RCRA units for which a Phase I RFI/RI Work Plan is required. The work plan has been formatted to incorporate both RCRA and CERCLA regulations/guidance in order to meet the requirements of the IAG.

The format of the OU 4 Phase I RFI/RI Work Plan includes the following major sections:

- Introduction
- Site Characterization
- Applicable or Relevant and Appropriate Requirements
- Data Needs and Data Quality Objectives
- RCRA Facility Investigations/Remedial Investigation Tasks
- Schedule
- Field Sampling Plan
- Human Health Risk Assessment Plan
- Environmental Evaluation
- Quality Assurance Addendum
- Standard Operations Procedures and Addenda
- References

Three sections of the Phase I RFI/RI work plan are the most crucial in demonstrating the goal of the IAG: Site Characterization, Data Needs and Data Quality Objectives, and

the Field Sampling Plan. The Site Characterization section of the Phase I RFI/RI work plan includes an extensive review of existing documentation. Information collected includes waste inventories, as-built drawings, historical photos, operator logs, and reports of previous investigations. The Data Needs and Data Quality Objectives (DQOs) section in the Phase I RFI/RI work plan was developed for identification of data gaps from the existing historical information. The collected information was evaluated to determine data needs and uses and identify the data quality and quantity needs for field activities necessary for the Phase I RFI/RI process. The Field Sampling Plan is designed to obtain sufficient and adequate data to meet data quantity and quality needs identified in the DQOs. Results from the field investigation will also provide the information to support a Baseline Human Health Risk Assessment, an Environmental Evaluation, and primarily characterize the source and soils in the area of the SEPs (1).

#### THE FIELD SAMPLING PLAN

The objectives of the Field Sampling Plan stated in the Phase I RFI/RI are as follows (2):

##### Characterize Original and Existing Solar Ponds

1. Characterize location, type of contaminants, variation in contaminants and other unique characteristics of the Original Pond (Fig. 2);
2. Evaluate effectiveness of pond liner material as barriers to or sources of contamination;
3. Characterize surficial soil in the vicinity of the ponds and subsurface unconsolidated materials at depth;
4. Evaluate vadose zone contamination in the SEPs area and evaluate location and type of contaminants;
5. Provide upgradient ground water monitoring wells to serve as a basis for comparison to contaminant concentrations in ground water downgradient of the SEPs;
6. Locate and identify subsurface features e.g. piping, tanks or structures near the SEPs;
7. Identify geologic features that may provide information on subsurface migration pathways for contaminants.

##### Characterize Interceptor Trench System

1. Evaluate the construction of the ITS in an attempt to verify effectiveness of ground water collection;
2. Characterize location, type of contaminants, and variability in contaminant concentration in unconsolidated materials in the vicinity of the ITS.

To accomplish the stated objectives, the following activities are planned:

##### IHSS 101 and areas surrounding the ITS - Sampling Activities

- Review of existing data and information
- Visual inspection
- Surface radiological survey (350 locations)
- Application of vadose zone monitoring/sampling techniques
- Ground penetrating radar for location of piping, tanks, etc.

- Piezometer installation to quantify effectiveness of the ITS
- Drilling soil borings and unconsolidated soil sampling (55 locations)
- Installation and sampling monitoring wells (6 locations)
- Surficial sediment sampling (35 locations)
- Location surveying of sampled points

Analytical parameters for sediments, soil, and ground water samples collected during investigation of the SEPs include volatile organics, semivolatiles, metals, inorganic analytes, and radionuclides. Primary contaminants of concern at IHSS 101 are radionuclides, inorganics (specifically nitrates) and metals (2).

#### SCHEDULE

The IAG stipulates that field activities as outlined in the Phase I RFI/RI Work Plan at the SEPs begin in February, 1992 (1). The RFI/RI Field Sampling Plan will provide information to complete the Phase I RFI/RI Report by October, 1993. After submittal of the Phase I RFI/RI Report, work on another IM/IRA report will be performed to address remedial approaches to be applied to the source and soils for SEPs. This IM/IRA will consist of treatability studies, bench scale testing, and evaluation of selected interim remedial approach alternatives. The IM/IRA treatability results and evaluations will be incorporated into an IM/IRA Decision Document scheduled for completion in April 1995.

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