DOE/RL--89-09-Draft-Rev.A

DE90 003498

DOE/RL 89-09
Draft Revision A

RCRA Facility Investigation/ Corrective Measures Study Work Plan for the 100-DR-1 Operable Unit, Hanford Site, Richland, Washington

Date Published
October 1989

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

This page intentionally left blank.

PREFACE

The Resource Conservation and Recovery Act (RCRA) provides for corrective action at solid waste management units located at permitted RCRA facilities, regardless of when waste was received at a unit. The Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) focuses on waste site cleanups whenever there is a release or substantial threat of a release to the environment of a hazardous substance, pollutant, or contaminant. High priority sites are placed on a National Priorities List (NPL) by the U.S. Environmental Protection Agency (EPA) in accordance with CERCLA. CERCLA requires that federal facilities that qualify be placed on the NPL. The 100 Area of the Hanford Site is one of four Hanford aggregate areas currently proposed for the NPL.

This work plan was prepared in accordance with Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA (Interim Final) (EPA 1988a). However, in accordance with the Hanford Federal Facility Agreement and Consent Order, the EPA and State of Washington Department of Ecology (Ecology) have determined that the 100-DR-1 operable unit will be addressed under RCRA corrective action authority. The EPA and Ecology have determined that the EPA guidance for conducting a remedial investigation/feasibility study under CERCLA may be used at the Hanford Site in the performance of a RCRA facility investigation/corrective measures study. Therefore, although RCRA terminology has been used where appropriate, the content and format of this work plan conform to EPA guidance for CERCLA activities.

Of significance are the requirements under CERCLA for complying with applicable or relevant and appropriate requirements (ARARs). It is the intent of the EPA, Ecology, and the DOE that the CERCLA ARARs process, which addresses all RCRA relevant and applicable standards, be used for this project. Section 3.2 of this work plan, which addresses potential contaminant- and location-specific requirements was written to comply with CERCLA.

Since this operable unit is being addressed under RCRA corrective action authority, the corrective action decision will be made through modification of the Hanford Site RCRA permit, rather than a record of decision, as required under CERCLA.

This page intentionally left blank.

CONTENTS

CONTENTS (Cont)

CONTENTS (Cont)

LIST OF APPENDICES

LIST OF ATTACHMENTS

LIST OF TABLES

LIST OF TABLES (Cont)

LIST OF FIGURES

This page intentionally left blank.

ACRONYMS AND ABBREVIATIONS

ALARA	as low as reasonably achievable
alum	aluminum sulfate
amsl	above mean sea level
ARAR	applicable or relevant and appropriate requirement
ASTM	American Society of Testing and Materials
BTDS	Basalt Waste Isolation Project Technical Data System
BWIP	Basalt Waste Isolation Project
CCS	Committment Control System
CEQ	Council on Environmental Quality
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
CLP	contract laboratory program
CMS	corrective measures study
CPR	cardiopulmonary resuscitation
CRP	community relations plan
DAC	derived allowable concentration
DOE	U.S. Department of Energy
DMP	Data Management Plan
DMS	Data Management System
DQO	data quality objective
ECD	electron-capture detector
Ecology	Washington Department of Ecology
ECTS	Environmental Compliance Tracking System
EDMI	electronic distance measuring instrument
EE&T	Environmental Engineering and Technology
EFS	Environmental Field Services
EII	environmental investigations instructions
EIS	environmental impact statement
EMI	electromagnetic induction
EMT	emergency medical technician
EPA	U.S. Environmental Protection Agency
ERC	Environmental Resource Center
ERP	Environmental Restoration Program
FS	feasibility study
FSP	field sampling plan
FTS	Financial Tracking System
GC	gas chromatography
GEU	geotechnical engineering unit
GIS	Geographic Information System
GPR	ground-penetrating radar

ACRONYMS AND ABBREVIATIONS (Cont)

HECR	Hanford Environmental Compliance System
HEHF	Hanford Environmental Health Foundation
HEIS	Hanford Environmental Information System
HEPA	high-efficiency particulate air (filter)
HGWDB	Hanford Groundwater Data Base
HISS	Hanford Inactive Site Survey
HMPD	Hanford multipurpose dosimeter
HMS	Hanford Meteorological Station
HRS	Hazard Ranking System
HSP	Health and Safety Plan
IARC	International Agency for Research on Cancer
ICP	inductively coupled plasma
IRA	interim remedial action
ISFP	Industrial Safety and Fire Protection
M&TE	measurement and testing equipment
MAG	magnetometer
MCS	Management Control System
MDC	minimum detectable concentration
MDL	minimum detection limit
MHRS	modified hazard ranking system
MOU	memorandum of understanding
MSDS	material safety data sheet
N-S/E-W	north-south/east-west
NBR	nitrile-butadiene rubber
NCP	National Contingency Plan
NEPA	National Environmental Policy Act of 1970
NIOSH	National Institute of Occupational Safety and Health
NPL	National Priorities List
OHP	Occupational Health Physics
ORE	occupational radiation exposure
OSHA	Occupational Safety and Health Administration
OVA	organic vapor analyzer
PA	preliminary assessment
PARCC	precision, accuracy, representativeness, completeness, and comparability
PCB	polychlorinated biphenyl
PDMS	Program Data and Management System
PID	photo-ionization detector
PJSP	Pre-job Safety Plan
PMP	Project Management Plan
PNL	Pacific Northwest Laboratory
PPE	personal protection equipment
PVC	polyvinyl chloride

ACRONYMS AND ABBREVIATIONS (Cont)

QA	quality assurance
QAPP	Quality Assurance Project Plan
QC	quality control
QCBSDB	Quality Control Blind Standards Data Base
RA	remedial action
RAS	routine analytical services
RCR	review comment record
RCRA	Resource Conservation and Recovery Act of 1976
RDR	remedial design report
REL	recommended exposure limit
RfD	reference dose
RFI	RCRA Facility Investigation
RI	remedial investigation
ROD	record of decision
RPT	radiation protection technologist
RSD	risk-specific dose
RSR	radiation shipping record
RWP	radiation work permit
SAP	Sampling and Analysis Plan
SAS	special analytical services
SCBA	self-contained breathing apparatus
SG	soil gas
SI	site inspection
SPS	Sample Preparation System
TAL	target analyte list for inorganic constituents
TBD	to be determined
TCL	target compound list for organic compounds
TLV	threshold limit value
TRIS	Training Records Information System
USGS	U.S. Geological Survey
VOC	volatile organic compounds
WAC	Washington Administrative Code
Westinghouse Hanford	Westinghouse Hanford Company
WHC	Westinghouse Hanford Company
WIDS	Waste Information Data System
WIMS	Waste Inventory Management System
WPPSS	Washington Public Power Supply System

This page intentionally left blank.

WORK PLAN

This page intentionally left blank.

1.0 INTRODUCTION

Over 1,400 waste sites have been identified on the Hanford Site. These include active treatment, storage, and disposal (TSD) facilities subject to permit application and/or closure under the Resource Conservation and Recovery Act of 1976 42 USC 6901 et. seq. (RCRA) and the State of Washington Dangerous Waste Regulations [Washington Administrative Code (WAC) 173-303], as well as inactive waste sites subject to corrective action under RCRA or remedial action under the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) and the Superfund Amendments and Reauthorization Act (SARA) of 1986. Further reference to CERCLA should be interpreted as meaning 'CERCLA as amended by SARA.'

Most of the waste sites are located within one of four geographic areas on the Hanford Site that are referred to as the 100, 200, 300, and 1100 Areas. Figure 1 shows the location of these areas. Each has been proposed for listing on the National Priorities List (NPL) under CERCLA. The four aggregate areas are subdivided into 21 waste area groups on the basis of facility and type of operation. Each waste area group is further subdivided into operable units according to waste disposal practices, geology, hydrogeology, and other pertinent site characteristics. A total of 74 operable units have currently been identified. This process is continuing, and the total number of operable units, as well as the individual sites within each operable unit, are subject to change.

The purposes of this work plan and the attached project plans are to document the project scoping process and to outline all RCRA Facility Investigation/Corrective Measures Study (RFI/CMS) activities for the 100-DR-1 operable unit. This work plan was developed in accordance with the Hanford Federal Facility Agreement and Consent Order (Ecology et al. 1989). All work conducted under this plan will conform to the conditions set forth in the agreement and consent order. Pursuant to the agreement and consent order, relevant U.S. Environmental Protection Agency (EPA) guidance documents were consulted in the preparation of this work plan, including:

- Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA (EPA 1988a)
- Data Quality Objectives for Remedial Response Activities (EPA 1987)
- Superfund Public Health Evaluation Manual (EPA 1986a)
- Superfund Exposure Assessment Manual (EPA 1988b).

U.S. Department of Energy (DOE) Orders that will affect the course of work described in this Work Plan, and for which compliance is required, include:

DOE 1324.2	Records Management
DOE 5400.1	General Environmental Protection Program
DOE 5480.1B	Environment, Safety, and Health Program for DOE Operations

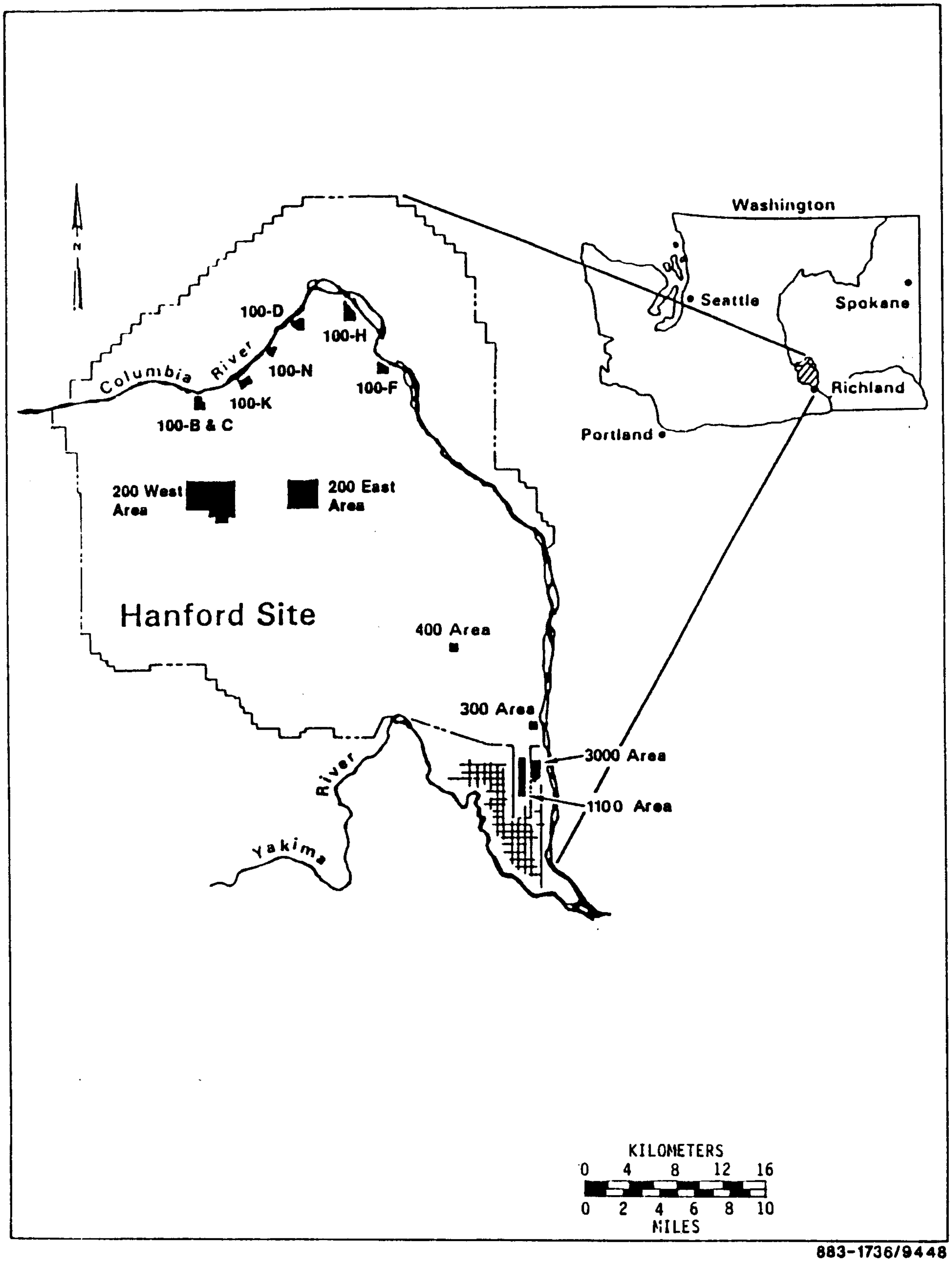


Figure 1. Hanford Site Map.

DOE 5480.4	Environment, Safety, and Health Protection Standards
DOE 5480.12	General Environmental Protection Program Requirements (Draft)
DOE 5482.1B	Environment, Safety, and Health Appraisal Program
DOE 5484.1	Environmental Protection, Safety, and Health Protection Information Reporting Requirements
DOE 5700.6B	Quality Assurance
DOE 5820.2	Radioactive Waste Management (Guidance Document).

This chapter sets forth the general purpose, scope, and goals of the project. The structure of the Work Plan and functions of the various chapters and attachments are also outlined.

1.1 PURPOSE AND SCOPE OF THE RFI/CMS

Pursuant to CERCLA, EPA proposed the 100 Areas at the DOE Hanford Site for inclusion on the NPL in the summer of 1988. In anticipation of this proposal being finalized, EPA, the Washington Department of Ecology (Ecology), and DOE have agreed upon the division of the 100 Areas into operable units for the purpose of increasing the manageability of the site characterization and remediation processes (WHC 1989a).

A cluster of nominated waste sites is located within the 100-D/DR Area, and the area has been further subdivided into three operable units, one of which is 100-DR-1 (see Section 2.1.2 for details). The 100-DR-1 operable unit is known as a reactor liquid-effluent operable unit because it contains all of the liquid waste disposal facilities within the 100-D/DR Area. The DOE has assigned top priority to the reactor liquid-effluent operable units because of documented groundwater contamination.

Several facilities within the 100-DR-1 operable unit are assigned to the ongoing Defense Decontamination and Decommissioning program, and some facilities have already been decommissioned as part of this program. Facilities assigned to that program that are sources of identified or potential contaminants are addressed in this Work Plan. The reactor building and its associated nuclear fuel storage basin will be decommissioned as part of the surplus production reactors decommissioning program at the Hanford Site. The reactor facilities are therefore addressed by the Environmental Impact Statement for that decommissioning program (DOE 1989) and are not within the scope of this Work Plan.

A separate groundwater/surface water operable unit, 100-HR-3, has been designated, which includes the 100-D/DR Area. As such, all groundwater, surface water, and aquatic biota investigation activities for the entire 100-D/DR Area will be carried out in accordance with the 100-HR-3 Work Plan being prepared.

Pursuant to the Hanford Federal Facility Agreement and Consent Order (Ecology et al. 1989), this RFI/CMS is being prepared in accordance with CERCLA guidance but reflects RCRA terminology. The purposes of this enhanced

RFI/CMS are to determine the nature and extent of the threat presented by releases of hazardous and radioactive substances from the 100-DR-1 operable unit and to evaluate proposed corrective measures for such releases.

1.2 PROJECT GOALS

The goal of the 100-DR-1 RFI is to provide sufficient information needed to conduct the CMS, by determining the following:

- The nature and extent of the threat to public health and the environment posed by releases of hazardous substances from the operable unit facilities in soil, air, and terrestrial biota (groundwater, surface water and associated sediments, and aquatic biota will be addressed in the 100-HR-3 operable unit RFI)
- The performance of specific corrective measure technologies.

Such determinations will be carried out to the extent necessary and sufficient to allow evaluation of corrective measure alternatives during the CMS.

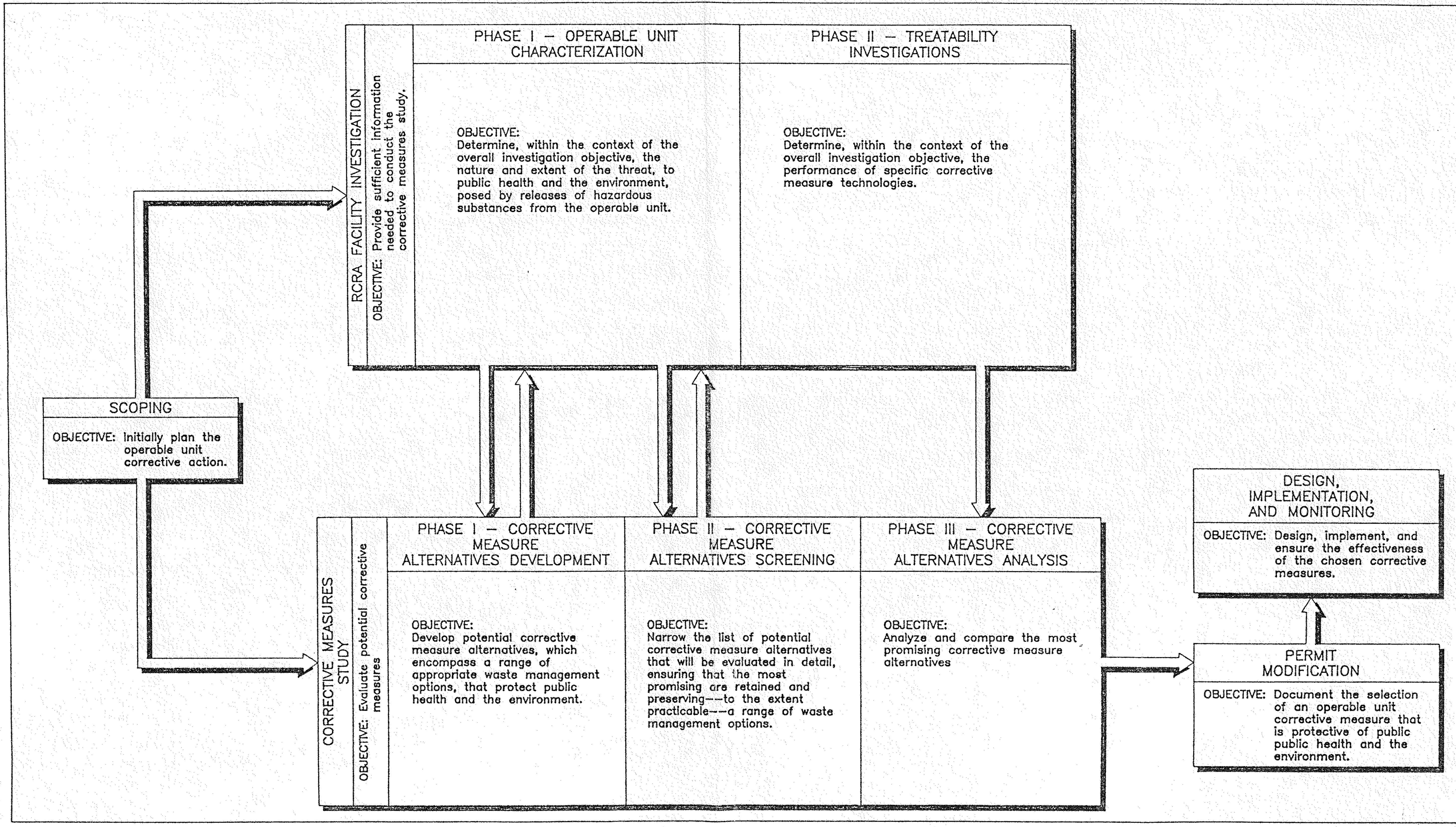
The goal of the 100-DR-1 CMS is to evaluate potential corrective measures that encompass a range of appropriate waste management options by developing, screening, and analyzing corrective measure alternatives. The ultimate goal of the RFI/CMS is to allow the selection and subsequent implementation of a cost-effective corrective measure that ensures the protection of public health and the environment. After public review of the RFI and CMS reports, DOE, EPA, and Ecology will select an appropriate remedy and document this choice by modification of the Hanford Site RCRA permit. This will be followed by design, implementation, and monitoring of the chosen corrective measures.

The RFI/CMS is divided into five phases--two RFI phases (operable unit characterization and treatability investigation) and three CMS phases (corrective measure alternatives development, screening, and analysis). The RFI and CMS are conducted concurrently. The data collected during the RFI provide the information needed to evaluate corrective measure alternatives in the CMS; the CMS, in turn, determines the data collection objectives for the RFI.

Figure 2 shows how the RFI/CMS fits into the overall corrective action process. Each phase of the RFI/CMS and its corresponding objective is indicated.

1.3 ORGANIZATION OF WORK PLAN

As noted in the preface, although written in RCRA RFI/CMS terminology, this Work Plan conforms with current draft guidance for RI/FS activities under CERCLA and the National Contingency Plan (NCP) (EPA 1988a). It has been completed with current knowledge of conditions at the operable unit and may



8831736/WP/14130

Figure 2. Corrective Action Process.

require modifications during the later phases of the project, once additional information becomes available.

The 100-DR-1 Work Plan also conforms, in part, with the CEQ requirements promulgated under NEPA (CEQ 1978). The Work Plan, the results of work performed pursuant to it, and subsequent remediation decisions will be circulated for public, federal, and state agency review to satisfy CEQ procedural requirements.

This Work Plan is intended to be a dynamic document that will be amended, as necessary, throughout the project. In this manner, the Work Plan will provide efficient and effective directions consistent with project goals. A dynamic work plan will also serve to help document the rationale for project decisions and conclusions and thereby provide assistance in making subsequent corrective measures decisions.

Eight chapters, including this introduction, are included in the Work Plan. Chapter 2.0 presents the history and current understanding of the 100-DR-1 waste generation, transfer, storage, and disposal processes and facilities. The environmental setting of the 100-D/DR Area and its surroundings are also summarized.

Available data and potential contaminant exposure pathways are reviewed in Chapter 3.0 to develop a conceptual model for the operable unit. Waste sources, quantities, and characteristics are identified, along with the current understanding of the extent of contamination in the various environmental media. Federal and state standards, requirements, criteria, or limitations that will be evaluated as potential legally applicable or relevant and appropriate requirements (ARARs) are identified, potential impacts to public health and the environment are assessed, and preliminary corrective action objectives are presented.

Chapter 4.0 provides the rationale and objectives for RFI/CMS activities. Data needs and data quality required to attain these objectives are defined.

Chapter 5.0 presents the activities necessary to conduct the two phases of the RFI (operable unit characterization and treatability investigation) and the three phases of the CMS (corrective measure alternatives development, screening, and evaluation). Detailed activities for the treatability investigation are not set forth, because such activities will be dependent on the information gathered during the site characterization phase of the RFI and the results of the initial phases of the CMS.

A project schedule is presented in Chapter 6.0. Modifications to the schedule may need to be made as information is obtained during project implementation. Chapter 7.0 discusses project management responsibilities. References for the Work Plan are provided in Chapter 8.0.

Attachments to this Work Plan include support project plans that are necessary to manage, conduct, and control the RFI/CMS project. The project plans include the following:

- Attachment 1: Sampling and Analysis Plan (SAP)
  1a Field Sampling Plan (FSP)
  1b Quality Assurance Project Plan (QAPP)
- Attachment 2: Health and Safety Plan (HSP)
- Attachment 3: Project Management Plan (PMP)
- Attachment 4: Data Management Plan (DMP)
- Attachment 5: Community Relations Plan (CRP).

Each plan is developed to be used in conjunction with the Work Plan and the other plans, hence minimizing duplication of information and description.

1.4 QUALITY ASSURANCE

The 100-DR-1 Work Plan and its supporting project plans (i.e., the SAP, FSP, QAPP, PMP, DMP, and HSP) have been developed to meet specific EPA guidelines for format and structure, within the overall quality assurance (QA) program structure mandated by DOE-Richland (DOE-RL) for all activities at the Hanford Site. The hierarchy of QA program documents applicable to this project is described as follows:

- DOE-RL Order 5700.1A, Quality Assurance (DOE-RL 1983): This directive establishes broadly applicable QA program requirements, based on ANSI/ASME NQA-1, Quality Assurance Program Requirements for Nuclear Facilities (ANSI/ASME 1986), for all projects conducted on the Hanford Site.

- Westinghouse Hanford Company Quality Assurance Manual (WHC-CM-4-2) (WHC 1989b): This document describes the program and procedures to be used to implement DOE-RL Order 5700.1A for all activities conducted by Westinghouse Hanford on the Hanford Site.

- Westinghouse Hanford QA program plan for CERCLA RI/FS activities: This plan describes the means selected to implement WHC-CM-4-2 for CERCLA RI/FS environmental investigations, while accommodating the specific requirements for project plan format and consent agreed upon in the Hanford Federal Facility Agreement and Consent Order (Ecology et al. 1989). Although specific to CERCLA RI/FS activities, the guidance provided by this document has been interpreted to be equally applicable to RCRA RFI/CMS activities under the terms of the Hanford Federal Facility Agreement and Consent Order. It contains a complete matrix of procedural resources (from WHC-CM-4-2 and from the Westinghouse Hanford Environmental Investigations and Site Characterization Manual [WHC 1989c], and from other sources) that may be drawn upon to support lower-tier operable unit-specific project plans.

- 100-DR-1 QA Project Plan (QAPP): Included as Part 1(b) of this Work Plan, the QAPP supports the 100-DR-1 SAP and FSP. The QAPP defines the specific means that will be used to ensure that the sampling and analytical data obtained as part of RFI Phase 1 will be defensible and will effectively support the purposes of the investigation. As required by the Westinghouse Hanford QA program plan for CERCLA RI/FS activities and the Hanford Federal Facility Agreement and Consent Order, the structure and content of the QAPP is based on Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans (EPA 1983). Where required, the QAPP invokes appropriate procedural controls selected from those listed in the Westinghouse Hanford QA program plan for CERCLA RI/FS activities, or that have been developed to accommodate the unique needs of this investigation.

This page intentionally left blank.

2.0 OPERABLE UNIT BACKGROUND AND SETTING

This chapter provides a summary of the pertinent physical, biological, and sociological settings for the 100-DR-1 operable unit. The chemical setting for the operable unit (i.e., the known and suspected nature and extent of contamination and contaminant background conditions) is discussed in Chapter 3.0. Information describing the 100-DR-1 operable unit and the history of operations at the 100 Area can be found in Dorian and Richards (1978), DOE-RL (1989a), EPA (1988c), and Stenner et al. (1988). Regional and local geology and hydrogeology are discussed in Myers/Price et al. (1979), DOE (1988), and DOE-RL (1988). Additional descriptive and historical data may be found in the list of references in Section 8.

2.1 OPERABLE UNIT DESCRIPTION

2.1.1 Location

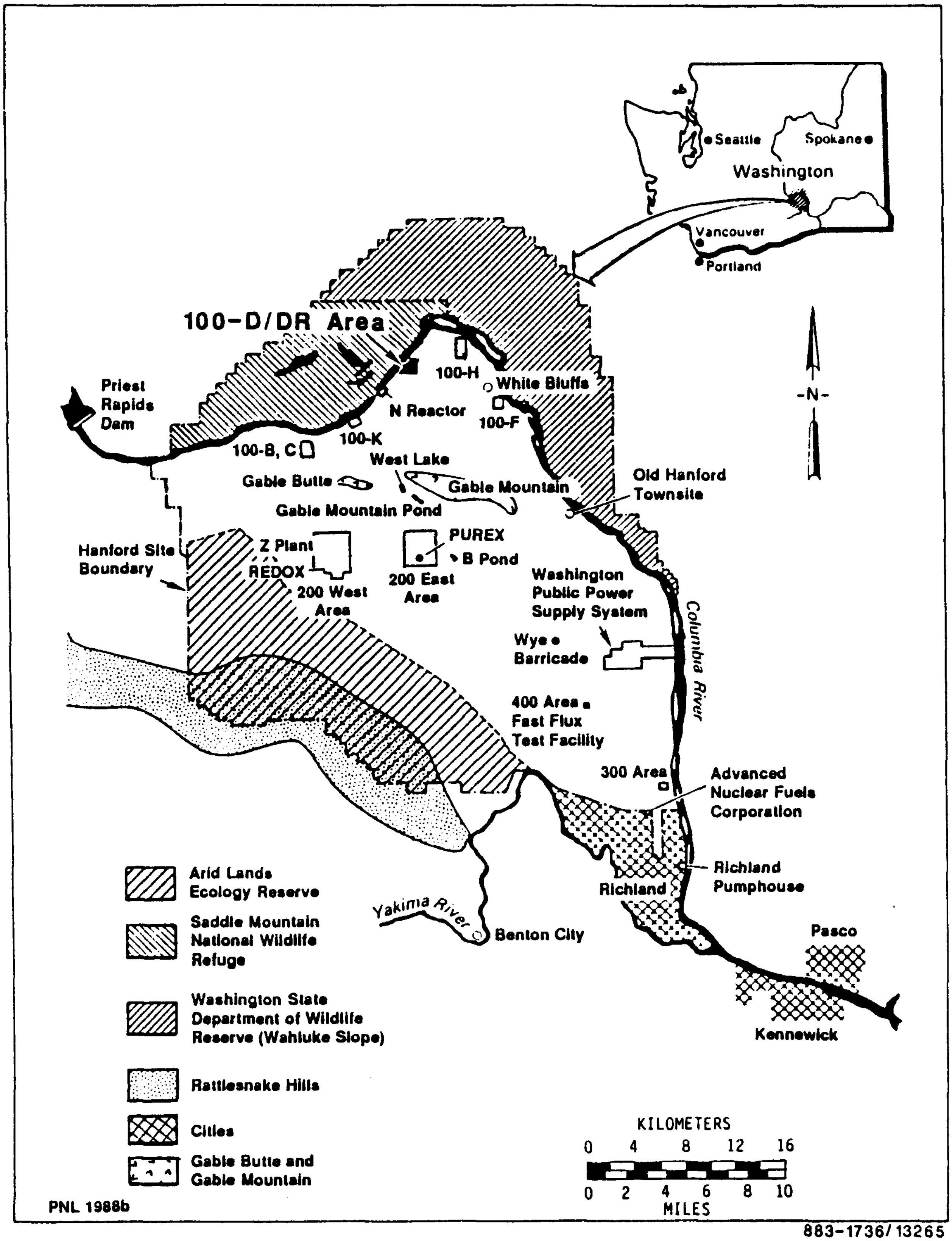
The 100-DR-1 operable unit is one of three operable units within the 100-D/DR Area of the DOE Hanford Site. The Hanford Site is located in the south-central portion of the State of Washington. The 100-D/DR Area is located in Benton County along the south bank of the Columbia River in the north-central part of the Hanford Site, approximately 50 km (31 mi) north-northwest of the City of Richland, Washington, as shown in Figure 3.

The 100-DR-1 operable unit is immediately adjacent to the Columbia River, north-northeast of the 100-DR-2 operable unit, and north-northwest of 100-DR-3 operable unit as shown in Figure 4. The 100-DR-1 area encompasses approximately 1.5 km^2 (0.59 mi^2) and lies predominantly within the southeast quadrant of Section 15 and the southwest quadrant of Section 14 of T.14N., R.26E., and is located within latitude 46°41'30" and 46°42'30" north and longitude 119°31'45" and 119°33'00" west. Figure 4 indicates the boundaries for the 100-DR-1 operable unit.

2.1.2 History of Operations

Between the years 1943 and 1963, nine water-cooled, graphite-moderated plutonium production reactors were built along the Hanford reach of the Columbia River. Eight of the reactors (B, C, D, DR, F, H, KE, and KW) have been retired from service and are under evaluation for decommissioning. The N reactor in 100-N Area recently has been placed in standby mode.

The 100-D/DR Area contains the D and DR reactors and their operational support facilities. The D Reactor is located in the 100-DR-1 operable unit, and the DR reactor is located in the 100-DR-2 operable unit, with their support facilities distributed throughout both units. Fuel elements for the D reactor were manufactured in the 300 Area, and the plutonium-enriched fuel produced by the reactor was processed in the 200 Areas. The D reactor



883-1736/13265

Figure 3. The Hanford Site.

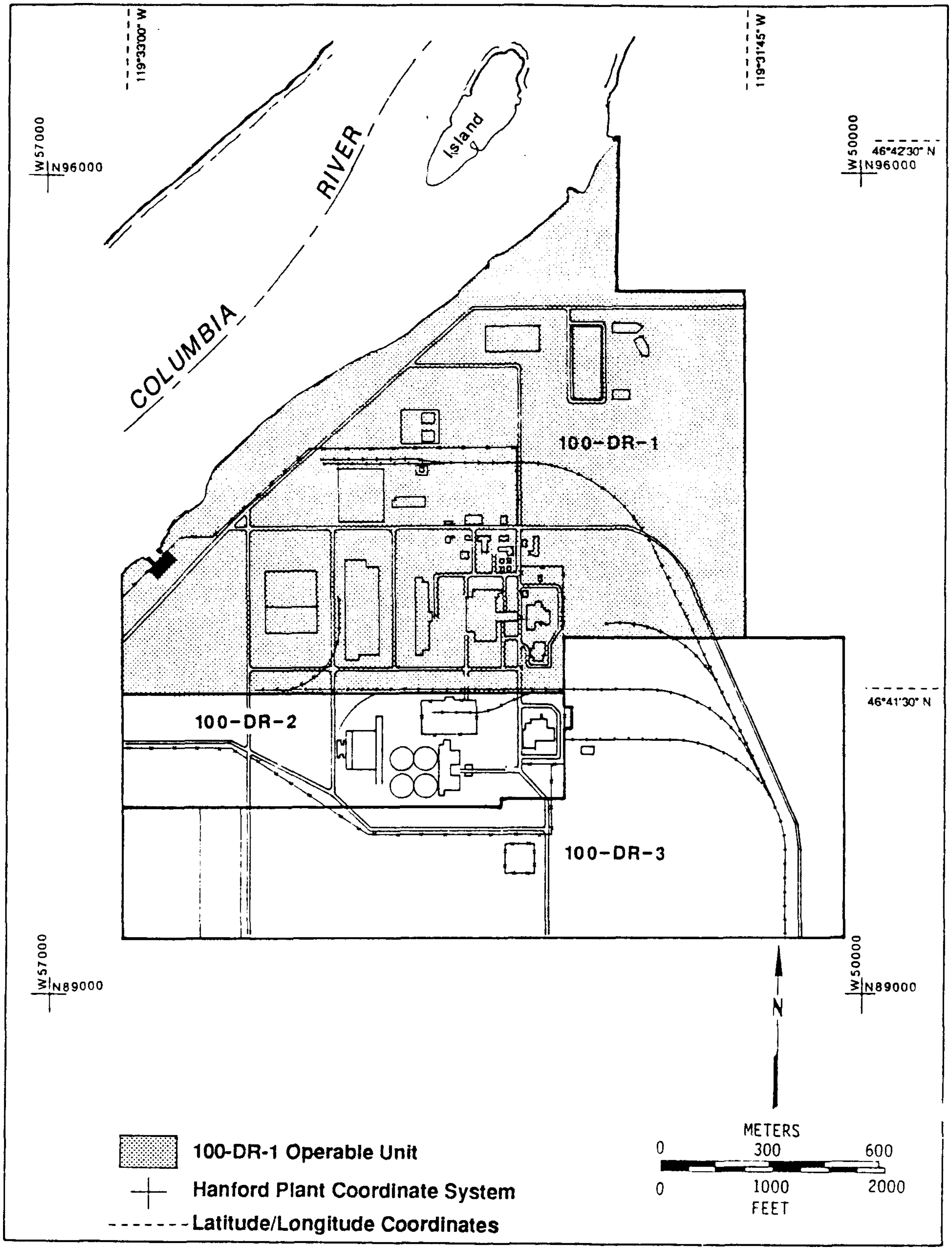


Figure 4. The 100-D/DR Operable Units.

operated from 1944 to 1967, at which time it was retired. Currently, sanitary and fire protection water is provided to the 100-H and 100-F Areas from the 100-D Area. The water system is also a backup for systems from the 100-B Area that supply the 200 Areas.

The 100-D/DR Area support facilities for the D reactor included an access road, a rail spur, offices, warehouses, a laboratory, a major substation located within the 100-DR-2 operable unit and several intermediate smaller substations located throughout both 100-DR-1 and 100-DR-2, maintenance shops, a fallout shelter, a powerhouse with optional coal-fired or fuel-fired boilers, and coal storage and fly ash disposal facilities. Additional facilities include the river pumphouse, water reservoir, filter plant, a sanitary water supply system, a process effluent system, a subsurface sanitary sewage disposal system, and a solid waste landfill. Most of the aboveground facilities have undergone some degree of decommissioning, and in many instances facilities no longer exist. The layout of the 100-DR-1 operable unit is shown in Figure 5. This drawing illustrates both present and past facilities.

2.1.3 Waste Generation Processes

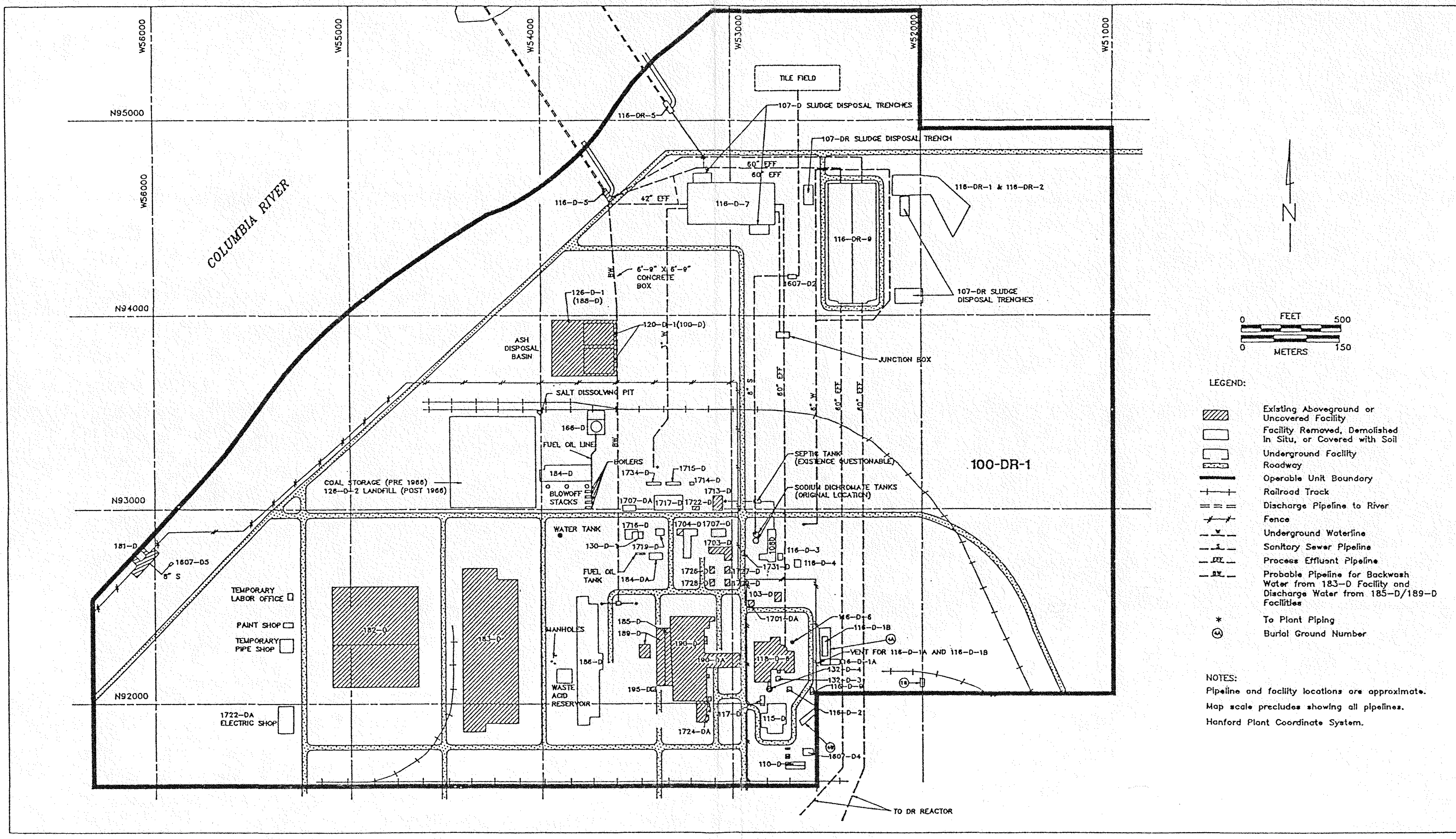
Wastes present at the 100-DR-1 operable unit have been generated by various processes. Wastes generated by these processes can be categorized as follows:

- Process liquid wastes and sludges
- Reactor exhaust stack emissions
- Radioactive solid wastes
- Sanitary liquid wastes
- Nonradioactive solid waste
- Other liquid waste
- Hazardous waste.

2.1.3.1 Process Liquid Wastes and Sludges. Process wastes were generated as a result of reactor cooling, reactor and equipment decontamination, and filtration of reactor exhaust stack emissions.

2.1.3.1.1 Reactor Cooling. The D reactor used a once-through cooling process whereby water from the Columbia River was circulated through the reactor one time and then ultimately discharged back to the river or to soil column disposal facilities (Dorian and Richards 1978).

Before being introduced into the reactor, river water was treated in a large, onsite water treatment plant. Treatment included flocculation and settling of suspended particulates using hydrated aluminum sulfate (alum). The water was then filtered through charcoal beds. Before the cooling water was introduced into the reactor, sodium dichromate was added to help prevent corrosion of the aluminum process tubes that held the uranium fuel elements. Sulfuric acid was added to adjust the pH, and chlorine and copper sulfate were added from time to time to prevent algal growth (EPA 1988c).



8831736\H&S\32850

Figure 5. 100-DR-1 Operable Unit.
(Sheet 1 of 2)

WIDS Site Designation Number (Alias)	Facility Description
116-D-1A (105-D)	Fuel Storage Basin Trench No. 1
116-D-1B (105-D)	Fuel Storage Basin Trench No. 2
116-D-2 (105-D)	Pluto Crib
116-D-3 (108-D)	Crib No. 1
116-D-4 (108-D)	Crib No. 2
116-D-5 (1904-D)	Outfall Structure
116-D-6 (105-D)	Cushion Corridor Decontamination French Drain
116-D-7 (107-D)	Process Effluent Retention Basin
116-D-9 (117-D)	Reactor Confinement Seal Pit Drainage Crib
116-DR-1 (107-DR)	Liquid Waste Process Effluent Disposal Trench No. 1
116-DR-2 (107-DR)	Liquid Waste Process Effluent Disposal Trench No. 2
116-DR-5 (1904-DR)	Outfall Structure
116-DR-9 (107-DR)	Process Effluent Retention Basin
118-D-6 (105-D)	Reactor Building
120-D-1 (100-D)	Ponds
126-D-1 (188-D)	Ash Disposal Basin
126-D-2	Solid Waste Landfill
130-D-1 (1716-D)	Gasoline Storage Tank
132-D-3 (1608-D)	Effluent Pumping Station
132-D-4 (116-D)	Reactor Exhaust Stack
1607-D2	Septic Tank
1607-D4	Septic Tank
1607-D5	Septic Tank

Non-WIDS Site Designation Number	Facility Description
103-D	Fuel Element Storage Building
107-D and 107-DR	Five Sludge Disposal Trenches
108-D	Office Building and Equipment Decontamination Station
110-D	Helium Storage Tanks
115-D	Gas Recirculation Building
117-D	Reactor Exhaust Air Filter Building
166-D	Fuel Oil Tank
181-D	River Pumphouse (Serves D and DR)
182-D	Reservoir and Pumphouse
183-D	Filter Plant Operations Building
184-D	Powerhouse

Non-WIDS Site Designation Number (Cont.)	Facility Description
184-DA	Steam Generating Facility
185-D	Thermal Hydraulics Building
186-D	Demineralization Building
189-D	Mechanical Development Lab
189-D	Storage Yard
190-D	Pump House
190-DA	Pump House Annex
195-D	Vertical Rod Safety Test Tower
1701-DA	Office Building/Badge House
1703-D	Technical Office Building
1704-D	Vault/Supervisor's Office
1707-D	Change House
1707-DA	Change House
1713-D	Instrument and Electrical Development Lab
1714-D	Solvent Storage
1715-D	Oil and Paint Storage
1716-D	Gas Station
1717-D	Combined Shops/Change Room
1719-D	First Aid
1722-D	Equipment Development Lab
1724-DA	Underwater Test Facility
1726-D	Mobile Office Trailer
1727-D	Mobile Office Trailer
1728-D	Mobile Office Trailer
1729-D	Mobile Office Trailer
1731-D	Mobile Office Trailer
1734-D	Cylinder Storage

No Site Designation Number	Facility Description
	Three 1.52 m (60 in) process effluent pipelines
	15 cm (6 in) and 7.6 cm (3 in) waterline near retention basins
	Discharge Pipelines to Columbia River
	Sanitary Sewer Pipelines
	Probable pipeline for backwash water from 183-D facility and discharge water from 185-D/189-D facilities
	Septic Tank at N93050, W52850
	Paint Shop (West of 182-D Reservoir)
	Waste Acid Reservoir
	Underground Fuel Oil Tank (west of 184-DA steam generating facility)
	Fuel Oil Line Associated with 166-D Tank
	Sodium Dichromate Tanks
	Burial Grounds 4A, 4B, 18
	Salt Dissolving Pit
	Sanitary Sewer Tile Field (north of retention basins)

8831736/13770.

Figure 5. 100-DR-1 Operable Unit. (Sheet 2 of 2)

The cooling water was irradiated while in the reactor. This led to the formation of activation products and various short-lived radionuclides. Upon exiting the reactor, cooling water was usually held for a time in a retention basin to allow for thermal cooling and radioactive decay before being discharged to the river (Dorian and Richards 1978).

In the event of a fuel element cladding rupture within the process tubes, cooling water would directly contact the uranium fuel and pick up fission and activation products. These products included ^{60}Co, ^{63}Ni, ^{90}Sr, ^{134}Cs, ^{137}Cs, ^{152}Eu, ^{154}Eu, ^{155}Eu, ^{235}U, ^{238}U, ^{238}Pu, ^{239}Pu, and ^{240}Pu. Cooling water contaminated as a result of ruptured fuel elements was segregated and disposed of in percolation trenches and cribs (Dorian and Richards 1978; Stenner et al. 1988).

2.1.3.1.2 Decontamination. Decontamination solutions were routinely used to remove radionuclides from equipment and facility surfaces. Large quantities of decontamination solutions were also used during reactor shutdown and standby periods of the D reactor. Decontamination solutions included chromic, citric, oxalic, and sulfuric acids (neutralized with sodium carbonate before disposal), sodium fluoride, and various proprietary compounds. Some decontamination wastes were disposed of in percolation cribs and trenches. Others were pumped into the cooling water waste stream, which ultimately flowed into the Columbia River (EPA 1988c).

2.1.3.1.3 Air Filtration. Confinement system seal water (used to isolate the reactor exhaust stack filtration system for periodic maintenance) contained very low levels of contamination. This waste water was disposed of in a percolation trench. Radionuclides included ^{90}Sr, ^{152}Eu, and ^{239}Pu (Dorian and Richards 1978; Stenner et al. 1988).

2.1.3.2 Reactor Exhaust Stack Emissions. Filtered gaseous and particulate materials were disposed of to the atmosphere through the 132-D-4 (116-D) reactor exhaust stack. Filters in the 117-D filter building removed particulate matter and gaseous waste from the exhaust air stream before it entered the exhaust stack, and radioactive detection systems continuously monitored radiation levels of airborne particulate matter in the exhaust air before and after filtering. No available information has been found on the composition of routine stack emissions or where the filters were disposed.

2.1.3.3 Radioactive Solid Wastes. Radioactive solid wastes generated in the 100-D/DR Area consisted mainly of discarded activated metallic reactor parts containing ^{60}Co. Most radioactive solid wastes from the 100-D/DR Area were discarded in burial grounds in the 100-DR-2 operable unit.

2.1.3.4 Sanitary Wastes. Sanitary wastes from the 100-D/DR Area were treated in the 1607-D2, 1607-D4, and 1607-D5 septic tanks and disposed of in associated tile fields. Some drawings indicate the presence of a fourth septic tank located approximately at N93050 and W52850, but no further information was found. The sewer drawing indicated a drop manhole structure at approximately the same location. However, a field visit in March 1989 did not reveal a manhole cover on the surface of the ground or any other indication of a septic tank. There are no records of hazardous or radioactive wastes being disposed of in these systems. However, 1607-D2 is located in the vicinity of the large-diameter process effluent lines that were reported to have leaked (Dorian and Richards 1978). This liquid could have potentially infiltrated the pipeline.

2.1.3.5 Nonradioactive Solid Waste. Nonradioactive solid waste generated within the 100-D/DR Area primarily includes decommissioning wastes such as scrap metal, concrete, and other building materials. It is currently unknown whether any nonradioactive solid waste from the operable unit was disposed of off-site.

2.1.3.6 Other Liquid Waste. Other liquid waste includes anything non-radioactive or not sanitary related. This category encompasses potential gasoline or oil leachate from underground or aboveground storage tanks, potential polychlorinated biphenyl (PCB) contamination of the soil from electrical facilities, potential acid leachate from a waste acid reservoir, and backwash and discharge water from various support facilities.

2.1.3.7 Hazardous Waste. Hazardous wastes include herbicides, insecticides, solvents, paints, and other chemicals generated either by industrial or support services operations.

2.1.4 Waste Facility Characteristics

All of the 100-DR-1 waste transfer, treatment, storage, and disposal facilities can be allocated among the following categories:

- Reactor building and associated disposal facilities
- Process effluent pipelines
- Retention basins and related facilities
- Contaminated reactor ancillary facilities
- Miscellaneous cribs and trenches
- Sanitary sewage, transfer, treatment, and disposal facilities
- RCRA-permitted facilities
- Support facilities
- Tanks and related facilities
- Solid waste landfill, ash disposal basin, burial grounds, and salt dissolving pit
- Electrical facilities.

Table 1 lists each of the 100-DR-1 facilities identified during the background research phase of this project. Photographs dating from 1948 to 1983, drawings, reports, and field visits were used as much as possible to locate all of the facilities. Each facility is listed, followed by the appropriate Waste Information Data System (DOE-RL 1989a) site number with any alias names shown in parentheses, facility name, years in service and present status, and types of wastes received or produced. These facilities are shown on Figure 5.

Table 1. Waste Transfer, Treatment, Storage, Disposal, and Related Facilities in the 100-DR-1 Operable Unit Area. (Sheet 1 of 12)

Site designation number[a]	Facility Name	Years in service; Status; Size[d]	Waste received or produced
		Reactor Building and Associated Disposal Facilities	
*118-D-6 (105-D)	Reactor building	1944-1967 Enclosed within security fence	Consists of reactor block, graphite moderator stack, biological and thermal shields, pressure tubes, the safety and control systems, the irradiated-fuel storage basin, and contaminated portions of reactor building.
*116-D-1A (105-D)	Fuel storage basin trench No. 1	1947-1952 Site no longer visible; covered in 1966; size - 40 m (130 ft) x 3 m (10 ft) x 1.8 m (6 ft) deep	Received contaminated water and sludge from fuel storage basin (118-D-6).
*116-D-1B (105-D)	Fuel storage basin trench No. 2	1953-1967 Site no longer visible; covered in 1967; size - 30 m (100 ft) x 3 m (10 ft) x 4.6 m (15 ft) deep	Received contaminated water and sludge from fuel storage basin (118-D-6).
*116-D-2 (105-D)	Pluto crib	1950-1956 Site no longer visible; covered with soil in 1956; size - 3 m (10 ft) x 3 m (10 ft) x 3 m (10 ft) deep	Received effluent water from process tubes following fuel cladding failures.
*116-D-6 (105-D)	Cushion corridor decontamination french drain	1961-1967 status - b; size - 0.9 m (3 ft) diam. x 0.9 m (3 ft) deep	Received domestic water from the changing room and water from the mask decontamination station.

Table 1. Waste Transfer, Treatment, Storage, Disposal, and Related Facilities in the 100-DR-1 Operable Unit Area.
(Sheet 2 of 12)

Site designation number[a]	Facility Name	Years in service; Status; Size[d]	Waste received or produced
		Process Effluent Pipelines	
c	Process effluent pipelines (three)	b Buried; size 1.52-m (60-in) diameter	Process effluents (i.e., reactor cooling water, some decontamination wastes, contaminated reactor cooling water, and/or reactor confinement seal pit drainage).
c	Soil in the vicinity of the process effluent pipelines	1950-1964 Posted radioactive and secured with a chain link barrier	Because the three 1.52 m (60-in.) effluent pipelines leaked, this area received process effluents (i.e., reactor cooling water, decontamination wastes, contaminated reactor cooling water, and/or reactor confinement seal pit drainage).
		Retention Basins and Related Facilities	
*116-D-7 (107-D)	Process effluent retention basin	1944-1967 Basin has been partially filled with soil; size - 142 m (467 ft) x 70 m (230 ft) x 6.1 m (20 ft) deep	Received cooling water effluent from the 118-D-6 (105-D) reactor for radioactive decay and thermal cooling before effluent was released to the Columbia River. There is a chance that the basin received ruptured fuel-element waste after 1954.

Table 1. Waste Transfer, Treatment, Storage, Disposal, and Related Facilities in the 100-DR-1 Operable Unit Area. (Sheet 3 of 12)

Site designation number[a]	Facility Name	Years in service; Status; Size[d]	Waste received or produced
*116-DR-9 (107-DR)	Process effluent retention basin	1950-1964 Basin has been partially filled with soil; size 182 m (600 ft) x 70 m (230 ft) x 6.1 m (20 ft) deep	Received cooling water effluent from the 118-DR-2 (105-DR) Reactor for radioactive decay and thermal cooling before effluent was released to the Columbia River. There is a possibility that the basin received ruptured fuel- element waste after 1954.
c	Area around retention basins	1944-1967 Posted radioactive and secured by a chain link fence	Because of leakage from basins, this area received large amounts of liquid process effluent.
c	Water pipeline near retention basins	b Buried; size - 15.2-cm (6-in) and 7.6-cm (3-in) diameters	Because the retention basin leaked, there is a possibility of infiltration of contaminated effluent into this pipeline.
*116-DR-1 (107-DR)	Liquid waste process effluent disposal trench No. 1	1950-1954 Basin partially filled with soil; size - 91 m (300 ft) x 4.6 m (15 ft) x 6.1 m (20 ft) deep	Received effluent from the 116-D-7 and 116-DR-9 Retention basins after 118-D-6 (105-D) and 118-D-2 (105-DR) had outages caused by ruptured fuel elements.
*116-DR-2 (107-DR)	Liquid waste process effluent disposal trench No. 2	1952-1954 Basin partially filled with soil; size - 46 m (150 ft) x 3.0 m (10 ft) x 6.1 m (20 ft) deep	Received effluent from the 116-D-7 and 116-DR-9 retention basins after 118-D-6 (105-D) and 118-D-2 (105-DR) had outages caused by ruptured fuel elements.

Table 1. Waste Transfer, Treatment, Storage, Disposal, and Related Facilities in the 100-DR-1 Operable Unit Area. (Sheet 4 of 12)

Site designation number[a]	Facility Name	Years in service; Status; Size[d]	Waste received or produced
(107-D) and (107-DR)	Sludge disposal trenches (five)	1953 1.8 m (6 ft) of soil placed on top	Received sludge from retention basins 116-D-7 and 116-DR-9 when they were dredged in 1953 for repairs. Sludge contained sand that had blown into the basins and the trenches.
116-D-5 (1904-D)	Outfall structure	1947-1964 Chain link fence around outfall	Received effluent from 116-D-7 and 116-DR-9 retention basins according to drawings.
116-DR-5 (1904-DR)	Outfall structure	1950-1964 No visible site	Drawings do not indicate this structure but photos do. Received same waste as 116-D-5.
c	Discharge pipelines to Columbia River	b Still buried	Received effluent from retention basins.
		Contaminated Reactor Ancillary Facilities	
(103-D)	Fuel element storage building	b Still on site	Originally stored unirradiated fuel elements before their use in reactor. Later used to store packaged radioactive samples collected for study by Dorian and Richards (1978). Field visit revealed herbicide and solvent warning signs posted outside of building.

Table 1. Waste Transfer, Treatment, Storage, Disposal, and Related Facilities in the 100-DR-1 Operable Unit Area. (Sheet 5 of 12)

Site designation number[a]	Facility Name	Years in service; Status; Size[d]	Waste received or produced
(108-D)	Office building and equipment decontamination station	b Has been demolished; size - 40.2 m (132 ft) long, 9.75 m (32 ft) wide, 12.5 m (41 ft) high	Received wastes associated with decontamination and repair of contaminated reactor process tube equipment. Two cribs, 116-D-3 and 116-D-4, are associated with this building. Also had a drain to effluent pipeline.
132-D-3 (1608-D)	Effluent pumping station	1944-1965 Decommissioned in 1987, demolished in situ	Received water from the 118-D-6 reactor fuel storage basin overflows. Water was pumped from the reactor collection pits into the reactor effluent lines and became part of the 116-D-7 and 116-DR-9 effluent, which was discharged to the Columbia River.
(115-D)	Gas recirculation building	b Has been demolished	Helium and carbon dioxide cover gas for the graphite circulated through equipment in this building.
(117-D)	Reactor exhaust air filter building	1961 - ? Has been demolished; size - 18 m (59 ft) long, 12 m (39 ft) wide, 11 m (35 ft) high	Received reactor building exhaust gas.
132-D-4 (116-D)	Reactor exhaust stack	1950-1964 Still on site; size - 61 m (200 ft) high	Received filtered confinement air emissions.

Table 1. Waste Transfer, Treatment, Storage, Disposal, and Related Facilities in the 100-DR-1 Operable Unit Area. (Sheet 6 of 12)

Site designation number[a]	Facility Name	Years in service; Status; Size[d]	Waste received or produced
		Miscellaneous Cribs and Trenches	
*116-D-3 (108-D)	Crib No. 1	1951-1967 Site no longer visible; size - 9 m (30 ft) diameter x 1.5 m (5 ft) deep	Received low-level fission and activation product wastes from a contaminated maintenance shop and cask decontamination pad in the 108-D building.
*116-D-4 (108-D)	Crib No. 2	1956-1967 Site no longer visible; size - 9 m (30 ft) diameter x 1.5 m (5 ft) deep	Received low-level fission and activation product wastes from contaminated maintenance shops in the 108-D building.
*116-D-9 (117-D)	Reactor confinement seal pit drainage crib	1960-1967 Vent is still visible. Covered to grade with clean soil; size - 3 m (10 ft) x 3 m (10 ft)	Received drainage from exhaust air filtration building (117-D) seal pits. Radioactive elements received had short half-lives and were released from radiological controls before 1967.
		Sanitary Sewage Transfer, Treatment, and Disposal Facilities	
c	Sanitary sewer pipelines	b Still buried	Sanitary sewage. No records of hazardous or radioactive materials received.
1607-D2	Septic tank	1950-present Site visit on 3/7/89 indicated flow still present in pipeline	Received sanitary waste from office maintenance services, process water pumping building (190-DA), 189-D, 185-D, 182-D, 183-D, 170-D, and 118-D-6 reactor building.

Table 1. Waste Transfer, Treatment, Storage, Disposal, and Related Facilities in the 100-DR-1 Operable Unit Area. (Sheet 7 of 12)

Site designation number[a]	Facility Name	Years in service; Status; Size[d]	Waste received or produced
1607-D4	Septic tank	1944-1968	Received sanitary waste from 115-D gas recirculation building.
1607-D5	Septic tank	b	Received sanitary waste from 181-D river pumphouse. Received no hazardous wastes.
c	Septic tank at N93050 and W52850	b	b
c	Sanitary sewer tile field	b Still on site	b
		RCRA-Permitted Facilities	
120-D-1 (100-D)	Ponds	1977-present Site visit 3/8/89 revealed water standing in one pond; size (combined dimensions) - 67 m (220 ft) x 55 m (180 ft)	Received sandfilter backwash (nonhazardous), small quantities of filtered/ chlorinated water from hydraulic test loops and fuel discharge trampoline tests. Received demineralizer recharge effluent from floor and sink drains.
		Support Facilities	
(1714-D)	Solvent storage	b Demolished in 1978 or 1979	Contained solvents.
(1716-D)	Gas station	b Demolished in 1978	Leaded gasoline and waste oil.

Table 1. Waste Transfer, Treatment, Storage, Disposal, and Related Facilities in the 100-DR-1 Operable Unit Area. (Sheet 8 of 12)

Site designation number[a]	Facility Name	Years in service; Status; Size[d]	Waste received or produced
(1715-D)	Oil and paint storage	b Concrete slab found	Oil and paint.
(1734-D)	Cylinder storage	b	b
(1722-D)	Equipment development lab	b Still on site	None identified.
(181-D)	River pumphouse (serves D and DR)	1944-present still on site	None identified.
(182-D)	Reservoir and pump-house	1944-present still on site	None identified.
(183-D)	Filter plant operations building	1944-present still on site	Possibly oxidants and alum.
(186-D)	Demineralization building	b Has been demolished	None identified.
(185-D)	Thermal hydraulics building	b Still on site	None identified.
(189-D)	Storage yard	b Still on site	b
(189-D)	Mechanical development lab	b Still on site	After shutdown this building was used for fuel-element testing. Unirradiated fuel elements were purposely ruptured during testing, which may have resulted in potential uranium contamination.
(190-D)	Pump house	b Structure still on site	None identified.

Table 1. Waste Transfer, Treatment, Storage, Disposal, and Related Facilities in the 100-DR-1 Operable Unit Area. (Sheet 9 of 12)

Site designation number[a]	Facility Name	Years in service; Status; Size[d]	Waste received or produced
(190-DA)	Pump house annex	b	None identified.
(195-D)	Vertical rod safety test tower	b Structure still on site	None identified.
(1724-DA)	Underwater test facility	b Structure still on site	b
(184-D)	Powerhouse	b Has been demolished	None identified.
(184-DA)	Steam generating facility	b Has been demolished	b
(1707-D)	Change house	b	None identified.
(1707-DA)	Change house	b Has been demolished	None identified.
(1713-D)	Instrument and electrical development lab	b Still on site	None identified.
(1717-D)	Combined shops/change room	b Has been demolished	None identified.
(1719-D)	First aid	b Has been demolished	None identified.
(1701-DA)	Office building/badge house	b Still on site	None identified.
(1704-D)	Vault/supervisors office	b Still on site	None identified.
(1703-D)	Technical office building	b Has been demolished	None identified.
(1726-D)	Mobile office trailer	b Still on site	None identified.

Table 1. Waste Transfer, Treatment, Storage, Disposal, and Related Facilities in the 100-DR-1 Operable Unit Area. (Sheet 10 of 12)

Site designation number[a]	Facility Name	Years in service; Status; Size[d]	Waste received or produced
(1727-D)	Mobile office trailer	b Still on site	None identified.
(1728-D)	Mobile office trailer	b Still on site	None identified.
(1729-D)	Mobile office trailer	b Still on site	None identified.
(1731-D)	Mobile office trailer	b Still on site	None identified.
c	Paint shop (west of 182-D reservoir)	b Has been removed	b
		Tanks and Related Facilities	
130-D-1 (1716-D)	Gasoline storage tank	1944-1950's Removed in July 1989 as part of ongoing Hanford Site underground gasoline storage tank removal program; size - 15,140 L (4,000 gallons)	Stored leaded gasoline.
(166-D)	Fuel oil tank	b Has been removed; size - 681,300 L (180,000 gallons)	Fuel oil.
c	Fuel oil line Associated with 166-D tank	b Buried	Fuel oil.

Table 1. Waste Transfer, Treatment, Storage, Disposal, and Related Facilities in the 100-DR-1 Operable Unit Area. (Sheet 11 of 12)

Site designation number[a]	Facility Name	Years in service; Status; Size[d]	Waste received or produced
		Tanks and Related Facilities (Continued)	
c	Fuel oil tank	b Buried; scheduled for removal in 1990	Fuel oil.
c	Waste acid reservoir	b Buried	b
c	Sodium dichromate tanks	b Have been removed	Stored sodium dichromate.
(110-D)	Helium storage tank	b Has been removed	None.
	Solid Waste Landfill, Ash Disposal Basin, Burial Grounds, and Salt Dissolving Pit		
126-D-1 (188-D)	Ash disposal basin	1950-1960 Ash piles still on site	Unknown amounts of coal ash from 184-D power house sluiced to pits with raw river water. Tested ash was nonhazardous (Dorian and Richards 1978).
126-D-2	Solid waste landfill	1966-1986 Covered with ash-like material	Coal storage pre 1966; received decommissioning/demolition waste post 1966. Drum seen in photograph. Asbestos-looking material on surface, tested ash was nonhazardous (Dorian and Richards 1978).
c	Burial grounds 4A, 4B, 18	b	Received radioactive and non-radioactive solid waste.
c	Salt dissolving pit	b	Possibly contained salt used in water softeners.

Table 1. Waste Transfer, Treatment, Storage, Disposal, and Related Facilities in the 100-DR-1 Operable Unit Area. (Sheet 12 of 12)

Site designation number[a]	Facility Name	Years in service; Status; Size[d]	Waste received or produced
		Electrical Facilities	
c	Transformers, capacitors, etc.	b Some still on site	Potential polychlorinated biphenyl contamination of soils.

[a]Waste Information Data System (DOE-RL 1989a); Non-WIDS designation numbers in parentheses. Numbers with asterisk represent facilities included in NPL nomination.
[b]No information currently available.
[c]No site designation number.
[d]Size given only if exact dimensions are available.

2.1.4.1 Reactor Building and Associated Disposal Facilities. This category includes all facilities involved with the 118-D-6 (105-D) reactor and the effluents generated by reactor operations, decontamination activities, and fuel storage that are not discharged immediately into the process effluent pipelines.

2.1.4.1.1 118-D-6 (105-D) Reactor Building. This building houses the plutonium production reactor, which is no longer operational. The 118-D-6 (105-D) building is located in the southeast corner of the operable unit. It is surrounded by a placarded chain-link security fence.

Along with most of the other facilities in 100-DR-1, the 118-D-6 building was constructed in 1943 and operated from 1944 through 1967. The building consists of the following:

- The reactor moderator stack, an assembly of graphite blocks with channels for the process tubes, control rods, and other equipment
- The process tubes that held the uranium metal fuel elements and provided channels for cooling water
- Control rods, fuel handling equipment, monitoring equipment, experimental test holes, etc.
- The thermal and biological shields
- A welded steel-plate box that encloses the biological shield and served to confine the gas atmosphere within the reactor
- An irradiated fuel storage basin (Dorian and Richards 1978).

The reactor building, although the ultimate source of much of the contamination in 100-DR-1, was not specifically designated in the NPL nomination for the 100 Areas. The ultimate disposition of the 118-D-6 reactor, along with the other retired reactors, is the subject of a draft environmental impact statement (DOE 1989).

2.1.4.1.2 116-D-1A and 116-D-1B (105-D) Fuel Storage Basin Trenches. These trenches received contaminated water and sludge from the 118-D-6 fuel storage basin where irradiated fuel elements were discharged from the 118-D-6 reactor. In the 1950's, sludge was pumped from the fuel storage basin into the fuel storage basin trenches (116-D-1A and 116-D-1B) for disposal (Dorian and Richards 1978). One or both of these trenches received decontamination waste from the 108-D facility. The 116-D-1A trench was 40 m (130 ft) in length, 3 m (10 ft) in width, and 1.8 m (6 ft) in depth. It was covered with clean soil in 1955. The 116-D-1B trench was 30 m (100 ft) in length, 3 m (10 ft) in width, and 4.6 m (15 ft) in depth. It was covered with clean soil in 1967 (DOE-RL 1989a).

2.1.4.1.3 116-D-2 (105-D) Pluto Crib. The 116-D-2 crib, also known as the plutonium or "pluto" crib, was located southeast of the 132-D-3 (1608-D) pumping station. It is situated within the security fence that surrounds the reactor building. This facility, which was specifically included in the NPL proposal, was constructed in 1950 to receive process effluents contaminated by fuel element ruptures (DOE-RL 1989a).

The crib was small, 3.0 m (10 ft) long and wide, and 3.0 m (10 ft) deep and probably only received the small amounts of process effluent that resided within process tubes containing ruptured fuel. This crib operated only until 1956, at which time it was covered to grade with clean soil. Later sampling efforts in the crib area were inconclusive as to the correct location of the crib (Stenner et al. 1988).

2.1.4.1.4 116-D-6 (105-D) Cushion Corridor Decontamination French Drain. This drain is located within the 118-D-6 (105-D) reactor building security perimeter directly northeast of the building. The drain is 0.9 m (3 ft) in diameter and 0.9 m (3 ft) deep, and is made of vitreous tile conduit. This drain received domestic water from the changing room and very low-level radioactive contaminates from the personnel mask decontamination station. The NPL nomination specifically referenced this facility.

2.1.4.2 Process Effluent Pipelines. Process effluent pipelines emanate from the 118-D-6 (105-D) and 118-DR-2 (105-DR) buildings (D and DR reactor buildings, respectively) to the various process effluent disposal and treatment facilities. These lines continue out from the 116-D-7 (107-D) and 116-DR-9 (107-DR) basins (described below) to both the river and disposal trenches. Several drawings show alternate layouts for these pipelines west of the 116-D-7 retention basin. The lines are constructed of carbon steel and/or concrete pipe and are buried below the land surface. They are presumably still in place. Portions of this transfer system lie beneath areas surrounded by security fences.

These pipelines, which transferred reactor coolant and some decontamination wastes, were not specifically referenced in the NPL nomination for the 100 Areas. Some of these pipelines are known to have developed leaks at various times during their periods of operation (Dorian and Richards 1978). Leaks along the effluent lines about 492 m (150 ft) southeast of the 116-D-7 retention basin were reported in 1951. Extensive leakage also occurred at the inlet end of the 116-DR-9 retention basin in 1952 as a result of the pipes pulling loose from the basin wall. The locations of other possible leaks along the pipelines are currently unknown.

2.1.4.3 Retention Basins and Related Facilities. This category includes all facilities involved with the 116-D-7 (107-D) and 116-DR-9 (107-DR) retention basins and the liquid and sludge wastes remaining after primary settling, radioactive decay, and thermal cooling.

2.1.4.3.1 116-D-7 and 116-DR-9 (107-D and DR) Process Effluent Retention Basins. The 116-D-7 and 116-DR-9 retention basins were located in the north-central portion of the 100-DR-1 operable unit and received process effluents, primarily cooling water effluent, from the 118-D-6 and 118-DR-2 reactors, respectively. The 116-D-7 basin was 142 m (467 ft) long, 70 m (230 ft) wide, and 6.1 m (20 ft) deep; and the 116-DR-9 basin was 182 m (600 ft) long, 70 m (230 ft) wide, and 6.1 m (20 ft) deep (Stenner et al. 1988). The

116-DR-9 (107-DR) basin was constructed above the tile field for the 1607-D2 septic tank, but this tile field was subsequently relocated north of the basin.

These facilities were designed to retain cooling water effluent to allow for radioactive decay and thermal cooling. The effluent was then discharged directly to the Columbia River. Decontamination wastes from the 118-D-6 (105-D) reactor building drains were also pumped into the process effluent pipeline by the 132-D-3 (1608-D) pumping station (discussed below).

Reactor effluents were normally routed to one of the two concrete-lined cells of these basins. In the event of a fuel-element cladding rupture, cooling water would come in direct contact with the uranium fuel, thereby picking up high-activity fission products. When this occurred, the water from the side of the basin that had received the contaminated effluent would be drained to the 116-DR-1 or 116-DR-2 liquid waste process effluent disposal trenches (described in Section 2.1.4.3.3) for soil column disposal (Dorian and Richards 1978). Normal cooling water would then be routed to the empty cell of the basin.

Beginning approximately 1954, concern surfaced as to the structural integrity of the 116-D-7 and 116-DR-9 basins because process effluents were leaking from the cells containing water into the cells that were empty at the time. In addition, the volume of cooling water being used had increased to the point where there was concern about the potential for overflow. Therefore, a new policy required that the basins be operated in parallel. This enabled the basins to be kept full at all times. Upon implementing this procedure there was essentially no means of segregating the ruptured fuel- element effluent. A groundwater study in 1962 indicated that these basins, and/or their associated effluent lines, were leaking substantially (Dorian and Richards 1978).

Sludge from the 116-D-7 and 116-DR-9 retention basins was removed in 1953. The material was placed in the adjacent 107-D and 107-DR sludge disposal trenches surrounding the basin area (see Section 2.1.4.3.4).

The concrete walls of the 116-D-7 (107-D) and 116-DR-9 (107-DR) basins have been demolished and pushed into the basins, and the facilities are now covered with clean gravel. The basins were designated in the 100 Areas NPL nomination. A security fence has been placed around the basins and radiation warning signs are posted.

2.1.4.3.2 Area Around the Basins. The area around the basins includes the area north of the retention basins and immediately adjacent to the basins as well as along the alignment of the outfalls and outfall structures. The area south of the basins containing the process effluent pipelines was described in Section 2.1.4.2. The area around the basins has been included in this section because of reports of substantial leakage from the basins. Verbal reports of vapor rising from the ground north of the basins during reactor operation indicate a potential pathway of contamination. Included within this area are two sanitary water pipelines identified on drawings of the sanitary and export water systems. A 15.24-cm (6-in) water line surrounds the 116-DR-9 process effluent retention basin and was installed to provide fire protection. It is unclear as to the use of the 7.62-cm (3-in) cast iron pipeline located just west of the 116-D-7 process effluent retention basin. These pipelines could possibly have provided a means of transport for contaminated water from the retention basin area to the center portion of the plant if infiltration occurred.

2.1.4.3.3 116-DR-1 and 116-DR-2 Process Effluent Disposal Trenches. The 116-DR-1 and 116-DR-2 trenches were located directly east of the 116-DR-9 (107-DR) retention basin, in the northeast corner of the operable unit. The 116-DR-1 trench was about 91 m (300 ft) in length, 4.6 m (15 ft) in width, and 6.1 m (20 ft) deep; and the 116-DR-2 trench was 46 m (150 ft) in long, 3.0 m (10 ft) wide, and 6.1 m (20 ft) deep (Stenner et al. 1988). These NPL-designated facilities served as emergency disposal cribs for process effluents contaminated by fuel-element ruptures. When such ruptures occurred, process effluents were diverted from the 116-D-7 and 116-DR-9 basins to these facilities to prevent direct discharge of the highly contaminated waste stream to the Columbia River.

After 1954, when both sides of the 116-D-7 and 116-DR-9 basins began to be used simultaneously, these facilities were apparently no longer used (Dorian and Richards 1978). However, there is no information about where fuel-element rupture effluents were disposed of after that time.

2.1.4.3.4 107-D and 107-DR Sludge Disposal Trenches. Five sludge disposal trenches were excavated around the 116-D-7 and 116-DR-9 retention basins to dispose of accumulated sludges from the basin bottoms while the basins were being repaired in 1953. The trenches were covered with clean soil when work was completed. It is possible that materials from these trenches were used as fill in the 116-D-7 (107-D) and 116-DR-9 (107-DR) retention basins when they were undergoing deactivation (Dorian and Richards 1978). It is also possible that this sludge included sands and silt from blowing winds because of the physical location of the basins.

2.1.4.3.5 116-D-5 and 116-DR-5 (1904-D and 1904-DR) Process Effluent Outfall Structures and Discharge Pipelines. The 116-D-5 and 116-DR-5 outfall structures were located west of the 116-D-7 basin, overlooking the Columbia River. The locations of these structures and pipelines are shown in Figure 5. The 116-D-5 and 116-DR-5 outfall structures received treated process effluents from the 116-D-7 (107-D) and 116-DR-9 (107-DR) retention basins, directing them to the Columbia River. Backwash water from the 183-D filter plant and discharge water from the 185-D/189-D facilities were also reported to have been discharged directly to the 116-D-5 outfall structure prior to the construction of the 120-D-1 ponds. These structures were not specifically referenced in the NPL nomination, but are included in this RFI/CMS.

The pipelines under the Columbia River discharging the effluent from the 116-D-5 and 116-DR-5 outfall structures lie outside the 100-DR-1 operable unit boundary. The pipelines are presumably still in place and extend approximately 564 m (1,850 ft) from the bank to the northern side of the small island in the Columbia River. The pipelines are buried beneath the island adjacent to the bank where the outfall structures were located.

2.1.4.4 Contaminated Reactor Ancillary Facilities. This includes all facilities involved with the secondary wastes from the 118-D-6 (105-D) reactor building maintenance activities that may involve irradiated products. None of these facilities were specifically referenced in the NPL nomination.

2.1.4.4.1 103-D Fuel Element Storage Building. The fuel-element storage building is located just north of the 118-D-6 reactor building and is contained within the security fence surrounding the reactor. During the period of reactor operation this building was used to store unirradiated fuel elements before they were used in the reactor (Dorian and Richards 1978). A field visit in March 1989 revealed two signs located on the outside of the building identifying solvent and herbicide storage. Verbal accounts indicated that this building most recently housed 100-DR-1 radioactive samples, and that the building has been subsequently cleaned and no longer contains herbicide and solvent containers or samples. The specific types of herbicides that were stored at this facility are currently unknown.

2.1.4.4.2 108-D Office Building and Equipment Decontamination Station. This building was located just north of the 103-D fuel-element storage building. The building was a large structure with 3 floors and a basement, approximately 40.2 m (132 ft) in length, 9.75 m (32 ft) in width, and 12.5 m (41 ft) in height. The 108 buildings were originally built in all of the reactor areas for the purpose of adding chemicals to the process water before it entered the reactor. Two large stainless steel tanks were constructed on the west side of the building for storage of sodium dichromate. However, the original purpose for this building was abandoned and the building was used as an office complex and a decontamination and repair shop for contaminated reactor process tube replacement equipment. The building was connected to a sanitary sewer pipeline and housed drains that were connected to the process effluent pipeline. Two cribs, 116-D-3 and 116-D-4, were located east of the building to receive waste that was to be disposed of to the soil column.

2.1.4.4.3 132-D-3 (1608-D) Effluent Pumping Station. This facility was located in the southeast corner of the operable unit, within the 118-D-6 (105-D) building security fence, near the southeastern edge of the reactor building. This station collected and pumped water from the 118-D-6 building drains into the process effluent system and to the 116-D-7 (107-D) and 116-DR-9 (107-DR) retention basins. The primary source of water came from the fuel storage basin overflows. The 132-D-3 (1608-D) pumping station was not specified in the NPL nomination.

2.1.4.4.4 115-D Gas Recirculation Building. This building housed the driers and injection and circulation equipment that was used to recirculate the helium and carbon dioxide cover gases in the 118-D-6 (105-D) and 118-DR-2 (105-DR) reactors. This building was demolished in 1986.

2.1.4.4.5 117-D Exhaust Air Filter Building. The 118-D-6 (105-D) reactor building exhaust air filters and air flow control systems were housed in the 117-D building. Reactor exhaust gases passed through both particulate and activated charcoal filters in a two-filter cell underground facility that was 18 m (59 ft) in length, 12 m (39 ft) in width, and 11 m (35 ft) high. Contaminated concrete ventilation and gas piping tunnels connected this facility with the reactor exhaust stack. The 117-D filter building was built in 1960 and began operation in 1961. This building was demolished in 1986.

2.1.4.4.6 132-D-4 (116-D) Reactor Exhaust Stack. The reactor stack is located directly to the southeast of the 118-D-6 (105-D) reactor building, within the reactor complex security fence. This 61-m (200-ft) stack received filtered exhaust air from the 117-D building. Dorian and Richards (1978) report that contamination is present.

2.1.4.5 Miscellaneous Cribs and Trenches.

2.1.4.5.1 116-D-3 and 116-D-4 (108-D) Cribs #1 and #2. These cribs operated as French drains and were 9 m (30 ft) in diameter and 1.5 m (5 ft) deep. They received low-level wastes from the 108-D equipment decontamination and repair building. Effluents from the cask decontamination pad in the 108-D building were disposed of into the 116-D-3 crib. Both cribs are now covered with soil (Dorian and Richards 1978).

2.1.4.5.2 116-D-9 (117-D) Reactor Confinement Seal Pit Drainage Crib. This small, 3 m by 3 m (10 ft by 10 ft) disposal crib is directly east of the 118-D-6 reactor building, outside of the fence that encompasses the reactor building. Water from seal pits in the 117-D exhaust air filter building was transferred to this crib for disposal. Air emitted from reactor spaces was filtered in the confinement system before being discharged through the 132-D-4 (116-D) reactor exhaust stack.

This facility was constructed in 1960, when controls on air emissions from the reactor were first installed. The crib was last sampled in 1978 (Stenner et al. 1988) and was specifically designated in the NPL proposal.

2.1.4.6 Sanitary Sewage Transfer, Treatment, and Disposal Facilities. Sanitary sewage generated at the 100-D/DR Area was treated in underground septic tanks and subsequently discharged to associated tile fields. There is no documentation of hazardous wastes being disposed of in any of these facilities, and none were specifically referenced in the NPL nomination. However, because of the diversity of the support functions carried out in the 100-D/DR Area (e.g., the laboratory and the maintenance shops, which included a paint shop and an automotive repair shop), it is conceivable that some chemical or radiological wastes could have been disposed of in these facilities. It is currently unknown whether any sludges were pumped from the septic tanks, and if so, where they were disposed.

2.1.4.6.1 Sanitary Sewer Pipelines. Sanitary sewage was collected from the various buildings within the 100-D/DR Area and transported to at least three different septic systems. No details as to the construction of these pipelines are available, but such pipelines in the 300 Area were constructed of vitreous tile pipe. These pipelines are presumably still in existence.

2.1.4.6.2 1607-D2 Sanitary Septic System. This tank served the 182-D, 183-D, 190-D, and several 1700-D office and maintenance service buildings. It also served the 118-D-6 reactor building. The septic tank is located in the 116-D-7 and 116-DR-9 retention basin area in the northeast corner of the 100-DR-1 operable unit. The associated tile field was constructed in the location of 116-DR-9 but was relocated in 1950 when 116-DR-9 was constructed. A field visit in March 1989 revealed a small quantity of flow along the pipeline.

2.1.4.6.3 1607-D4 Sanitary Septic System. This septic tank received sanitary sewage from the 115-D gas recirculation building. It is located in the southeast corner of 100-DR-1 near the 118-D-6 reactor building and related facilities.

2.1.4.6.4 1607-D5 Sanitary Septic System. This tank and drainfield received sanitary sewage from the 181-D river pumphouse. It is located in the southwest corner of 100-DR-1 near the banks of the Columbia River adjacent to the river pumphouse.

2.1.4.6.5 Septic Tank at N93050 and W52850 (existence questionable). There is no information as to the waste received at this location or whether a septic tank in this location even existed. According to sewer drawings, this is a drop manhole structure.

2.1.4.7 Resource Conservation and Recovery Act of 1976 Facilities. The 100-DR-1 operable unit currently contains one waste storage and treatment facility subject to permitting and/or closure as a TSD facility under RCRA, the 120-D-1 (100-D) ponds. These ponds are located in the 188-D ash disposal basin just north of the 184-D powerhouse. In 1977, the original ash pit was excavated to a depth of 9 m (30 ft) below grade and 0.8 ha (2 ac) in area. The ponds occupy approximately half of the area of the original ash pit. The ponds received backwash water from the 183-D filter plant, and discharge water from the 185-D/189-D thermal hydraulics test and fuel discharge trampoline test facilities. The waste stream also contained demineralizer that contained hydrochloric acid. This constituent was the reason for the ponds' listing as a RCRA site. In 1979, a dike was constructed to form a settling pond and a percolation pond. Since this modification, very little water has been received.

The means of transport for this waste was a 2.06-m (6-ft 9-in) wide and 2.06-m (6-ft 9-in) high concrete box structure that was connected to the pipeline that sluiced ash from the 184-D powerhouse building to the 126-D-1 ash pit. Before this water began being transported to the ponds, it was discharged directly to the Columbia River by means of the 116-D-5 outfall structure (see Figure 5 for the probable location of this pipeline).

The 189-D facility was reported to be the location of a satellite hazardous waste storage area, which has been dismantled. The nature of the wastes stored at this facility is currently unknown.

2.1.4.8 Support Facilities. Located throughout the 100-DR-1 operable unit are facilities that provide support services so that the primary function of the reactor building, generation of plutonium, may be accomplished. Limited information was found in the background search on a majority of the buildings. However, it is important that all possible previously existing buildings be identified so that a thorough analysis regarding waste generation and contaminant potential can be made. The buildings that have been identified are listed in Table 1. Their locations, whether existing or demolished, are shown in Figure 5. The waste handling procedures for these facilities are currently unknown. The facilities that are of primary concern include the following:

- The 189-D mechanical development and fuel element testing building
- The 1714-D solvent storage building
- The 1715-D oil and paint storage
- The 1716-D gas station and bus maintenance shop
- The 1722-D equipment development lab
- The 1724-DA underwater test facility
- The 1734-D cylinder storage
- The paint shop located west of the 182-D reservoir.

Upon shutdown, the 189-D building was used for fuel-element testing and served as a mechanical development lab. The building is a part of the same structure as the 190-D building west of the 118-D-6 reactor building. Unirradiated fuel elements were purposely ruptured during testing, which presents a possible source of contamination. Limited information has been found as to the quantity or extent of use. The 189-D facility is connected to a sanitary sewer line.

The 1714-D solvent storage building was located east of the 184-D powerhouse. It was removed in 1978-79 and the solvent material was reportedly taken to other areas. The building was demolished and taken to the solid waste landfill (see Section 2.1.4.10.1). The quantities of solvent and extent of this building's operations are unknown.

The 1715-D oil and paint storage and 1734-D cylinder storage facilities are relatively small areas located north of the 1717-D combined shops building. It is unclear whether these were enclosed areas or not. Estimates of quantities and a description of types of cylinders are unknown.

The 1716-D gas station and bus maintenance building was located northwest of the 190-D building and performed normal operations associated with a gas/maintenance station. An underground gasoline storage tank was located east of this building (see Section 2.1.4.9.1). The size and extent of operations is unknown. The 1716-D gas station was decommissioned in 1978.

The 1722-D equipment development lab is included because of some existing structures on the north side that are unidentified. A concrete slab with 5.08-cm (2-in) pipes protruding could possibly indicate an underground tank or a foundation for another building. An enclosed, bolted, metal structure is located in the west side of the slab and appears to have an electrical conduit penetrating the enclosure. Further information is required for these two areas. The 1722-D facility is connected to a sanitary sewer line.

No information was obtained during work plan development on the use of the 1724-DA underwater test facility.

A building labeled 'Paint Shop' was located on site drawings west of the 182-D reservoir. Buildings at the approximate location were also noted in photographs. No other documentation of the building or materials stored there has been found.

In addition to the above facilities, the following support facilities are also included:

- Various buried pipelines
- Partially dismantled rail spur
- Old service roads.

Some of the facilities have the potential to interfere with certain types of field investigation and activities or with subsequent implementation of the corrective measures. The pipelines could have served as preferred pathways for contaminant migration.

2.1.4.9 Tanks and Related Facilities. Drawings and field visits revealed the presence of miscellaneous underground tanks and a waste acid reservoir.

2.1.4.9.1 130-D-1 (1716-D) Gasoline Storage Tank. The underground gasoline storage tank was located on the east side of the 1716-D gas station. Following the deactivation of the 100-D/DR Areas the tank was emptied and filled with water (DOE-RL 1989a). During a site visit in March 1989, the tank was located by an aboveground vent pipe. A rock dropped into the tank hit the tank's bottom, indicating that the tank was empty and had leaked. This tank was removed in July 1989 as part of an ongoing underground gasoline storage tank removal program at the Hanford Site. Visual examination after removal indicated that the tank was heavily rusted over most of its exterior. A hole was noted that is suspected of being the source of contamination identified in the soil beneath the tank.

2.1.4.9.2 Waste Acid Reservoir. A large underground brick structure that was intended for use as a waste acid storage facility was located on the west side of the 186-D building. Information is limited as to whether this was ever used for its intended purpose and what the process was that generated the waste product. It is possible that chromic acid, used in the treatment of process water, could have been an acid contained in this reservoir. Photographs verify the existence of the structure. The size is questionable; drawings indicate a size of approximately 27 m (90 ft) x 27 m (90 ft), but verbal accounts indicate a size of approximately 9 m (30 ft) x 9 m (30 ft). A manhole cover nearby may mark the location of a suspected sump for the waste acid reservoir. A recent site visit showed that soil materials in a caved portion of this manhole were discolored with yellow and blue stains.

2.1.4.9.3 Fuel Oil Tank. An underground fuel oil tank is located just west of the 184-DA steam generating building. This facility was constructed and placed in operation following plant shutdown and deactivation. In the facility, the fuel fed the boilers to generate electricity for the area. The size of the tank is unknown; it is scheduled for removal in 1990.

2.1.4.9.4 166-D Fuel Oil Tank. This aboveground 681,300-L (180,000-gallon) diesel fuel storage tank was located at the confluence of the railroads north of the 184-D powerhouse. Diesel fuel was used to feed the boilers during operation of the plant. The tank has a 137-m (450-ft) fuel oil line that transported oil to the boilers.

2.1.4.9.5. Sodium Dichromate Tanks. Two large tanks for sodium dichromate storage were originally installed aboveground west of the 108-D office and equipment decontamination building in accordance with the original proposed purpose of the 108-D building, of chemical feeding for water process water treatment. It is thought that these tanks were moved to a location south of the 190-D building, but this has not been confirmed.

2.1.4.9.6 110-D Helium Storage Tank. This storage area was located in the southeast corner of the 100-DR-1 operable unit. Helium was used in the 115-D gas recirculation building as one constituent of the cover gas for the reactor moderator. No waste generation is associated with this storage facility.

2.1.4.10 Solid Waste Landfill, Ash Disposal Basin, Burial Grounds, and Salt Pit

2.1.4.10.1 126-D-2 Solid Waste Landfill. Radioactive solid waste generated within the 100-D/DR Area was disposed of in the 118-D-3 solid waste burial grounds located within the 100-DR-2 operable unit area. However, a 1983 photograph indicated the presence of a landfill in the 100-DR-1 operable unit. Verbal accounts verified that in 1966, when the 184-D coal storage area located west of the 184-D powerhouse was no longer used for storing coal, it was subsequently used as an open landfill for approximately 20 years. It was covered in 1986. Most of the materials disposed of included decommissioning/demolition wastes, concrete, steel, and other building materials. There are no reports of radioactive material at this location. A field visit revealed a possible asbestos-looking material scattered on the surface. The 1983 photograph revealed a drum. No one individual monitored the waste received at this site.

2.1.4.10.2 126-D-1 (188-D) Ash Disposal Basin. This site received unknown quantities of ash from the 184-D powerhouse during the period when coal was used to generate steam. The ash was sluiced using a water solution from the 184-D powerhouse. This water solution subsequently went to the 126-D-1 ash disposal basin. The eastern half of the ash disposal basin was excavated in 1977 for the 120-D-1 (100-D) ponds. Currently piles of ash approximately 7 to 9 m (20 to 30 ft) high remain on site. Tested ash was nonhazardous (Dorian and Richards 1978).

2.1.4.10.3 Burial Grounds No. 4A, 4B, and 18. These burial grounds are located in the southeast portion of the 100-DR-1 operable unit and were among several small construction burial grounds that are now collectively known as the 118-D-4 Construction Burial Ground. There is a discrepancy in the description and location of these burial grounds. They received both radioactive and nonradioactive wastes.

2.1.4.10.4 Salt Dissolving Pit. The salt dissolving pit was located north of the 184-D powerhouse. Little is known about the site, but verbal accounts suggest it contained salt, which was used in a water softener.

A recent field investigation revealed an area of reduced vegetation that corresponds with the location of the pit on site drawings.

2.1.4.11 Electrical Transmission Facilities. This category includes the transformers, capacitors, switches, and other miscellaneous electrical facilities within the 100-DR-1 operable unit. The main substation for the 100 D/DR Area was located within the 100-DR-2 operable unit. However, many substations are located throughout 100-DR-1. All PCB transformers on the Hanford Site have been characterized for PCB content and are tracked on a computer file. Transformers are inspected regularly, and any leaks are addressed promptly. However, there is a possibility of PCB-contaminated soil due to past practices.

2.2 OPERABLE UNIT SETTING

2.2.1 Topography

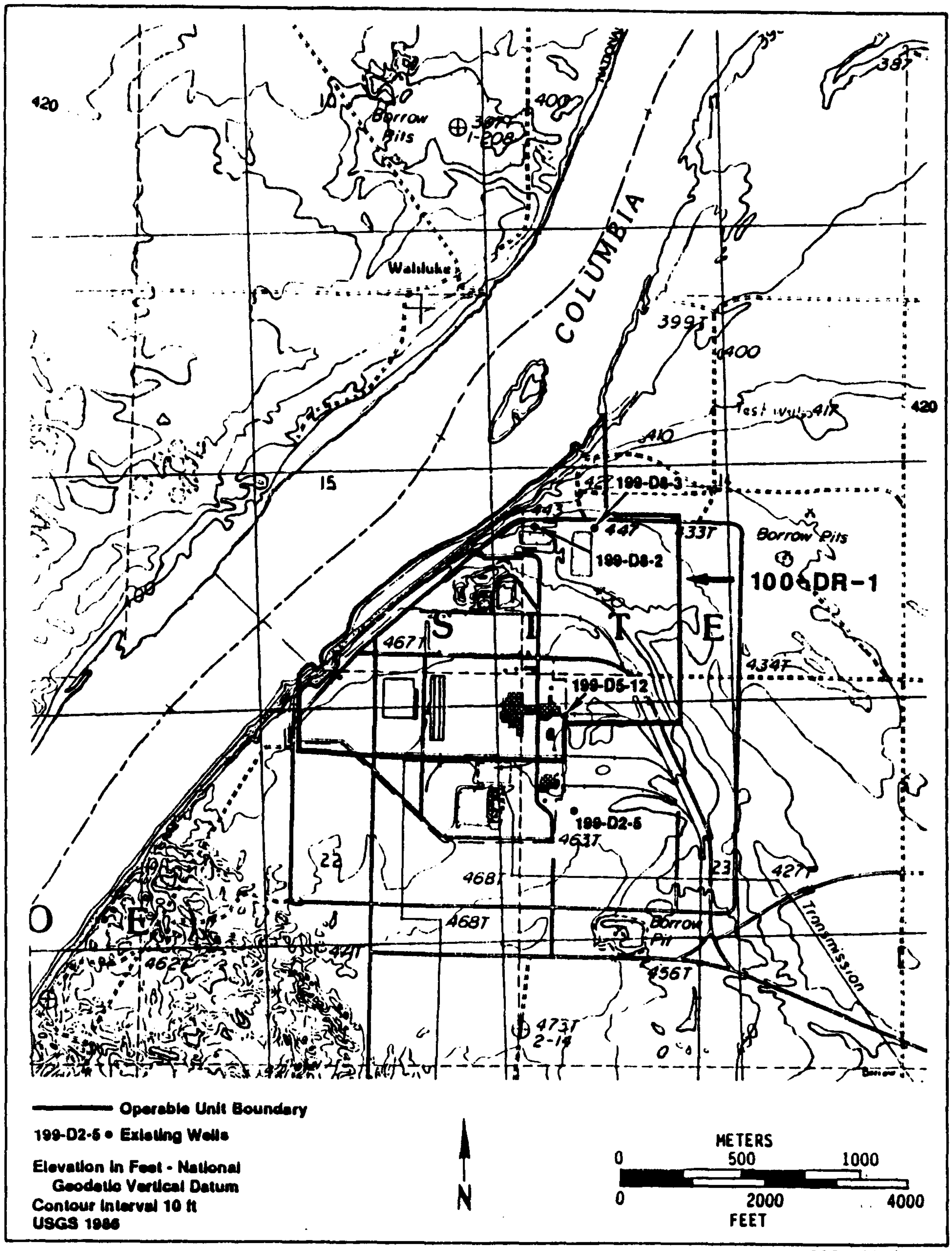
The 100-DR-1 operable unit is situated on an essentially flat, semiarid bench within the Pasco Basin (a structural and topographic basin that includes the Hanford Site) immediately southeast of a portion of the free-flowing Hanford reach of the Columbia River. A topographic map of the operable unit and surrounding area is presented in Figure 6. The elevation of the land surface near the center of the site is approximately 142 m (466 ft) above mean sea level (amsl).

The land surface slopes gently to the northeast (about 1% gradient) to an elevation of approximately 134 m (440 ft) amsl. A steep embankment of about 18 m (60 ft) is present at the river's edge along the northwestern margin of the unit (USGS 1986). The Columbia River lies at an elevation of approximately 119 m (390 ft) amsl.

2.2.2 Geology

The scope of the 100-DR-1 geologic investigation is to characterize the surficial materials and the vadose zone at the 100-DR-1 operable unit. Therefore, the following geologic description is limited primarily to local suprabasalt stratigraphy. An investigation of local structural features in the basalts does not lie within the scope of this work, and is covered in the 100-HR-3 work plan.

The three uppermost stratigraphic units beneath the 100-D/DR Area are (from oldest to youngest) the Saddle Mountains Basalt of the Columbia River Basalt Group, which is the uppermost bedrock unit, and two overlying unconsolidated sedimentary units, the Ringold Formation and the Hanford formation (informal name). Although there are four monitoring wells in the 100-D/DR Area (shown in Figure 6), none of these are deep enough to penetrate the Saddle Mountains Basalt. The generalized upper stratigraphic column for the 100-DR-1 operable unit (shown in Figure 7) is based on the stratigraphic column for the nearby 100-H Area, where more-detailed geologic studies have



883-1736/13632

Figure 6. Topographic Map.

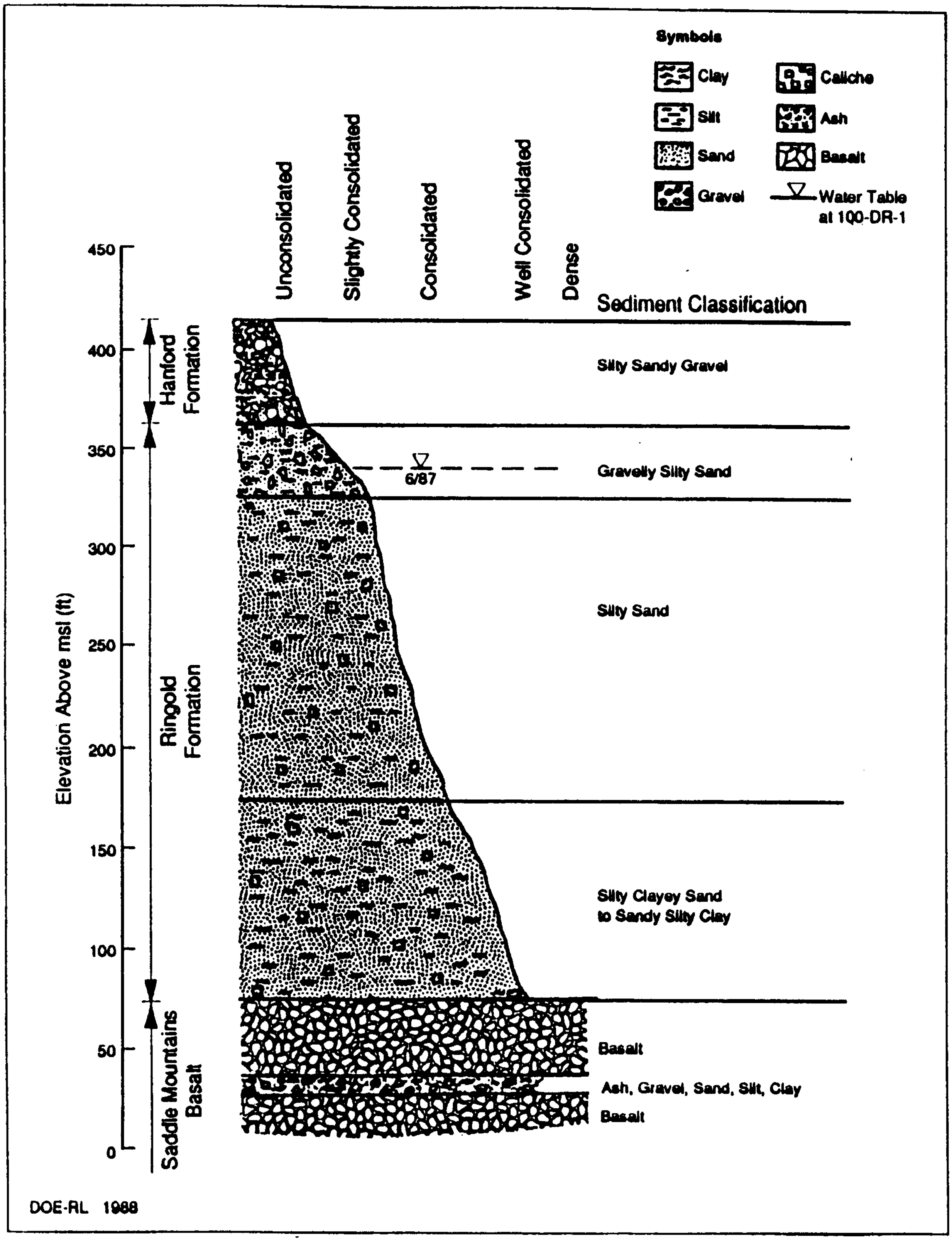


Figure 7. Generalized Stratigraphic Column for the 100-H Area, Assumed to be Similar in the 100-D/DR Area.

been performed. Borehole geophysical logs are not available for the 100-D Area wells. However, geophysical data used to discern stratigraphic relationships in the nearby 100-N Area are currently available (Prater 1984). The basalt surface at the operable unit dips gently to the south-southwest, and no bedrock geologic structures are currently known to exist at the operable unit. Geologic structures in the upper portion of the Ringold Formation and the Hanford formation have not been reported.

2.2.2.1 Saddle Mountains Basalt. The Saddle Mountains Basalt underlies the Ringold Formation beneath the 100-D/DR Area. This basalt is the youngest formation of the Miocene-age Columbia River Basalt Group, a thick sequence of flood basalts that covers a large area in eastern Washington, western Idaho, and northeastern Oregon. The Columbia River Basalts erupted from vent systems in north-central and northeastern Oregon, eastern Washington, and western Idaho and accumulated within the downwarping Pasco Basin to depths in excess of 3,050 m (10,000 ft) (DOE 1988). Sedimentary units, or interbeds, of the Ellensburg Formation occur within the Saddle Mountains Basalt. Ellensburg Formation sediments include both fluvial facies and volcaniclastic facies. The basalt surface in the 100-D/DR Area lies approximately 140 m (460 ft) below the ground surface (Myers/Price et al. 1979) and dips gently to the south-southwest toward the Wahluke Syncline (Figure 8).

2.2.2.2 Ringold Formation. The Ringold Formation overlies the Saddle Mountains Basalt and consists of horizontally stratified deposits of sand, silt, clay, and minor gravel. The Ringold Formation is late Miocene to late Pliocene in age (DOE 1988) and is interpreted to represent fluvial, overbank, lacustrine, and fanglomerate deposits. Four units of the Ringold Formation have been identified by DOE (1988) south of Gable Mountain, where the Ringold is interpreted to consist of main river-channel facies. These units include, from upper to lower:

- fine sands and muds of the upper Ringold;
- occasionally cemented sand and gravel of the middle Ringold;
- clay, silt, fine sand with lenses of gravel in the lower Ringold; and
- sand and gravel of the basal Ringold (DOE 1988).

Interpretations based on logs of the four monitoring wells in the 100-D/DR Area (199-D8-2, 199-D8-3, 199-D5-12, and 199-D2-5) suggest that all of these units, except the upper Ringold unit, appear to be present at the site. However, the shallow depth of these wells and the lack of data concerning the basal and lower Ringold units make detailed stratigraphic interpretations difficult.

The Ringold Formation facies in the 100-D/DR Area is interpreted by DOE (1988) to consist mostly of floodplain-overbank deposits. Three units of the Ringold Formation have been identified by DOE-RL (1988), principally on the basis of texture, in 100-H Area wells approximately 3.5 km (2 mi) east-northeast of the 100-D/DR Area. Given the flat, uniform topography of the area and the depositional history of the Ringold, the Ringold Formation

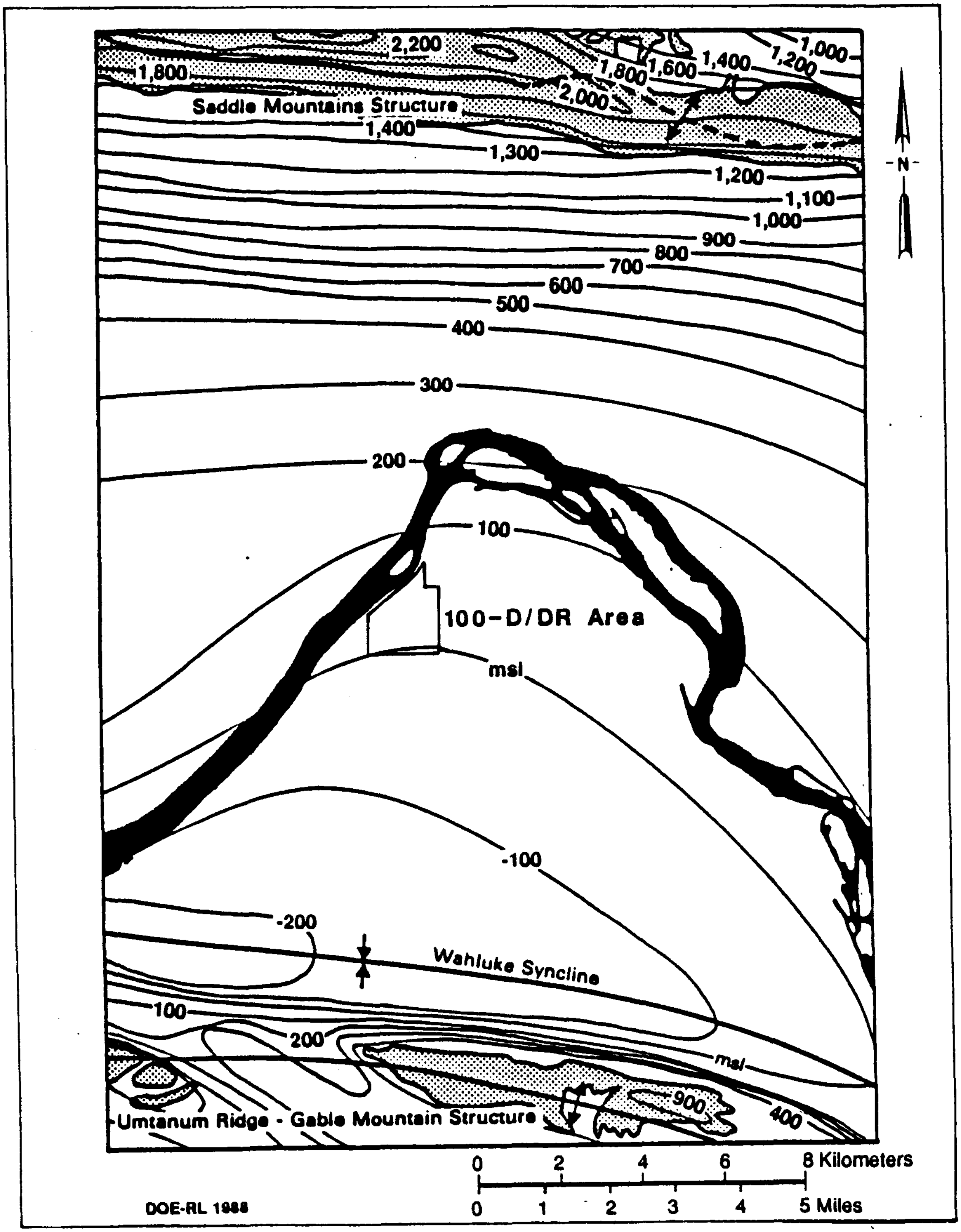


Figure 8. Surface of the Saddle Mountains Basalt Formation Near the 100-D/DR Area (Contours in Feet Above or Below Mean Sea Level).

units are assumed to be similar to those in the nearby 100-H Area. These units are, from upper to lower, as follows,

- Gravelly silty sand
- Silty sand
- Silty clayey sand to sandy silty clay.

If it can be assumed that the 100-D Area stratigraphy is similar to that at the 100-H Area, then these three units may be considered to be the middle, lower, and basal units of the Ringold, respectively. Well logs from the 100-N Area show similar Ringold Formation stratigraphy.

The gravelly silty sand at the top of the Ringold Formation in the 100-H Area is poorly sorted, reddish-brown, and unconsolidated to slightly consolidated and includes quartz-rich and basaltic sediments and some caliche (DOE-RL 1988). The unit consists of 5% gravel, 70% sand, 20% silt, and 5% clay and is about 11 m (35 ft) thick in the 100-H Area. The silty sand unit of the Ringold Formation in the 100-H Area is well sorted and consists of quartz-rich and basaltic sediments, with some caliche, and is approximately 44 m (145 ft) thick in the 100-H Area. The silty-clayey-sand to sandy-silty-clay unit at the base of the Ringold Formation in the 100-H Area typically consists of sand, silt, and clay, with minor gravel and caliche near the top of the underlying basalt (DOE-RL 1988). This unit is approximately 30 m (100 ft) thick in the 100-H Area.

2.2.2.3 Hanford Formation (informal name). The surficial stratigraphic unit at 100-DR-1 consists of poorly sorted, unconsolidated glaciofluvial sediments. These sediments were deposited during episodes of catastrophic flooding associated with failures of the Lake Missoula ice dam during the late Pleistocene epoch (Baker 1981). The last major flood sequence has been dated at about 13,000 yr before present (Mullineaux et al. 1977). Within the Pasco Basin, the coarse-grained main-channel facies of these flood deposits are referred to as the Pasco gravels member of the Hanford formation (informal name) (Myers/Price et al. 1979). A finer-grained slackwater facies of the Hanford formation is known as the Touchet Beds.

The Pasco gravels of the Hanford formation in the 100-H Area consist of a variable mixture of boulders, cobbles, gravel, sand, and silt; however, most of the sediments can be classified as a silty sandy gravel consisting of 50% gravel, 40% sand, and 10% silt (DOE-RL 1988). The gravels are composed mainly of subrounded to rounded basaltic clasts with some quartz-rich and metamorphic clasts; calcium carbonate deposits occur on some clasts. The silts and sands are gray, black, and brown. The sands are quartz-rich and basaltic and very coarse to very fine grained. The Pasco gravels member of the Hanford formation is approximately 20 m (65 ft) thick in the 100-H Area (DOE-RL 1988). Based on 100-DR-1 Area well logs, the Pasco gravels are the dominant facies of the Hanford formation at the site and appear to be approximately 14 m (45 ft) thick. The Ringold/Hanford formation contact therefore occurs at approximately 14 m (45 ft) below ground level. The distinction between the two formations is generally made on the basis of cementation, mineralogy, and grain size. The Ringold Formation is generally finer-grained, has a greater degree of cementation, and a higher percentage of quartz/silica-rich materials.

2.2.2.4 Surficial Deposits. Surficial eolian deposits locally overlie the Hanford formation at the 100-DR-1 Area. The deposits include dune and sheet sand, alluvium, colluvium, and loess, which were derived primarily from reworked Hanford formation sediments. Surficial materials also include coal fly ash and backfill materials, which are commonly indistinguishable from the in-situ gravels and sands.

2.2.3 Hydrogeology

2.2.3.1 Hydrostratigraphy. The hydrostratigraphic units described here for the 100-DR-1 operable unit are based on the hydrostratigraphic units identified during the geohydrologic characterization of the area surrounding the 183-H Solar Evaporation Basins (PNL 1988a; DOE-RL 1988) and the draft RCRA facility investigation/corrective measures study work plan for the 100-HR-3 operable unit on groundwater (in preparation), which includes the 100-D/DR operable unit. Although limited in detail, hydrogeologic information from the 100-N Area was also examined (Gilmore 1989; Prater 1984).

Figure 9 presents a generalized hydrostratigraphic column for the 100-H Area that has been modified using shallow well data from the 100-D/DR Area for defining hydrostratigraphic units in the Hanford formation and the upper portion of the Ringold Formation. Generally, hydraulic potentials increase with depth, which indicates an upward hydraulic gradient. Based on analysis of well data in the 100-H and 100-D/DR Areas, five principal hydrostratigraphic units have been defined in the uppermost stratigraphic column, which includes the upper flow of the Elephant Mountain Member and the overlying suprabasalt sediments. In ascending order starting with basalt, these hydrostratigraphic units are as follows:

- A lower confined aquifer within the Saddle Mountains Basalt
- An upper confined or partially confined aquifer within the silty-clayey-sand to sandy-silty-clay unit of the Ringold Formation
- The unconfined aquifer in silty-sand and gravelly-silty-sand units of the Ringold Formation
- The unsaturated sediments in silty-sand and gravelly-silty-sand units of the Ringold Formation
- The unsaturated sediments of the Hanford formation.

Hydrostratigraphic units below the confined aquifer in the Elephant Mountain Member have not been considered for purposes of this study.

2.2.3.1.1 Lower Confined Aquifer in Uppermost Basalt Unit. The lower confined aquifer occurs within the Elephant Mountain Member of the Saddle Mountains Basalt. Two wells in the 100-H Area penetrate this aquifer: 199-H4-2 and 199-H4-15C. The upper 1.2 m (4 ft) of the basalt flow is thought to be the confining layer for this aquifer in the 100-H Area (DOE-RL 1988),

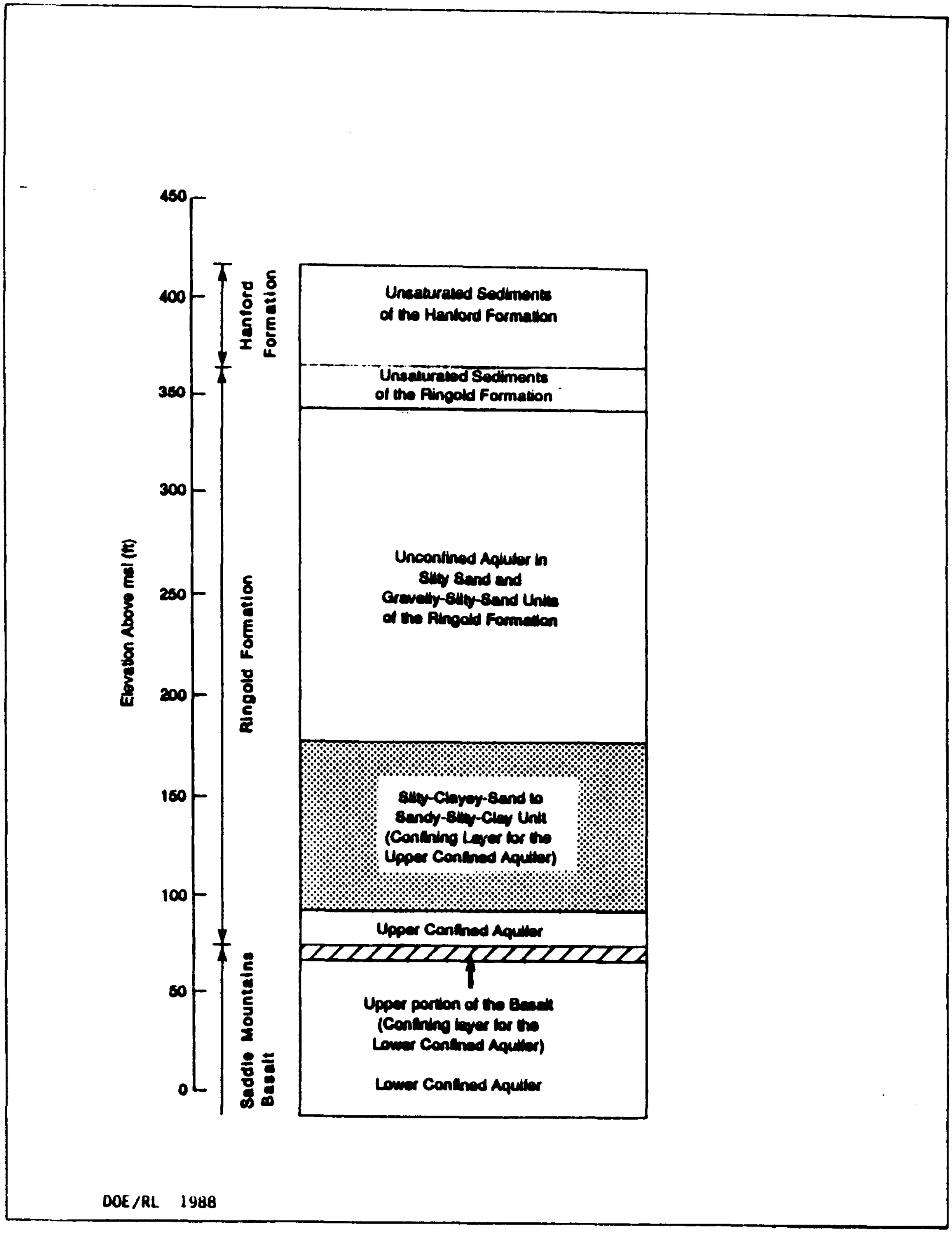


Figure 9. Generalized Hydrostratigraphic Column Assumed for the 100-D/DR Area, Based on 100-H and 100-D/DR Area Well Data.

although fine-grained sediments of the lower Ringold Formation could possibly serve as the confining layer.

2.2.3.1.2 Upper Confined Aquifer in Lower Unit of Ringold Formation. The upper confined aquifer occurs in the silty-clayey-sand to sandy-silty-clay unit in the lower portion of the Ringold Formation. Approximately the upper 24 m (80 ft) of this unit in the 100-H Area is considered to be the confining layer for the upper confined aquifer (PNL 1988a).

2.2.3.1.3 Unconfined Aquifer in Ringold Formation Silty-Sand and Gravelly-Silty-Sand Units. The silty-sand and gravelly-silty-sand units of the Ringold Formation overlie the upper confining layer in the Ringold Formation and are, in turn, overlain by the unsaturated sediments in the Ringold and Hanford Formations. At the 100-D Area, the unconfined aquifer is contained primarily within the middle member of the Ringold Formation. In the 100-N Area, the water table surface occurs in the middle Ringold Formation, just below the Ringold Formation-Hanford formation contact. The thickness of the unconfined aquifer in the 100-N Area is estimated at 80 to 90 feet (Gilmore 1989).

2.2.3.1.4 Unsaturated Sediments of the Ringold Formation. The depth to the water table in the 100-DR-1 Operable Unit ranges from 15 to 24 m (50 to 80 ft) below ground level. The depth to the water table in June 1987 was approximately 23 m (74 ft) in well number 199-D2-5 (Schatz et al. 1987). Assuming that the Hanford formation is approximately 14 m (45 ft) thick, a portion of the unsaturated zone is in the gravelly silty sand unit of the middle Ringold Formation just below the Ringold Formation-Hanford formation contact. The thickness of the unsaturated sediments of the Ringold Formation in the operable unit is estimated to range from 5 to 35 ft thick.

2.2.3.1.5 Unsaturated Sediments of the Hanford Formation. The unsaturated sediments of the Hanford formation in the 100-D/DR Area are assumed to extend from the land surface to a depth of approximately 14 m (45 ft), the depth of the base of the Hanford formation as indicated by 100-DR-1 Area well logs. The depth of the unsaturated sediments of the Hanford formation is reported to range from 9 to 26 m (30 to 85 ft) in the 100-HR-3 operable unit, which includes 100-DR-1. In the 100-H Area, these sediments extend from 9 m to 15 m (30 to 50 ft) below the land surface (DOE-RL 1988). The sediments are a composite of unconsolidated and poorly sorted boulders, cobbles, pebbles, sand, and silt, with very low moisture content.

Gee and Heller (1985) report that water content at depth in sediments at the Hanford Site is generally low, ranging from 2 to 7 wt% in coarse- and medium-grained soils and 7 to 15 wt% in silts. Water content at depth in soils at the 100-H Area ranges from 0.8 to 10.7 wt%, with a mean value of 2.6% and a standard deviation of 1.7% (DOE-RL 1988). Measurements of matric potential at depths greater than 10 m (33 ft) in Hanford Site soils suggest that water in the deeper sediments is slowly draining to the water table (Gee and Heller 1985).

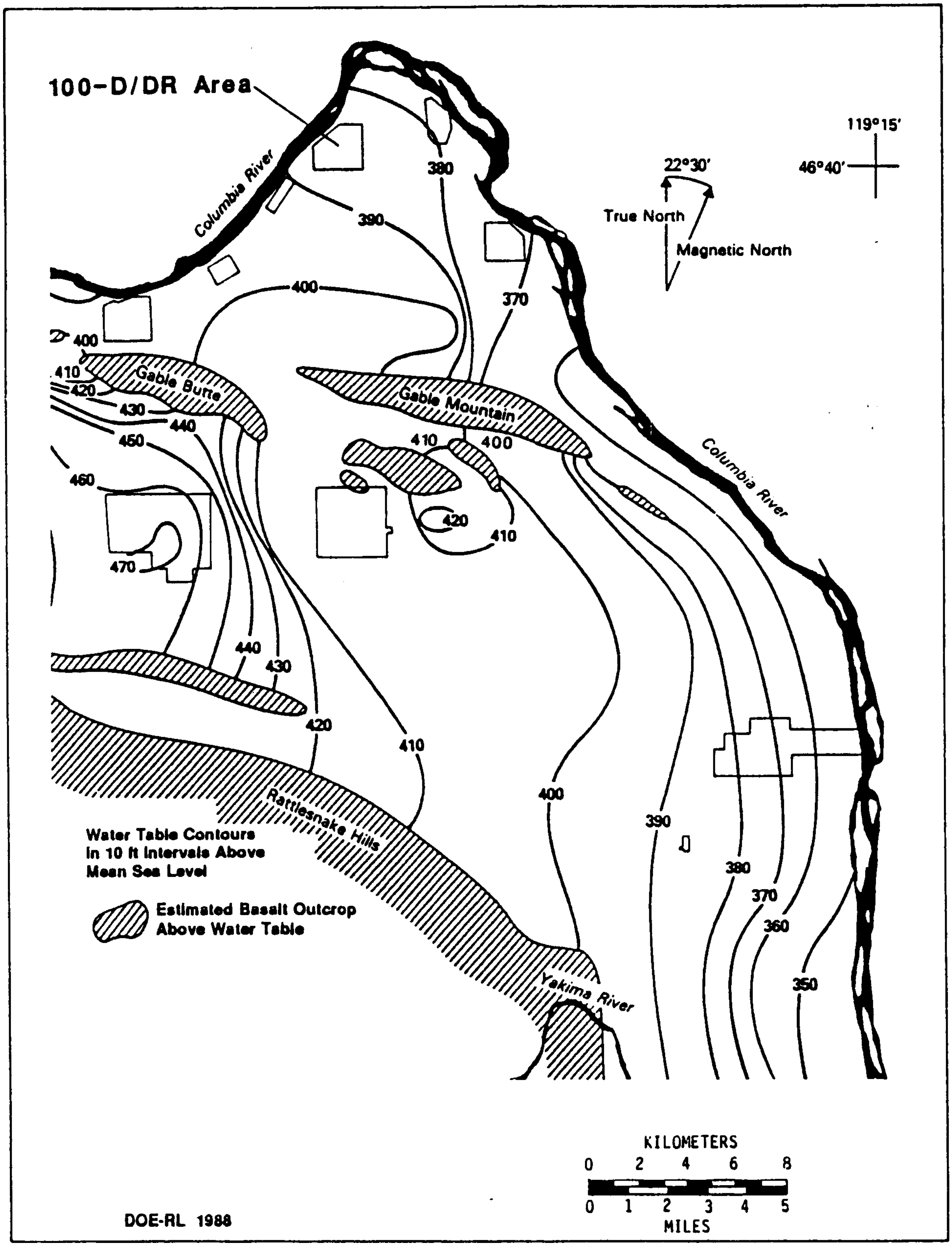
Lysimeter and field studies conducted between 1985 and 1987 at the 300 Area, which has a geologic setting relatively similar to the 100 Areas, indicate that significant drainage has occurred in this area. One vegetated (cheatgrass-covered) lysimeter in the 300 Area drained at an average rate of about 6 cm/yr (2.4 in/yr) and 12 bare-surfaced lysimeters exhibited drainage rates of 10 cm/yr (3.9 in/yr) (Gee 1987). Neutron probe data at a grass-covered field site near the 300 Area also suggest that water is draining below the root zone under conditions of coarse soil and shallow-rooted vegetation. Detailed information gathered to date has been insufficient to predict recharge accurately for specific sites; however, evidence to date indicates that maximum recharge occurs where coarse soils or gravels exist at the surface and soils are kept bare and that minimum recharge occurs where soils are fine-textured and surfaces are vegetated with deep-rooted plants (Gee 1987).

2.2.3.2 Groundwater Flow. Natural recharge to the unconfined aquifer occurs from rainfall and runoff from the higher bordering elevations, infiltration of water from small ephemeral streams, and river water along influent reaches of the Columbia River (DOE-RL 1988). The unconfined groundwater flows from the recharge areas to the west primarily eastward to the discharge areas along the Columbia River. Artificial recharge at the Hanford Site occurs primarily from the discharge of liquid wastes in man-made surface impoundments and subsequent leakage into the subsurface. The 120-D-1 ponds in the 100-DR-1 operable unit may contribute to artificial recharge. Gilmore (1989) notes that the elevations of groundwater mounds beneath 100-N Area facilities are dependent upon the operational status of the N Reactor and the associated liquid waste disposal facilities.

Figure 10 shows water-table elevations for a portion of the Hanford Site for June 1987. The water-table gradient is approximately 0.4 to 0.9 m/km (2 to 5 ft/mi) in the 100-HR-3 operable unit, and groundwater flow is in a northeasterly to easterly direction where the groundwater in the unconfined aquifer discharges to the Columbia River. However, Figure 10 is a generalized water table map of a very large area and localized flow directions may be considerably different. A more-detailed water table map will be developed during the 100-DR-1 and 100-HR-3 RFI efforts.

Groundwater levels in the unconfined aquifer in and adjacent to the 100-DR-1 operable unit are influenced by changes in the Columbia River stage because the aquifer is hydraulically connected to the river. In general, the influence of river level on groundwater levels is greatest in wells near the river and decreases inland. The water table gradient may be temporarily reversed near the river at the high river stage, and river water may infiltrate the unconfined aquifer as bank storage. Due to a lack of data, the direction of groundwater flow between the 100-D wells and the river, and the influence of river stage on flow direction, is unknown.

A groundwater seep has been reported by McCormack and Carlile (1984) along the river at the northern margin of the 100-DR-1 operable unit. The springs along this stretch of the river flow intermittently, influenced primarily by changes in river level. The volume of the seep discharge has not been quantified, but it can be readily sampled at low-water stages.



883-1736/13264

Figure 10. Water Table Elevations for June 1987.

2.2.4 Surface Hydrology

Drainage patterns for surface water runoff at the operable unit and flow characteristics of the adjacent Columbia River are described in the following sections.

2.2.4.1 Drainage Patterns. Because of the relatively flat topography and coarse nature of the sediments, there are no well-defined drainage channels within the operable unit. Surface runoff, if any, from 100-DR-1 would flow down the gentle gradient to the east and northeast and down the steep embankment to the northwest to the Columbia River.

2.2.4.2 Infiltration. The primary controlling factors for the amount of infiltration that can be expected in the 100-D/DR Area are the amount of unpaved area, the amount of evapotranspiration during the higher precipitation months, and the runoff characteristics of the soil. Although no specific studies have been performed on infiltration at the operable unit, the coarse nature of the soils suggests that soil infiltration capacity is high.

2.2.4.3 Columbia River. The Hanford reach of the Columbia River forms the northwestern boundary for 100-DR-1 operable unit. This free-flowing reach is regulated by Priest Rapids Dam, which is located about 31 km (19 mi) upstream from the operable unit. The width of the river in the vicinity of 100-DR-1 is about 0.6 km (0.4 mi). A small island is situated in the center of the river just north of the operable unit (Figure 6). It is approximately 0.4 km (0.2 mi) long and up to 0.15 km (0.1 mi) wide (USGS 1986).

The quantity of discharge in the Hanford reach fluctuates significantly depending on the operational practices at Priest Rapids and other upstream dams. These dams also form reservoirs having relatively small storage capacities. A minimum regulated discharge of 1,050 m^3/s (37,000 ft^3/s) has been established at the Priest Rapids Dam. Daily discharge typically ranges upwards to 7,000 m^3/s (250,000 ft^3/s), with peak spring runoff flows of up to 12,600 m^3/s (450,000 ft^3/s). Annual average discharge rates run from 2,800 to 3,400 m^3/s (100,000 to 120,000 ft^3/s), and monthly mean discharges generally peak from April to June and are lowest from September to October (PNL 1988a).

Flood elevations from the probable maximum flood (the flood discharge that may be expected from the most severe combination of meteorologic and hydrologic conditions reasonably possible in the region) would be about 129 m (423 ft) at the 100-N Area (DOE 1987), approximately 3 km (2 mi) upstream from the 100-D/DR Area. This flood would not affect the 100-D/DR Area. Similarly, the 100-year and 500-year floods, which would be of lower flow magnitude than the probable maximum flood, would not affect the area.

2.2.5 Meteorology

Climatological data are available from the Hanford Meteorological Station (HMS), located between the 200 East and West Areas in the central portion of the Hanford Site. Data have been collected at the HMS since 1945, and precipitation and temperature data from nearby locations are also available from 1912 through 1943. Data from the HMS are assumed to be representative of the general climatic conditions for the entire site. The summaries presented in the following sections were extracted from DOE (1987).

2.2.5.1 Precipitation. The Hanford Site is located within a rain shadow formed by the Cascade Mountains to the west. The average annual precipitation at the site is 16 cm (6.3 in). Most of the precipitation takes place during the winter, with nearly half of the annual amount occurring from November through February. Average winter monthly snowfall ranges from 0.8 cm (0.3 in) in March to 13.5 cm (5.3 in) in January. The record snowfall of 62 cm (24 in) occurred in February 1916, but the second highest snowfall is less than half this amount.

Days with precipitation greater than 1.3 cm (0.50 in) occur with a frequency of less than 1% during the year. Rainfall intensities of 1.3 cm/h (0.50 in/h) persisting for 1 hour are expected once every 10 years. Rainfall intensities of 2.5 cm/h (1.0 in/h) for 1 hour are expected only once every 500 years.

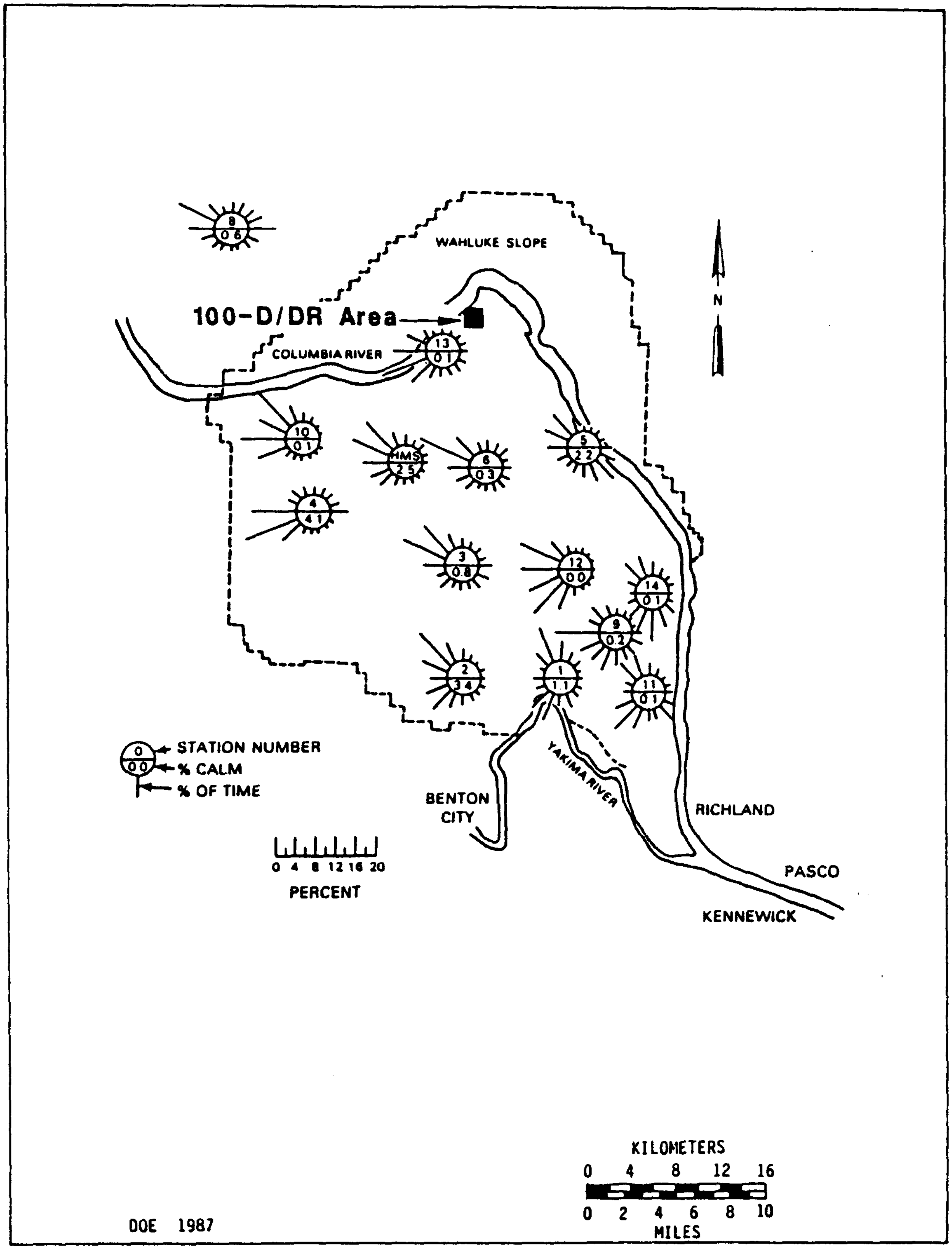
The average annual relative humidity is 54%. Humidity is higher in winter than in summer, averaging about 75% and 35%, respectively.

2.2.5.2 Temperature. Average monthly temperatures at the Hanford Site range from -1.5°C (29°F) in January to 24.7°C (76°F) in July. The lowest recorded monthly average winter temperature was -5.9°C (21°F), and the highest recorded monthly average winter temperature was 6.9°C (44°F); both of these records were set during February. The highest recorded monthly average summer temperature was 27.7°C (82°F), which occurred during July. The coolest summer month on record was in June at 17.2°C (63°F).

2.2.5.3 Wind. In general, prevailing wind directions are from the northwest throughout the year. Secondary maxima are indicated for southwesterly winds. Winds from the northwest quadrant occur most often during the winter and summer. During the spring and fall, the frequency of southwesterly winds increases. Winds blowing from other directions display minimal seasonal variation. Wind roses for various locations on the Hanford Site are displayed in Figure 11. The closest Hanford Telemetry Network Station to the 100-D/DR Area is Station 13.

Monthly average wind speeds are generally lowest during the winter, averaging 10 to 11 km/h (6.2 to 6.8 mi/h). Monthly average wind speeds peak in the summer, averaging 14 to 16 km/h (8.7 to 9.9 mi/h). Wind speeds well above average are usually associated with southwesterly winds. In the summer, high-speed winds from the southwest are responsible for most of the dust storms in the region.

High-speed winds are also associated with afternoon winds and thunderstorms. The summertime drainage winds are generally northwesterly and frequently reach 50 km/h (31 mi/h). An average of 10 thunderstorms occur each year, usually during the summer, and the winds associated with them do not display a directional preference.



883-1736/13263

Figure 11. Wind Roses for the Hanford Telemetry Network, 1979-1982.

2.2.5.4 Evapotranspiration. Mean annual potential (or maximum) evapotranspiration for the Tri-Cities area immediately southeast of the Hanford Site has been estimated to be about 74 cm (29 in). The actual annual evapotranspiration rate under normal conditions for a 15-cm (6-in) assumed available water capacity is estimated to be about 18 cm (7 in) (USWB/USDOA 1962).

2.2.6 Environmental Resources

The flora, fauna, critical habitats, land-use characteristics, water-use characteristics, and sensitive environments for the area in and around 100-DR-1 are summarized in the following sections.

2.2.6.1 Flora. The semiarid bench above the Columbia River, on which most of the 100-DR-1 operable unit lies, has been subjected to various landscape manipulations as a result of 100-D/DR Area construction, operations, and decommissioning activities. The natural vegetation consists mostly of a sparse covering of desert shrubs and drought-resistant grasses. The predominant vegetation type is the big sagebrush/cheatgrass/bluegrass community. Bitterbrush and rabbitbrush are also common shrubs (DOE 1987; PNL 1988b). A narrow riparian zone, consisting of herbs interspersed with a few scattered deciduous shrubs, exists along the banks of the Columbia River.

Table 2 includes state-designated endangered and threatened flora that could potentially occur at the Hanford Site. State designations are as strict as or stricter than federal designations. The endangered persistentsepal yellowcress, generally found in moist to marshy places, is known to inhabit the wetted shoreline of the Hanford reach of the Columbia River. Therefore, this endangered species could potentially occur in the vicinity of 100-DR-1. The threatened species, eatonella, is known to occur along the Columbia River in nearby Grant County. This species could therefore potentially occur in or near 100-DR-1. The threatened Columbia milk-vetch is locally endemic to the area in the immediate vicinity of Priest Rapids Dam, and it is unlikely that this species would be encountered near 100-DR-1. Hoover's desert parsley is known to exist in Benton County, but appears to inhabit only rocky hillsides and is thus unlikely to occur at 100-DR-1.

2.2.6.2 Fauna. Predominant fauna of the sagebrush/grass community that could potentially reside in or near the operable unit are the cottontail rabbit, jackrabbit, Great Basin pocket mouse, horned lark, and the western meadowlark. Mule deer, coyotes, and various species of raptors forage in this habitat type, and grasshoppers are the most conspicuous insects in the community (DOE 1987).

Dominant riparian fauna along the Columbia River include muskrat, porcupine, racoon, quail, pheasant, and waterfowl (ducks and geese) (DOE 1987). The long-billed curlew is also known to nest within the cheat-grass habitat in the vicinity of the 100-D/DR Area (Allen 1980). A spit on the south side of the island at the tip of the peninsula between the 100-D/DR and 100-H Areas serves as the primary loafing and staging area for curlews

Table 2. List of Endangered and Threatened Washington State Species Having the Potential to Occur on the Hanford Site. (Sheet 1 of 2)

Endangered Vascular Plants

persistentsepal yellowcress (*Rorippa columbiae*): Known to have a scattered distribution because of specialized habitat requirements or habitat loss; generally occurs in moist to marshy places and is known to inhabit the wetted shoreline of the Hanford reach of the Columbia River in Benton County.

Threatened Vascular Plants

Columbia milk-vetch (*Astragalus columbianus*): Locally endemic to the area in the immediate vicinity of Priest Rapids Dam, including a portion of Benton County; could potentially occur along the Columbia River in the northwestern portion of the Hanford Site.

eatonella (*Eatonella nivea*): Known to occur along the Columbia River in Grant County; could potentially occur along the river in the northern portion of the Hanford Site.

Hoover's desert parsley (*Lomatium tuberosum*): Locally endemic to southcentral Washington, including Benton County; known to inhabit rocky hillsides.

Endangered Birds

Aleutian Canada goose (*Branta canadensis leucopareia*): Nests in the Aleutian Islands of Alaska and winters in California; has been occasionally sighted, as a migrant, in Benton County; a potential seasonal user of the Columbia River valley, feeding on grasses, sedges, and berries.

American white pelican (*Pelecanus erythrorhynchus*): Winters along the southern Pacific Coast and the Gulf Coast and nests in northern prairie and intermontane lakes; no longer nests in Washington; migrates through eastern Washington; flocks are common in the Columbia Basin during the summer; known to occasionally winter on the Columbia River, foraging on fish, amphibians, and crustaceans and roosting on islands.

peregrine falcon (*Falco peregrinus*): Breeds and winters in eastern Washington, inhabiting open marshes, river shorelines, wide meadows and farmlands; nests on undisturbed cliff faces; an erratic visitor at the Hanford Site, feeding on songbirds, shorebirds, and waterfowl.

sandhill crane (*Grus canadensis*): Inhabits open prairies, grainfields, shallow lakes, marshes, and ponds, nesting in drier grassy and marshy areas; common migrant during the spring and fall in Washington; some known and suspected nesting sites in eastern Washington; unlikely visitor at the Hanford Site.

Table 2. List of Endangered and Threatened Washington State Species Having the Potential to Occur on the Hanford Site. (Sheet 2 of 2)

Endangered Birds (cont.)

---

upland sandpiper (*Bartramia longicauda*): Inhabits ungrazed and lightly grazed prairies, upland meadows, and fields that are usually located near lakes or rivers; breeds in the northern and central portions of North America and winters in South America; uncommon in eastern Washington; a potential migratory visitor at the Hanford Site, feeding on insects, worms, and some vegetation.

western snowy plover (*Charadrius alexandrus*): A coastal species rarely observed in eastern Washington.

Threatened Birds

---

bald eagle (*Haliaeetus leucocephalus*): A regular winter visitor to the Columbia River, feeding on spawning salmon and perhaps waterfowl and small mammals; roosting areas are known to exist in the 100 Areas of the Hanford Site (roost sites and winter feeding areas constitute critical habitats for this species).

ferruginous hawk (*Buteo regalis*): Inhabits open prairies and sagebrush plains, usually with rocky outcrops or scattered trees, located well away from human disturbance; known to nest in Benton and Franklin counties, with Franklin County possessing the majority of the nests within Washington; known to nest in the Hanford Site on the Arid Lands Ecology Reserve; rarely winters in Washington; known to occasionally forage on small mammals, birds, and reptiles on sagebrush plains in the Hanford Site.

Threatened Mammals

---

pygmy rabbit (*Sylvilagus idahoensis*): May be extirpated from Washington; inhabits undisturbed areas of sagebrush having soils soft enough to dig burrows in; once known to exist on the Hanford Site near springs in the Snively Basin, west of the 200 Area plateau.

Note: State designations are as strict as or stricter than federal designations.

Information taken from:

DOE (1987), Hitchcock and Cronquist (1978), Washington State Department of Natural Resources (1987), Washington State Department of Wildlife (1987).

from the Hanford Site and the Wahluke Slope (Allen 1980). Peak waterfowl use occurs from late December through mid-January. A resident flock of Great Basin Canada geese nests on islands in the Columbia River near the 100-D/DR Area (Fitzner and Rickard 1983). This population forages heavily on the riparian vegetation (Eberhardt 1987).

The Columbia River itself provides habitat for a wide diversity of fish. Important game species are chinook salmon, steelhead, coho salmon, sockeye salmon, smallmouth bass, largemouth bass, sturgeon, walleye, yellow perch, and channel catfish. The Hanford reach sustains a fall spawning population of chinook salmon. Increases in this population over the years are responsible for attracting numerous bald eagles to the area in the fall and winter to feed on the spawned-out salmon carcasses (DOE 1987).

Table 2 also includes state endangered and threatened fauna that could potentially occur at the Hanford Site. Endangered animal species most likely to occasionally occur on and along the Columbia River near 100-DR-1 are the American white pelican and the Aleutian Canada goose. Of the threatened species that could potentially occur at the Hanford Site, only the bald eagle is known to frequent the environment near the 100-D/DR Area. This species visits each fall and winter to feed on spawning salmon in the river and is known to use a grove of trees near the 100-H Area as a roosting site (Fitzner et al. 1981).

2.2.6.3 Critical Habitats. Bald eagle roost trees and foraging areas are regarded as critical habitats for this species; therefore, such sites must be protected (Washington State Department of Wildlife 1987). Because of the transient nature of the other endangered and threatened animal species' use of the 100-DR-1 environment, no other critical animal habitats exist at 100-DR-1.

If the endangered persistentsepal yellowcress or the threatened eatonella are found to exist within or near 100-DR-1, part of the operable unit may constitute a critical habitat for the plants. No specific information as to the occurrence of these species within the project boundaries is currently available.

2.2.6.4 Land Use. For reasons of national security, as well as to ensure public health and safety, access to the entire Hanford Site is administratively controlled and is expected to remain this way for the foreseeable future (DOE 1987). The entire site is currently zoned as an unclassified use district by Benton County. Under the county's comprehensive land-use plan, the Hanford Site may be used for nuclear-related activities. Non-nuclear activities are authorized only on approval from DOE (DOE-RL 1988).

Land use in the area surrounding the Hanford Site consists primarily of irrigated and dry-land farming, livestock grazing, and urban and industrial development. Principal agricultural crops include hay, wheat, potatoes, corn, apples, soft fruit, hops, grapes, and vegetables. Most industrial activities in the area are associated with either agriculture or energy production (DOE 1987).

Immediately north and across the river from the 100 Areas are the 130 km^2 (32,100 ac) Saddle Mountain National Wildlife Refuge and the 225 km^2 (55,600 ac) State of Washington Department of Wildlife Reserve (Figure 3). These lands provide a buffer zone around the reactor complexes (DOE 1987).

2.2.6.5 Water Use.

2.2.6.5.1 Surface Water. The Hanford reach of the Columbia River, in the immediate vicinity of the 100-D/DR Area, is used for boating, fishing, and hunting (EPA 1988c). The nearest surface-water intake is the 181-D pumphouse in the 100-DR-1 operable unit. This pumphouse serves as a backup to the 100-B pumphouse, which supplies water to the 100-B/C, 100-D, 100-N, 100-K, and 200 Areas. The nearest downstream water intake is the Ringold Fish Hatchery, which is located approximately 30 km (19 mi) downstream from the 100-D/DR Area.

2.2.6.5.2 Groundwater. Groundwater in the immediate vicinity (4.8 km [3.0 mi]) of the 100-D Area is not known to be used for any purpose. The nearest known wells drawing groundwater from the unconfined aquifer are located more than 18 km (11 mi) upstream at the Vernita Bridge Rest Stop (EPA 1988c). Because of the surrounding land use discussed previously, the nearest that a private well could be located to the 100-D Area would be approximately 8 km (5 mi) to the northwest, across the Columbia River.

2.2.6.6 Sensitive Environments. Because of the presence of critical bald eagle habitats (Section 2.2.6.3), the 100-DR-1 vicinity can be regarded as a sensitive environment, as defined in the 40 CFR Part 300, Appendix A. The grove of trees near the 100-H Area, which eagles use as a roosting site, must be preserved, and disturbances near this grove and the Columbia River, when eagles are roosting and feeding, respectively, should be avoided.

The Columbia River is regarded as an important environment with respect to 100-DR-1. The Hanford reach is the only significant stretch of the Columbia River within the United States that is not impounded by a dam (PNL 1988b). The reach has also been designated a class A (excellent) surface water by the State of Washington (Washington Administrative Code WAC 173-201-080(2)). This designation requires that water quality be maintained for the following uses (WAC 173-201-045(2)(b)):

- Domestic, industrial, and agricultural water supply
- Stock watering
- Fish and shellfish migration, rearing, spawning, and harvesting
- Wildlife habitat
- Recreation (including primary contact recreation)
- Commerce and navigation.

The river's importance as a recreational resource and a regional source of drinking and irrigation water, as well as being a productive habitat for waterfowl, economically important fish species, and transitory endangered and threatened wildlife, could merit special concern for this environment during implementation of the 100-DR-1 RFI/CMS.

2.2.7 Human Resources

2.2.7.1 Demography. No one resides within a 4.8 km (3.0 mi) radius of the 100-D/DR Area. Because of the surrounding land use discussed previously, the nearest a residential unit could be located to the 100-D Area would be approximately 8 km (5 mi). The working population for the entire 100 Areas is approximately 760 (EPA 1988c). Currently, there are less than 12 workers permanently stationed in the 100-D/DR Area.

2.2.7.2 Archaeological Resources. Archaeological sites are found in various locations on the Hanford Site, and many of these are found along the Hanford reach of the Columbia River (Rice 1980). There is, however, no specific information on any archaeological findings in the 100-D/DR Area.

2.2.7.3 Historical Resources. No designated historical sites are known to exist in the vicinity of the 100-D/DR Area.

2.2.7.4 Community Involvement. The involvement of the potentially impacted community with respect to the RFI/CMS for the 100-DR-1 operable unit is presented in detail in the Community Relations Plan (Attachment 5). The CRP includes a discussion and analysis of key community concerns and perceptions regarding the project, along with a list of all interested parties.

3.0 INITIAL EVALUATION

3.1 KNOWN AND SUSPECTED CONTAMINATION

A summary of the known and suspected contaminant sources and the nature and extent of contamination in the various environmental media at 100-DR-1 is provided in the following sections.

3.1.1 Sources

Waste sources are discussed by facility within the 100-DR-1 operable unit. The location of each facility is shown in Figure 5.

3.1.1.1 Reactor Building and Associated Disposal Facilities. Operation of the D and DR reactors was the source of much of the contamination in the 100-D/DR Area. In addition to irradiating uranium fuel to produce plutonium for weapons production, the 118-D-6 (105-D) reactor was also used to experimentally irradiate other materials. Facilities directly related to the 118-D-6 reactor include the 116-D-1A and 116-D-1B (105-D) fuel storage basin trenches, the 116-D-2 (105-D) pluto crib, and the 116-D-6 (105-D) cushion corridor decontamination French drain.

3.1.1.1.1 118-D-6 (105-D) Reactor Building. Although no direct sampling has been performed on the 118-D-6 reactor building, sampling was performed on the analogous 118-DR-2 (105-DR) reactor building in the 100-DR-2 operable unit. Miller and Steffes (1987) estimated the radionuclide inventories in the 100 Area reactor buildings, including the 118-D-6 reactor, with decayed values as of March 1, 1985. The inventory was based on the characterization results from core sampling of the 118-DR-2 reactor block, adjusted for operating and fluence differences of the other reactors. Estimated inventory for the graphite core of the 118-D-6 reactor was about 12,700 Ci. The estimated inventory for the thermal shield and cooling tubes was about 8,200 Ci. Table 3 presents the estimated inventory for the 118-D-6 reactor graphite core and thermal shield, as well as other reactor components.

The 118-D-6 reactor building also contains the fuel storage basin, which served as a collection, storage, and transfer facility for irradiated fuel elements. These elements were immersed in water within the basin. During its lifetime, the 118-D-6 fuel storage basin collected an estimated 50,000 kg (110,000 lb) of sludge. In the 1950s, sludge was pumped from the fuel storage basins to the 116-D-1A and 116-D-1B fuel storage basin trenches (Dorian and Richards 1978). During 1985, the 118-D-6 reactor fuel storage basin was washed down, and the remaining sludge was removed and taken to the 200 Areas' low-level waste burial ground. An asphalt emulsion was applied to the floor and walls to fix any remaining contamination as part of the decommissioning and decontamination process. The estimated inventory remaining in the fuel basin as presented in Table 3 was determined from surveys taken after cleanout of the basin (Miller and Steffes 1987).

Table 3. Radionuclide Inventory Estimate for 118-D-6 (105-D) Reactor, Summary as of March 1, 1985.

	Component (Ci)					
Radio-nuclide	Graphite Stack	Thermal Shield	Process Tubes	Control System	Bio-shield	Fuel Storage Basin
^{3}H	7,700	--	--	--	--	--
^{14}C	4,300	--	--	--	--	--
^{41}Ca	150	--	--	--	2	--
^{60}Co	90	7,380	270	110	--	0.05
^{59}Ni	2	7	0.1	--	--	0.002
^{63}Ni	280	810	10	--	--	0.27
^{36}Cl	34	--	--	--	--	--
^{90}Sr	10	--	0.2	--	--	0.06
^{93}Zr	--	--	--	--	--	--
^{93}Mo	--	0.04	--	--	--	--
^{94}Nb	0.3	0.02	--	--	--	--
^{99}Tc	--	0.002	--	--	--	--
^{108}Ag	--	0.03	--	--	--	--
^{137}Cs	30	--	--	--	--	0.12
^{152}Eu	40	--	1.7	--	--	2
^{154}Eu	20	--	1.2	--	--	0.007
^{238}U	--	--	--	--	--	--
^{238}Pu	--	--	--	--	--	--
^{239}Pu	1	--	--	--	--	0.024
^{241}Am	0.3	--	--	--	--	0.008

Miller and Steffes 1987.

3.1.1.1.2 116-D-1A and 116-D-1B (105-D) Fuel Storage Basin Trenches. Sludge from the 118-D-6 (105-D) fuel storage basin was disposed of in the 116-D-1A and 116-D-1B trenches. Approximately 1,000 kg (2,200 lb) of sodium dichromate was reportedly disposed of in the 116-D-1A trench. About 700 kg (1,540 lb) of sodium dichromate and 2,000 kg (4,400 lb) each of sodium oxalate and sodium sulfamate were reportedly disposed of in the 116-D-1B trench (Stenner et al. 1988). A radiological inventory of these trenches was conducted in 1976 (Dorian and Richards 1978). The inventory (decayed through April 1, 1986) was reported by Stenner et al. (1988) and is presented in Tables 4 and 5.

3.1.1.1.3 116-D-2 (105-D) Pluto Crib. The 116-D-2 pluto crib received effluent from individual process tubes following fuel cladding failures. A total of 0.004 kg (0.0088 lb) of sodium dichromate was disposed of in this crib (Stenner et al. 1988). Two test holes to 8.5 and 9 m (28 and 30 ft) were drilled at this crib in 1976. However, field screening did not indicate

Table 4. Radionuclide Inventory of the 116-D-1A Trench.

Radionuclide	(Ci)	Radionuclide	(Ci)
^{3}H	0.88100	^{144}Ce	0.00000
^{14}C	0.00000	^{144}Pr	0.00000
^{54}Mn	0.00000	^{147}Pm	0.00000
^{60}Co	0.13800	^{152}Eu	0.72300
^{63}Ni	0.00000	^{154}Eu	0.11300
^{85}Kr	0.00000	^{155}Eu	0.03470
^{90}Sr	0.12300	^{237}Np	0.00000
^{91}Y	0.00000	^{238}Pu	0.00000
^{95}Nb	0.00000	^{239}Pu	0.01800
^{95}Zr	0.00000	^{240}Pu	0.00200
^{99}Tc	0.00000	^{241}Pu	0.00000
^{103}Ru	0.00000	^{241}Am	0.00000
^{106}Ru	0.00000	^{233}U	0.00000
^{113}Sn	0.00000	^{235}U	0.00003
^{125}Sb	0.00000	^{238}U	0.00376
^{129}I	0.00000	^{232}Th	0.00000
^{134}Cs	0.00061	Beta	0.00000
^{137}Cs	1.08000	Gamma	0.00000
^{141}Ce	0.00000	Alpha	0.00000
		Total curies =	3.1

Note: These values are decayed through April 1, 1986.

Modified after Stenner et al. 1988.

Table 5. Radionuclide Inventory of the 116-D-1B Trench.

Radionuclide	(Ci)	Radionuclide	(Ci)
^{3}H	0.12600	^{144}Ce	0.00000
^{14}C	0.00000	^{144}Pr	0.00000
^{54}Mn	0.00000	^{147}Pm	0.00000
^{60}Co	0.06750	^{152}Eu	0.28300
^{63}Ni	0.00000	^{154}Eu	0.04270
^{85}Kr	0.00000	^{155}Eu	0.27800
^{90}Sr	0.16400	^{237}Np	0.00000
^{91}Y	0.00000	^{238}Pu	0.00000
^{95}Nb	0.00000	^{239}Pu	0.00603
^{95}Zr	0.00000	^{240}Pu	0.00067
^{99}Tc	0.00000	^{241}Pu	0.00000
^{103}Ru	0.00000	^{241}Am	0.00000
^{106}Ru	0.00000	^{233}U	0.00000
^{113}Sn	0.00000	^{235}U	0.00002
^{125}Sb	0.00000	^{238}U	0.00248
^{129}I	0.00000	^{232}Th	0.00000
^{134}Cs	0.00031	Beta	0.00000
^{137}Cs	0.51300	Gamma	0.00000
^{141}Ce	0.00000	Alpha	0.00000
		Total curies = 1.48	

Note: These values are decayed through April 1, 1986.

Modified after Stenner et al. 1988.

radioactivity above background levels and no laboratory analyses were conducted (Dorian and Richards 1978). This crib was retired in 1956 and covered to grade with clean soil. Stenner et al. (1988) indicated that the correct location of the crib may not have been found during sampling.

3.1.1.1.4 116-D-6 (105-D) Cushion Corridor Decontamination French Drain. This site received domestic water from the changing room and water from the mask decontamination station. There is no record of any sampling conducted.

3.1.1.2 Process Effluent Pipelines. Process effluent pipelines emanate from the 118-D-6 (105-D) and 118-DR-2 (105-DR) reactor buildings to the 116-D-7 and 116-DR-9 retention basins. Owen (1967) assumed that there is a significant accumulation of long-lived radionuclides in the process effluent lines, based on observed activity in the 100-F Area. Process effluent pipelines also run from the 116-D-7 (107-D) and 116-DR-9 (107-DR) retention basins both to the river and to the 116-DR-1 and -2 trenches. Some of the pipelines are known to have developed leaks near the retention basins during their operational periods (Dorian and Richards 1978).

Radiological screening of the soil surrounding some of the process effluent pipelines has also been conducted; these results are discussed in Section 3.1.2. In general, wastes transferred by the pipelines are assumed to be the same as wastes in the facilities served by the pipelines.

3.1.1.3 Retention Basins and Related Facilities. The retention basins and related facilities received once-through cooling water from the 118-D-6 (105-D) and 118-DR-2 (105-DR) reactors. Facilities include the 116-D-7 (107-D) and 116-DR-9 (107-DR) retention basins, the 116-DR-1 and -2 (107-DR-1 and -2) liquid waste disposal trenches, the 107-D and -DR sludge disposal trenches, the 116-D-5 (1904-D) and 116-DR-5 (1904-DR) outfall structures, and the discharge pipelines to the Columbia River.

3.1.1.3.1 116-D-7 and 116-DR-9 (107-D and 107-DR) Process Effluent Retention Basins. Considerable radiological sampling and analysis of 116-D-7 and 116-DR-9 process effluent retention basin materials has been undertaken (Dorian and Richards 1978). Radiological assessments included the concrete basin structures, the sludge remaining at the bottom of the basins, the soil that currently fills the basins, sludge in the 116-DR-9 (107-DR) inlet distribution chamber, the soil beneath and adjacent to the basins and associated pipelines, the soil associated with the 107-D and 107-DR sludge disposal trenches, the soil column associated with the 116-DR-1 and 116-DR-2 process effluent trenches, and the 116-D-5 (1904-D) outfall structure. Soil analyses are discussed in Section 3.1.2; the 116-DR-1 and 116-DR-2 trench inventory is discussed in Section 3.1.1.3.2; the 107-D and 107-DR sludge disposal trenches are discussed in Section 3.1.1.3.3; and the 116-D-5 and 116-DR-5 outfall structures are discussed in Section 3.1.1.3.4.

The 116-D-7 (107-D) retention basin contained an inventory of approximately 87 Ci in 1975. The sludge contributed approximately 75 Ci, the soil fill 4.1 Ci, and the concrete approximately 8 Ci. The 116-DR-9 (107-DR) basin contained an inventory of approximately 68 Ci. The sludge contained 48 Ci, the soil fill 7.3 Ci, and the concrete approximately 13 Ci. Predominant radionuclides in both basins are ^{60}Co, ^{63}Ni, ^{152}Eu, ^{154}Eu, and ^{155}Eu. The average concentration of ^{239}Pu and ^{240}Pu in the 116-D-7 basin sludge was 110 pCi/g and ranged up to 290 pCi/g. Concentrations of plutonium in the 116-DR-9 basin were less. The average concentration was 30 pCi/g and maximum concentration was 82 pCi/g. Tables 6 and 7 present radiological inventories of the sludge and basin fill for the 116-D-7 (107-D) basin. Tables 8 and 9 present the inventories for the 116-DR-9 (107-DR) basin. Radionuclide concentrations of sludge samples taken from the 116-DR-9 inlet distribution chamber are given in Table 10. The 116-D-7 basin did not include an inlet distribution chamber.

During 1985, the concrete walls of the 116-D-7 and 116-DR-9 retention basins were knocked into the basins and buried in place with at least 0.3 m (1 ft) of clean fill (Jacques 1986).

3.1.1.3.2 116-DR-1 and 116-DR-2 (107-DR) Liquid Waste Disposal Trenches. Approximately 40 kg (88 lb) of sodium dichromate was disposed of in the

Table 6. The 116-D-7 (107-D) Retention Basin Fill Basin Sludge.

Sample No.	^{238}Pu	$^{239/240}Pu$	^{90}Sr	^{3}H	^{152}Eu	^{60}Co	^{154}Eu	^{134}Cs	^{137}Cs	^{155}Eu	U	^{63}Ni	^{14}C
BN 2	4.7×10^{0}	1.9×10^{2}	3.3×10^{1}	4.3×10^{1}	6.7×10^{4}	1.8×10^{4}	3.5×10^{4}	2.9×10^{2}	1.0×10^{3}	5.9×10^{1}	1.5×10^{0}	2.2×10^{4}	5.9×10^{1}
DN 2-1/2	4.4×10^{0}	2.1×10^{2}	5.5×10^{2}	2.8×10^{1}	6.5×10^{4}	2.5×10^{4}	3.2×10^{4}	1.2×10^{2}	1.2×10^{3}	3.0×10^{2}	1.9×10^{0}		
EN 3-1/2	4.2×10^{0}	2.4×10^{2}	3.3×10^{1}	4.6×10^{1}	1.8×10^{4}	6.8×10^{3}	2.0×10^{4}	1.7×10^{3}	1.5×10^{3}	6.2×10^{3}	3.2×10^{0}	1.6×10^{4}	4.3×10^{2}
FN 3-1/2	4.7×10^{0}	2.9×10^{2}	3.1×10^{1}		9.0×10^{3}	6.5×10^{3}	1.4×10^{4}	7.5×10^{2}	7.3×10^{2}	3.7×10^{3}	1.1×10^{0}	5.7×10^{3}	4.3×10^{1}
AS 2	a	7.1×10^{0}	1.8×10^{1}		3.6×10^{3}	1.1×10^{3}	1.3×10^{3}	6.5×10^{0}	5.9×10^{1}	2.0×10^{1}			
AS 2-1/2	2.3×10^{0}	8.6×10^{1}	2.4×10^{1}	2.5×10^{1}	3.4×10^{4}	1.1×10^{4}	1.3×10^{4}	8.7×10^{1}	4.8×10^{2}	1.7×10^{3}	1.2×10^{0}	1.3×10^{4}	
BS 2-1/2	3.9×10^{-1}	1.9×10^{1}	2.6×10^{1}	2.1×10^{1}	5.0×10^{3}	1.6×10^{3}	1.7×10^{3}	9.1×10^{0}	6.4×10^{1}	8.5×10^{1}	5.8×10^{-1}		
CS 2	a	5.3×10^{0}	1.1×10^{1}		4.3×10^{3}	1.5×10^{3}	2.0×10^{3}	1.8×10^{1}	5.7×10^{1}	1.9×10^{3}			
CS 2-1/2	1.3×10^{0}	6.5×10^{1}	5.2×10^{0}	9.9×10^{0}	3.5×10^{4}	8.2×10^{3}	1.3×10^{4}	2.5×10^{1}	2.8×10^{2}	3.6×10^{2}	1.3×10^{0}		
DS 2-1/2	4.8×10^{-1}	2.6×10^{1}	1.8×10^{2}	1.3×10^{1}	1.4×10^{3}	1.4×10^{3}	6.6×10^{2}	5.4×10^{0}	1.9×10^{3}	6.1×10^{1}	1.6×10^{0}		
Average													
pCi/g	2.2×10^{0}	1.1×10^{2}	9.1×10^{1}	2.6×10^{1}	2.4×10^{4}	8.1×10^{3}	1.3×10^{4}	3.0×10^{2}	7.3×10^{2}	1.4×10^{3}	1.6×10^{0}	1.4×10^{4}	1.8×1
Curies	2.7×10^{-3}	1.4×10^{-1}	1.1×10^{-1}	3.1×10^{-2}	29	9.7	16	3.6×10^{-1}	8.7×10^{-1}	1.7	1.9×10^{-3}	17	2.1×10^{-1}

Total curies in sludge = 75

[a]Less than analytical detection limit.

Note: Average depth = 5.08 cm (2 in); mass = 1.2×10^{9} g; concentrations in pCi/g. Corrections have been made as necessary to errors in reference cited.

Dorian and Richards 1978.

Table 7. The 116-D-7 (107-D) Retention Basin Fill, Basin Fill (Excluding Sludge).

Sample Hole	^{238}Pu	$^{239/240}Pu$	^{90}Sr	^{3}H	^{152}Eu	^{60}Co	^{154}Eu	^{134}Cs	^{137}Cs	^{155}Eu	U	^{63}Ni	^{14}C
BN	a	3.9×10^{-1}	6.5×10^{-1}		1.3×10^{2}	6.0×10^{1}	6.3×10^{1}	1.5×10^{0}	2.9×10^{0}	2.1×10^{1}			
DN	a	a	4.1×10^{-1}		1.6×10^{1}	8.6×10^{0}	5.4×10^{0}	9.0×10^{-2}	9.8×10^{-1}	5.4×10^{1}			
EN	3.6×10^{-3}	2.6×10^{-1}	3.1×10^{-1}		1.6×10^{2}	6.0×10^{1}	5.9×10^{1}	4.3×10^{-1}	5.4×10^{0}	3.9×10^{-1}			
FN	a	1.4×10^{-1}	1.7×10^{-1}		1.3×10^{1}	6.2×10^{0}	6.5×10^{0}	a	5.2×10^{-1}	6.3×10^{-1}			
AS	a	1.6×10^{0}	4.4×10^{0}		3.3×10^{2}	1.2×10^{2}	6.7×10^{1}	1.3×10^{0}	1.5×10^{1}	1.2×10^{1}			
BS	a	1.1×10^{-1}	1.2×10^{-1}		2.2×10^{1}	6.5×10^{0}	6.9×10^{0}	3.4×10^{-2}	4.3×10^{-1}	4.6×10^{-1}			
CS	a	7.2×10^{-1}	3.3×10^{-1}		2.1×10^{2}	1.2×10^{2}	7.4×10^{1}	1.5×10^{0}	5.2×10^{1}	6.8×10^{1}			
DS	5.9×10^{-3}	1.4×10^{-1}	6.7×10^{-2}		2.9×10^{1}	7.2×10^{0}	8.7×10^{0}	2.7×10^{-1}	1.8×10^{-1}	2.8×10^{0}			
Average													
pCi/g	1.2×10^{-3}	4.2×10^{-1}	8.1×10^{-1}		1.1×10^{2}	4.9×10^{1}	3.6×10^{1}	6.4×10^{-1}	9.7×10^{0}	2.0×10^{1}			
Curies	2.2×10^{-5}	7.6×10^{-3}	1.5×10^{-2}		2.0	8.8×10^{-1}	6.5×10^{-1}	1.2×10^{-2}	1.7×10^{-1}	3.6×10^{-1}			

Total curies in fill (excluding sludge) = 4.1
Sludge = 75
Total curies in basin fill = 79

[a]Less than analytical detection limit.

Note: Average depth = 0.76 cm (2.5 ft); mass = 1.8×10^{10}g; concentrations in pCi/g.

Dorian and Richards 1978.

Table 8. The 116-DR-9 (107-DR) Retention Basin Fill, Basin Sludge.

Sample No.	^{238}Pu	$^{239/240}Pu$	^{90}Sr	^{3}H	^{152}Eu	^{60}Co	^{154}Eu	^{134}Cs	^{137}Cs	^{155}Eu	U	^{63}Ni	^{14}C
AA 3	1.1×10^{0}	6.5×10^{1}	2.5×10^{2}	1.4×10^{1}	2.5×10^{4}	1.7×10^{4}	1.4×10^{4}	2.7×10^{2}	4.7×10^{3}	2.0×10^{1}	9.0×10^{-1}	9.5×10^{3}	1.8×10^{2}
AB 3	5.3×10^{-1}	1.4×10^{1}	2.3×10^{2}	1.4×10^{1}	6.9×10^{3}	1.7×10^{3}	2.5×10^{3}	4.4×10^{0}	1.3×10^{3}	2.3×10^{2}	8.3×10^{-1}		
AC 3	a	9.5×10^{-1}	1.2×10^{1}	3.5×10^{0}	3.3×10^{2}	7.5×10^{1}	1.1×10^{2}	2.1×10^{0}	1.5×10^{2}	3.1×10^{1}	1.2×10^{-1}		
AE 3-1/2	5.6×10^{-2}	2.6×10^{0}	1.8×10^{1}	4.8×10^{0}	6.9×10^{2}	6.6×10^{2}	3.9×10^{2}	3.7×10^{0}	1.1×10^{3}	4.6×10^{1}	1.4×10^{-1}		
AW 3-1/2	4.9×10^{-1}	2.2×10^{1}	1.7×10^{2}	1.8×10^{1}	5.9×10^{3}	6.6×10^{3}	3.1×10^{3}	2.3×10^{0}	2.8×10^{2}	1.2×10^{2}	3.7×10^{-1}	2.7×10^{3}	
CW 3-1/2	4.7×10^{-1}	1.9×10^{1}	5.0×10^{0}	5.8×10^{1}	4.0×10^{2}	1.1×10^{2}	3.4×10^{2}	3.4×10^{0}	7.4×10^{1}	3.2×10^{1}	9.0×10^{-2}		
DW 3-1/2	2.3×10^{0}	8.2×10^{1}	9.3×10^{0}	1.3×10^{1}	2.3×10^{4}	4.5×10^{3}	8.8×10^{3}	1.8×10^{2}	1.2×10^{3}	8.4×10^{2}	1.6×10^{0}	5.4×10^{3}	
Ave. pCi/g	7.1×10^{-1}	3.0×10^{1}	9.9×10^{1}	1.8×10^{1}	8.9×10^{3}	4.4×10^{3}	4.2×10^{3}	6.7×10^{1}	1.3×10^{3}	1.8×10^{2}	5.8×10^{-1}	5.9×10^{3}	1.8×10^{2}
Curies	1.3×10^{-3}	5.7×10^{-2}	1.9×10^{-1}	3.4×10^{-2}	17	8.4	8.0	1.3×10^{-1}	2.5	3.4×10^{-1}	1.1×10^{-3}	11	3.4×10^{-1}

Total curies in sludge = 48

[a] Less than analytical detection limit.

Note: Average depth = 5.08 cm (2 in); mass = 1.9×10^{9}g; concentrations in pCi/g. Corrections have been made to errors in reference cited.

Dorian and Richards 1978.

Table 9. The 116-DR-9 (107-DR) Retention Basin Fill, Basin Fill (Excluding Sludge).

Location	^{238}Pu	$^{239/240}Pu$	^{90}Sr	^{3}H	^{152}Eu	^{60}Co	^{154}Eu	^{134}Cs	^{137}Cs	^{155}Eu
0.61 m to 0.15 m (2 ft to 6 in) above basin floor										
Mass = 3.7×10^{9}g										
Average pCi/g	2.7×10^{-2}	1.5×10^{0}	5.4×10^{0}		9.6×10^{2}	1.9×10^{2}	2.5×10^{2}	a	1.2×10^{2}	2.2×10^{1}
Curies	1.0×10^{-4}	5.6×10^{-3}	2.0×10^{-2}		3.6	7.0×10^{-1}	9.3×10^{-1}	0.0	4.4×10^{-1}	8.1×10^{-2}
Number of curies 0.61 m to 0.15 m (2 ft to 6 in) above floor = 5.8										
0.15 m (6 in) above basin floor to surface										
Mass = 2.8×10^{10}g										
Average pCi/g	2.0×10^{-3}	1.7×10^{-1}	4.8×10^{-1}		3.1×10^{1}	9.0	1.6×10^{1}	a	8.6	1.4
Curies	5.6×10^{-5}	4.8×10^{-3}	1.3×10^{-2}		8.7×10^{-1}	2.5×10^{-1}	4.5×10^{-2}	0.0	2.4×10^{-1}	3.9×10^{-2}
Number of curies 0.15 m (6 in) to surface = 1.5										
Total curies	1.6×10^{-4}	1.0×10^{-2}	3.3×10^{-2}		4.5×10^{0}	9.5×10^{-1}	9.8×10^{-1}		6.8×10^{-1}	1.2×10^{-1}
Number of curies in fill (excluding sludge) = 7.3										
Sludge = 48										
Total curies in basin fill = 55										

[a]Less than analytical detection limit.

Note: Average depth = 7.6 cm (3 in); mass = 3.3×10^{10}g; average concentrations in pCi/g. Corrections have been made as necessary to errors in reference cited.

Dorian and Richards 1978.

Table 10. The 116-DR-9 (107-DR) Inlet Distribution Chamber Sludge.

Radionuclide	Concentration (pCi/g)	Curies
^{238}Pu	7.1×10^{0}	7.8×10^{-5}
$^{239/240}Pu$	1.5×10^{2}	1.7×10^{-3}
^{90}Sr	2.2×10^{3}	2.4×10^{-2}
^{152}Eu	2.9×10^{4}	3.2×10^{-1}
^{60}Co	2.8×10^{4}	3.1×10^{-1}
^{154}Eu	8.3×10^{3}	9.1×10^{-2}
^{137}Cs	1.3×10^{5}	1.4×10^{0}
^{155}Eu	Not reported	
^{63}Ni[a]	5.6×10^{4}	6.2×10^{-1}
	Total curies	2.8

Note: Volume 150 ft x 20 ft x 1 in. - 2.5×10^{2} ft^3; mass = 1.1×10^{7}g.

Dorian and Richards 1978.

a ^{63}Ni concentration estimated by multiplying the ^{60}Co concentration in the inlet distribution chamber sludge by the $^{63}Ni/^{60}Co$ ratio of the sludge along the 116-DR-9 basin floor.

116-DR-1 and -2 trenches. These trenches were sampled in 1975 for radionuclide analysis. A combined radionuclide inventory for the potentially contaminated soil column for both trenches was reported as 31 Ci by Dorian and Richards (1978). Stenner et al. (1988) reported the radionuclide inventory (decayed through April 1, 1986) for the 116-DR-1 trench as 21.57 Ci. They reported the radionuclide inventory as being identical for each trench, which may double the actual inventory to approximately 44 Ci. The decayed values Stenner et al. (1988) reported for the 116-DR-1 trench are presented in Table 11. These values may represent the total contaminated soil column from both trenches.

3.1.1.3.3 107-D and 107-DR Sludge Disposal Trenches. Five trenches were dug in the 116-D-7 and 116-DR-9 (107-D/DR) retention basin area for the disposal of sludge that had accumulated in the bottom of the basins. It is believed that some sludges were used as fill dirt to cover sludges in the retention basins during deactivation (Dorian and Richards 1978). The sludge trenches were sampled in 1975. Contamination levels were indistinguishable from contamination in the surrounding soil resulting from basin leakage. Soil results are presented in Section 3.1.2.

3.1.1.3.4 116-D-5 and 116-DR-5 (1904-D and 1904-DR) Outfall Structures. The outfall structures were used to dispose of process effluent to the Columbia River. Sludge from the floor of the 116-D-5 (1904-D) outfall structure was sampled in 1978 and found to be contaminated (Dorian and

Table 11. Radionuclide Inventory of the 116-DR-1 Trench.

Radionuclide	(Ci)	Radionuclide	(Ci)
^{3}H	0.44700	^{144}Ce	0.00000
^{14}C	0.00000	^{144}Pr	0.00000
^{54}Mn	0.00000	^{147}Pm	0.00000
^{60}Co	1.08000	^{152}Eu	5.39000
^{63}Ni	0.00000	^{154}Eu	0.97800
^{85}Kr	0.00000	^{155}Eu	0.10700
^{90}Sr	0.30300	^{237}Np	0.00000
^{91}Y	0.00000	^{238}Pu	0.00000
^{95}Nb	0.00000	^{239}Pu	0.03150
^{95}Zr	0.00000	^{240}Pu	0.00350
^{99}Tc	0.00000	^{241}Pu	0.00000
^{103}Ru	0.00000	^{241}Am	0.00000
^{106}Ru	0.00000	^{233}U	0.00000
^{113}Sn	0.00000	^{235}U	0.00024
^{125}Sb	0.00000	^{238}U	0.02780
^{129}I	0.00000	^{232}Th	0.00000
^{134}Cs	0.00225	Beta	0.00000
^{137}Cs	13.20000	Gamma	0.00000
^{141}Ce	0.00000	Alpha	0.00000
		Total curies	21.57

Note: These values are decayed through April 1, 1986.

Modified after Stenner et al. 1988.

Richards 1978). The 116-DR-5 outfall structure was not sampled. The radionuclides involved at the 116-D-5 structure and their activities were as follows:

^{137}Cs	110 pCi/g
^{60}Cs	440 pCi/g
^{152}Eu	1,100 pCi/g
^{154}Eu	300 pCi/g
Total activity	1,950 pCi/g.

3.1.1.3.5 Discharge Pipelines. The buried pipelines discharged process effluent from the outfall structures to the Columbia River on the north side of the small island northwest of the 100-DR-1. It can be assumed that the contamination would be similar to that in the 116-D-5 (1904-D) outfall structure sampled by Dorian and Richards (1978). Samples analyzed from the 100-F Area discharge pipelines to the river, which should be representative of the 100-D Area discharge pipelines because of similar waste sources, may provide information on the wastes received. These data will be evaluated as part of the RFI Phase I source investigation.

3.1.1.4 Contaminated Reactor Ancillary Facilities. Several contaminated reactor ancillary facilities in the 100-DR-1 operable unit were surveyed for radiation levels (Dorian and Richards 1978). These facilities included the 132-D-3 (1608-D) effluent pumping station, the 115-D gas recirculation building, and the 117-D exhaust air filter building. Several of these facilities were demolished during 1985 and 1986. Radiation surveys of contaminated floors, equipment, pumps, and piping were conducted using portable survey instruments in 1976 (Dorian and Richards 1978). In addition, standard smears (100 cm^2) using dry filter paper were taken. The smears were counted for alpha and beta activity.

Reactor ancillary facilities for which there is no sampling information include the 132-D-4 reactor exhaust stack, the 103-D fuel-element storage building, and the 108-D office building and equipment decontamination station.

3.1.1.4.1 132-D-3 (1608-D) Effluent Pumping Station. The 132-D-3 pumping station functioned as a collection sump for potentially radioactive or contaminated liquids from the 118-D-6 reactor building, with the exception of the once-through reactor cooling water. General background gamma activity in the building was 200 counts per minute. The maximum survey reading on pumps in the 132-D-3 building was 800 counts per minute. The maximum reading on piping was 1,000 counts per minute. No alpha activity was detected on the standard smear samples. Beta activity was detected on the smear samples from the floor at 120 disintegrations per minute and from other areas at levels ranging from 60 to 80 disintegrations per minute (Dorian and Richards 1978).

Decontamination chemicals in the wastewater included sodium fluoride, oxalic acid, and citric acid (DOE-RL 1989a). Chromic acid may also have been a potential decontamination chemical present in this wastewater. Asbestos was removed from the 132-D-3 building during 1986 in preparation for demolition. The contaminated asbestos was properly packaged and taken to the 200 Areas for disposal in the low-level radioactive waste burial grounds (Jacques 1987).

3.1.1.4.2 115-D Gas Recirculation Building. The reactor moderator (graphite) had a helium and carbon dioxide cover gas. Gas driers and injection and circulation equipment were located in the 115-D building. Radiation surveys were conducted of the pipe tunnel, the cooler blower rooms, filter room, oil and equipment storage rooms, and dryer rooms (Dorian and Richards 1978). Direct scans of gamma activity of the piping and floor of the pipe tunnel measured 1,000 to 3,000 counts per minute with a general background for the area of 750 counts per minute. Standard smears 100 cm^2 (15.5 in^2) measured from less than 100 to 1,000 counts per minute in the pipe tunnel area. Total beta activity ranged from 40 to 31,000 disintegrations per minute (the highest levels were found on the floor of the 105 exhaust wing). Direct scans of the cooler blower room measured from 300 counts per minute for general background up to 2,000 counts per minute. Total beta activity from smear samples ranged from background up to 28,000 disintegrations per minute in the cooler blower room. Direct scans in the filter room ranged from the general background of 400 up to 1,000 counts per minute with total beta activity of 160 to 400 disintegrations per minute. Radioactivity in the oil and equipment storage room was low (less than 200 counts per minute on direct scans and 15 disintegrations per minute of total beta activity on smear samples). General background radioactivity in the five dryer rooms ranged from 300 to 400 counts per minute with a maximum of 4,000 counts per minute. Total beta activity ranged from 25 to 8,000 disintegrations per minute.

During 1985, the contaminated equipment was removed from the 115-D building and disposed of as solid waste. The superstructure of the building was demolished in 1986, and the rubble was taken to the 190-DR clearwells located in the 100-DR-2 operable unit. The below-grade structure was buried in place (Jacques 1986; Jacques 1987).

3.1.1.4.3 117-D Exhaust Air Filter Building. The 117-D building housed the 118-D-6 reactor building exhaust air filters and air flow control system. Reactor building exhaust gases (primarily ventilation) were directed to the 117-D building, where the air passed through particulate and activated charcoal filters and was then discharged to the atmosphere through a 61-m (200-ft) high stack (the 132-D-4 [116-D] reactor exhaust stack). Radiation surveys were conducted in the inlet tunnel, a cell, and the exhaust tunnel (Dorian and Richards 1978). General background gamma activity in the inlet tunnel was 500 counts per minute with levels up to 3,000 counts per minute. Total beta activity on smear samples up to 60,000 disintegrations per minute was detected. General background in the cell was 1,000 counts per minute with total beta activity up to 12,000 disintegrations per minute detected. General background in the exhaust tunnel was 200 counts per minute with total beta activity up to 2,000 disintegrations per minute.

The contaminated equipment and some structures within the 117-D building were packaged and shipped to the 200 Areas low-level radioactive waste burial grounds during 1985. The building was demolished and buried in place during 1986 (Jacques 1987).

3.1.1.4.4 132-D-4 (116-D) Reactor Exhaust Stack. No specific information is available on the reactor exhaust stack. Sampling information on the 116 stacks demolished in the 100-B and 100-F Areas may provide representative information for the 132-D-4 stack. These data will be evaluated during the RFI Phase 1 source investigations.

3.1.1.4.5 103-D Fuel Element Storage Building. No information is available on the fuel element storage building. Dorian and Richards (1978) report that the 103 buildings are major contaminated reactor ancillary facilities. Verbal reports indicate that the 103-D facility was not contaminated during its original use, storing unirradiated fuel, but may have become contaminated subsequent to this use when it was used to store packaged radioactive samples. During a field visit in March 1989, this building contained herbicide and solvent warning signs posted on the outside of the building. Recent verbal accounts indicate that the building has been cleaned and no longer contains samples, solvents, or herbicides.

3.1.1.4.6 108-D Office Building and Equipment Decontamination Station. No information is available on the 108-D building. The building, which received wastes associated with the decontamination and repair of contaminated reactor process tube equipment, has been demolished. A sanitary sewer pipeline was connected to this facility, and the possibility exists that non-sanitary wastes may have been disposed down this drain. Acidic decontamination fluids may have affected the integrity of the pipelines.

3.1.1.5 Miscellaneous Cribs and Trenches.

3.1.1.5.1 116-D-3 and 116-D-4 (108-D Cribs #1 and #2). The 116-D-3 and 116-D-4 cribs received low-level fission and activation product wastes from the contaminated maintenance shop and cask decontamination pad in the 108-D building. One sample at 1.5 m (5 ft) from crib #2 (116-D-4), taken in 1976, contained 0.33 pCi/g of $^{239/240}Pu$, 0.25 pCi/g of ^{90}Sr, and 0.11 pCi/g of ^{155}Eu (Dorian and Richards 1978).

3.1.1.5.2 116-D-9 (117-D) Reactor Confinement Seal Pit Drainage Crib. The 116-D-9 crib received drainage from the 117-D reactor exhaust air filter building seal pits. The radioactive effluents drained to this crib had short half-lives, and the crib was released from radiation zone status (Dorian and Richards 1978; Stenner et al. 1988).

3.1.1.6 Sanitary Sewage Transfer, Treatment, and Disposal Facilities. These facilities consist of the 1607-D2, 1607-D4, and 1607-D5, septic tanks, a possible septic tank at Hanford Site coordinates N93050 and W552850, and associated sanitary sewer pipelines and drainfields. These facilities received an unknown quantity of sanitary sewage from several 100-D/DR Area buildings. No waste inventories or sampling have been conducted for these facilities.

3.1.1.7 120-D-1 (100-D) Ponds Resource Conservation and Recovery Act Facility. The 120-D-1 ponds occupy the area formerly used as an ash disposal basin (126-D-1 [188-D]), which was used to dispose of ash from the coal-fired boilers that generated steam for the 100-D/DR reactors. Most of the discharge to the 120-D-1 ponds has been nonradioactive, nonhazardous, nonregulated, aqueous backwash from the sand filters at 183-D filter plant and discharge water from the thermal hydraulics test facility in the 185-D/189-D building and from the fuel discharge trampoline test facility.

In addition to these discharges, the ponds have received potentially hazardous effluent streams from demineralizer recharge and from floor and sink drains. Chemicals used in demineralizer regeneration are hydrochloric acid or sulfuric acid and sodium hydroxide. In the past, some demineralizer recharge effluent may have been released sequentially from the anion and cation columns, which may have caused the effluent to be outside the pH range of 2.0 to 12.5. Currently the recharge effluent is retained, tested, and neutralized before being discharged to the ponds. Because of past potential releases of effluent exceeding the pH limits, the 120-D-1 (100-D) ponds are classified as a RCRA site. However, the actual discharge of hazardous waste to the ponds is uncertain. Table 12 shows the results of 1987 sampling of the 183-D filter backwash wastewater before it entered the 120-D-1 ponds.

Table 12. Results of Sampling 183-D Filter Backwash Before It Enters 120-D-1 Ponds

Sample	1	2	3[a]	4[a]
Sampling Date	04/21/87	08/27/87	10/19/87	01/05/88
Aluminum	3.5E+04	4.2E+05	4.7E+04	3.7E+04
Ammonium	<5.0E+01	7.5E+02	6.2E+01	HTE
Antimony	<1.0E+02	<1.0E+02	<1.0E+02	<1.0E+02
Barium	9.4E+01	1.9E+02	6.1E+01	4.7E+01
Beryllium	<5.0E+00	<5.0E+00	<5.0E+00	<5.0E+00
Cadmium	<2.0E+00	<2.0E+00	<2.0E+00	<2.0E+00
Calcium	2.6E+04	2.2E+04	1.9E+04	2.2E+04
Chromium	4.1E+01	3.1E+02	4.2E+01	3.6E+01
Copper	1.2E+02	4.0E+02	6.6E+01	4.4E+01
Iron	1.0E+04	4.5E+04	5.8E+03	3.2E+03
Lead	7.0E+01	1.5E+02	2.1E+01	NIC
Magnesium	6.2E+03	7.0E+03	4.6E+03	4.5E+03
Manganese	4.7E+02	1.2E+03	3.4E+02	1.8E+02
Mercury	7.0E-01	HTE	HTE	HTE
Nickel	<1.0E+01	2.9E+01	<1.0E+01	<1.0E+01
Potassium	1.4E+03	1.8E+03	1.1E+03	8.7E+02
Silver	<1.0E+01	<1.0E+01	<1.0E+01	<1.0E+01
Sodium	2.7E+03	2.8E+03	2.6E+03	2.1E+03
Strontium	<3.0E+02	<3.0E+02	1.3E+02	1.2E+02
Uranium	3.3E+01	1.6E+01	9.9E+00	1.1E+00
Vanadium	1.6E+01	1.3E+02	2.4E+01	1.5E+01
Zinc	3.1E+02	1.2E+03	2.1E+02	1.1E+02
Chloride	2.4E+05	3.4E+03	4.0E+03	2.9E+03
Cyanide	<1.0E+01	6.7E+01	<1.0E+01	<1.0E+01
Fluoride	<5.0E+04	1.3E+02	9.2E+01	<5.0E+02
itrate	<5.0E+04	<5.0E+02	<5.0E+02	<5.0E+02
Phosphate	<1.0E+05	<1.0E+03	<1.0E+03	NIC
Sulfide	<1.0E+03	ISP	HTE	HTE
Sulfate	2.2E+06	8.9E+03	2.2E+04	1.8E+04
Chloroform	1.9E+01	<1.0E+01	1.0E+01	2.1E+01
Amount (L/month)	8.1E+03	8.1E+03	8.1E+03	8.1E+03
pH (dimensionless)	5.43	5.47	7.1	7.1
Temperature (celsius)	14.3	23.5	17	4.6
Alpha activity (pCi/L)	2.4E+01	1.0E+01	4.7E+00	<7.4E-01
Beta activity (pCi/L)	2.8E+01	1.2E+01	8.1E+00	4.2E+00
Conductivity (μSiemens/cm)	1.4E+02	9.4E+01	1.5E+02	1.7E+02
Total organic carbon (ppb)	5.2E+03	1.5E+05	1.9E+04	5.9E+03
Total organic halide (ppb)	7.2E+01	1.5E+02	NIC	HTE

Note: Analyte concentrations are in ppb. Notations include measurements made after holding times were exceeded (HTE), inadequate sample preparation (ISP), and measurements by methods that were not in control (NIC) at the time of measurement.

[a]No matrix spikes were run for inductively coupled plasma (ICP) metals or anion data.

Floor and sink drains in the 189-D mechanical development laboratory, the 185-D/189-D thermal hydraulics laboratory, and their associated shops also discharge to the 120-D-1 ponds. A portion of the pipeline that is thought to have transported these wastes is shown in Figure 5. The shops use a variety of hazardous substances, including paints, thinners, solvents, degreasers, and cleaning chemicals. Any substances that may have spilled could have been discharged to the 120-D-1 ponds.

The area where the 120-D-1 ponds are located was previously used for the 126-D-1 (188-D) ash disposal basin, which handled ash from the 184-D powerhouse. The ash was removed and is currently alongside the ponds in piles approximately 7 to 9 m (20 to 30 ft) high.

3.1.1.8 Support Facilities. Support facilities for operations within the 100-DR-1 operable unit were located throughout the unit. Only limited information on known or suspected contaminated sources was found for the majority of these facilities, which are shown in Figure 5 and described in Section 2.1.4.8. Some of the facilities have been demolished. The facilities of primary concern include the following:

- The 1714-D solvent storage building
- The 1716-D gas station and bus maintenance shop
- The 1715-D oil and paint storage
- The 1734-D cylinder storage
- The 1722-D equipment development lab (a concrete slab immediately to the north of the 1722-D building contains 5.08-cm (2-in) pipes that may indicate the presence of an underground tank or a foundation of another building; an unidentified, enclosed, bolted metal structure is immediately west of this slab)
- The 1724-DA underwater test facility
- The 189-D mechanical development laboratory, used for fuel-element testing that may have resulted in potential uranium contamination and the former location of a satellite hazardous waste storage area
- The paint shop located west of 182-D reservoir.

Table 1 in Section 2.1 lists additional support facilities for which no information is available on wastes received or produced or for which no wastes have been identified.

3.1.1.9 Storage Tanks and Related Facilities. Numerous aboveground and underground storage tanks and a waste acid reservoir have been identified within 100-DR-1. They are described in Section 2.1.4.9. The facilities that have been identified to date include the following:

- The 130-D-1 (1716-D) underground gasoline storage tank east of the 1716-D gas station (no releases are known to have occurred while this tank was in service; following deactivation of the 100-D/DR Area, the tank was emptied and filled with water; an onsite inspection in March 1989, revealed that it was empty). The tank was removed and samples were collected for analyses in July 1989 as part of the Hanford Site tank removal program. Prior to removal of the tank, a 6-cm (2.5-in) line was cut and a small amount of liquid release occurred into the adjacent soil. The tank was rusted and a single hole was noted that is suspected of being a source point for soil contamination observed under the tank (Lerch 1989). Three liquid samples were collected from the cut distribution line and 17 soil samples were collected from within the excavated hole. The results of this sampling program are shown in Table 13.

- The underground, brick waste acid reservoir west of 186-D demineralization building (it is currently unknown if this reservoir was ever used) and manhole that is possibly a sump associated with this facility

- Underground fuel oil tank west of the 184-D steam generating building

- Aboveground, 681,300-L (180,000-gal) diesel fuel storage tank (166-D) and line north of 184-D powerhouse

- Aboveground sodium dichromate storage tanks originally located west of the 108-D equipment decontamination building and thought to be subsequently moved south of the 190-D building.

No waste generation is associated with the 110-D helium storage tank in the southeastern corner of the 100-DR-1 operable unit.

3.1.1.10 Solid Waste Landfill, Ash Disposal Basin, Burial Grounds, and Salt Dissolving Pit.

3.1.1.10.1 126-D-2 Solid Waste Landfill. This landfill was originally used as the coal storage area for the 184-D powerhouse (Figure 5). It was subsequently used as an open, solid waste landfill for approximately 20 years; it was covered in 1986. The 126-D-2 landfill reportedly contains nonradioactive decommissioning/demolition wastes, concrete, steel, and other materials. A 1983 photograph revealed a potential drum. There has been no sampling at this site.

3.1.1.10.2 126-D-1 (188-D) Ash Disposal Basin. This site received unknown amounts of coal ash from the 184-D powerhouse. Ash from selected power plants at the Hanford Site have been characterized as nonradioactive and nonhazardous.

3.1.1.10.3 Burial Grounds No. 4A, 4B, and 18. These burial grounds, for which there currently exists a discrepancy as to their locations, received both radioactive and nonradioactive solid waste.

Table 13. Results of 130-D-1 Tank Sample Analysis for Total Hydrocarbons

Sample Number	Sample Description		Total Petroleum Hydrocarbons (ppm)
D101	Liquid from pipe		not available
D102	Liquid from pipe	composite sample	
D103	Liquid from pipe		
D104	Equipment blank		<50
D105	Equipment blank		<50
D106	Soil saturated by liquid from inlet pipe		<50
D107	Background soil		<50
D108	Soil below saturated soil after material was excavated		<50
D109	Soil in tank impression area		83.8
D110	Soil in tank impression area		69.8
D111	Soil in tank impression area		69.8
D112	Soil adjacent to hole in tank		1128
D113	Soil in tank impression area		<50
D114	Rusty area in soil		7430
D115	Soil in 15-in hole below hole in tank		279
D116	Soil in 15-in hole below hole in tank		not available
D117	Soil in 15-in hole below hole in tank		293
D118	Soil in 15-in hole below hole in tank		not available
D119	Trip blank		<50
D120	Trip blank		<50

Note: Volatile organic compounds (VOC) analysis was performed for samples D106 and D107.

D106 was found to contain: 1.1 ppm xylene
0.3 ppm n-propyl benzene
0.9 ppm 1,3,5 trimethyl benzene
3.9 ppm 1,2,4-trimethyl benzene
1.6 ppm n-butyl benzene

D107 was found to contain <0.6 ppm of any VOC compounds analyzed for in EPA Method 8021.

Lerch 1989

3.1.1.10.4 Salt Dissolving Pit. This site is located north of the 184-D powerhouse and west of the 106-D fuel oil tank. The site apparently contained salt used in a water softener.

3.1.1.11 Electrical Transmission Facilities. Electrical transformers, capacitors, switches, and other miscellaneous electrical facilities are located within the 100-DR-1 operable unit. Although electrical facilities on the Hanford Site are currently regularly inspected and any leaks are addressed promptly, there is a possibility of PCB-contaminated soil because of past practices.

3.1.2 Soil

3.1.2.1 Background Soil Quality. There are no operable unit-specific background soil data available for 100-DR-1. Surface soil radionuclide data are available for the Hanford Site as a whole, and background soil quality data are available from off-site locations. The background surface radionuclide stations are shown in Figure 12, and average background radionuclide concentrations in off-site surface soils are given in Table 14. No subsurface background soil data in close proximity to the operable unit are currently available.

Table 14. Radionuclide Concentrations in Off-site Background Surface Soils.

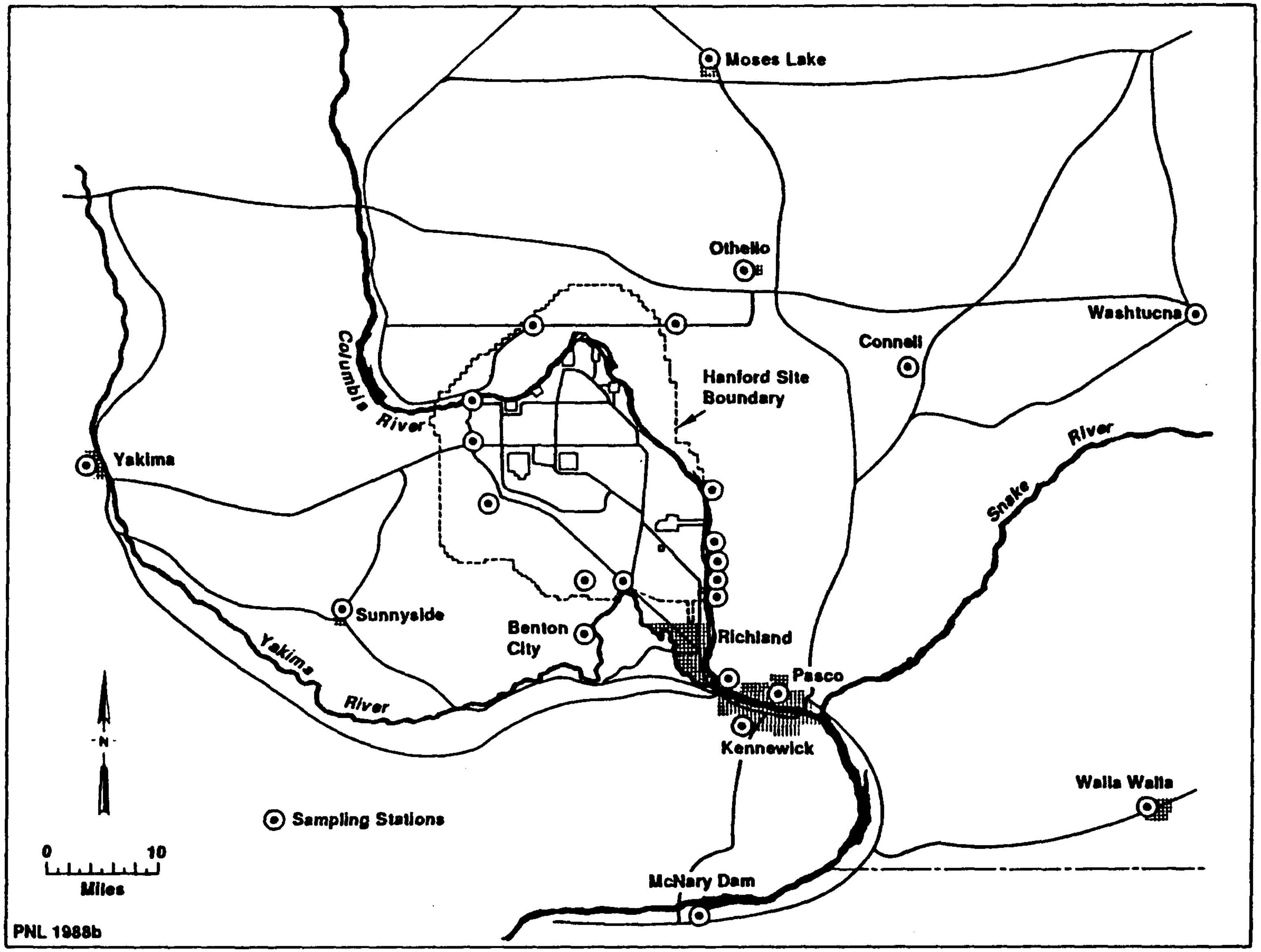
Parameter	Average ± 2 Standard Errors (pCi/g)
^{90}Sr	0.32 ± 0.67
^{137}Cs	0.61 ± 0.38
$^{239/240}Pu$	0.011 ± 0.001
U (total)	0.41 ± 0.20

PNL 1988b.

3.1.2.2 Soil Contamination. One surface soil sampling station located near the 100-D Area (1.6 km [1 mi] northeast of the 100-N Area) is sampled as part of the PNL environmental monitoring program at the Hanford Site (PNL 1988b). Samples analyzed for gamma-emitting radionuclides (^{90}Sr, $^{239/240}Pu$, and uranium) show, in general, radionuclide concentrations that are low when compared to onsite and offsite average concentrations.

Tables 15 and 16 present radionuclide inventories for the soil columns adjacent to and beneath, respectively, the 116-D-7 (107-D) retention basin in 1976, as reported by Dorian and Richards (1978). Tables 17 and 18 present this information for soils adjacent to and beneath the 116-DR-9 (107-DR) retention basin (Dorian and Richards 1978). The contaminated soil resulted from leaks of the retention basins and associated pipelines and from disposal of sludges from the basins.

Surface soils (150-g [5-oz] samples from the top 2.5 cm [1 in] of the soil surface) from four stations in the 116-D-7 and 116-DR-9 retention basin area (shown on Figure 13) have been analyzed annually for various radionuclides at least since 1981. The radionuclides detected in these analyses include the following:



883-1736/13061

Figure 12. Background Sampling Stations for Soil and Vegetation.

Table 15. Radionuclide Inventory of Contaminated Soil Column Adjacent to 116-D-7 (107-D) Basin.

Radionuclides	(Mass = 1.0 x 10^{11}g) Average (pCi/g)	Total (Ci)
^{238}Pu	1.1×10^{-2}	1.1×10^{-3}
$^{239/240}Pu$	5.3×10^{-1}	5.3×10^{-2}
^{90}Sr	1.1×10^{0}	1.1×10^{-1}
^{3}H	8.1×10^{0}	8.1×10^{-1}
^{152}Eu	9.3×10^{1}	9.3×10^{0}
^{60}Co	1.2×10^{2}	1.2×10^{1}
^{154}Eu	3.1×10^{1}	3.1×10^{0}
^{134}Cs	2.3×10^{-1}	2.3×10^{-2}
^{137}Cs	1.3×10^{1}	1.3×10^{0}
^{155}Cs	4.0×10^{0}	4.0×10^{-1}
U	3.1×10^{-1}	2.8×10^{-2}
		Total Ci = 27

Note: Includes area 30.5 m (100 ft) to the north of the basin and 7.6 m (25 ft) in all other directions x 6.1 m (20 ft) average depth.

Dorian and Richards 1978.

Table 16. Radionuclide Inventory of Contaminated Soil Column Beneath 116-D-7 (107-D) Basin.

0 to 6 ft below basin Mass = 4.5×10^{10}g

6 to 10 ft below basin Mass = 3.0×10^{10}g

Radionuclide	0 to 6 ft Average (pCi/g)	6 to 10 ft Average (pCi/g)	Total (Ci)
^{238}Pu	a	a	0.0
$^{239/240}Pu$	3.8×10^{-1}	a	1.7×10^{-2}
^{90}Sr	1.1×10^{0}	1.1×10^{0}	8.3×10^{-2}
^{3}H	8.8×10^{0}	NA(b)	6.6×10^{-1}
^{152}Eu	2.2×10^{1}	2.2×10^{-1}	1.0×10^{0}
^{60}Co	4.4×10^{1}	1.1×10^{-1}	2.0×10^{0}
^{154}Eu	7.8×10^{0}	a	3.5×10^{-1}
^{134}Cs	3.6×10^{-2}	5.3×10^{-2}	3.2×10^{-3}
^{137}Cs	4.1×10^{1}	1.7×10^{1}	2.4×10^{0}
^{155}Eu	7.7×10^{-1}	2.7×10^{-1}	4.3×10^{-2}
U	3.2×10^{-1}	NA[b]	2.4×10^{-2}
			Total Ci = 6.6

[a]Less than analytical detection limit.
[b]No analysis performed. Concentration conservatively assumed to be the same as 0 to 6-ft interval for total calculation.

Dorian and Richards 1978.

Table 17. Contaminated Soil Column Adjacent to 116-DR-9 (107-DR) Retention Basin.

$4.8 \times 10^4\ ft^2 \times 20\ ft = 9.6 \times 10^5\ ft^3$

Mass $= 6.5 \times 10^{10} g$

Radionuclide	Average (pCi/g)	Total (Ci)
^{238}Pu	a	a
$^{239/240}Pu$	$6.9.10^{-2}$	4.5×10^{-3}
^{90}Sr	4.4×10^{-1}	2.9×10^{-2}
^{3}H	2.6×10^{0}	1.7×10^{-1}
^{152}Eu	1.8×10^{1}	1.2×10^{0}
^{60}Co	1.4×10^{1}	9.1×10^{-1}
^{154}Eu	6.2×10^{0}	4.0×10^{-1}
^{134}Cs	1.1×10^{-2}	7.2×10^{-4}
^{137}Cs	1.1×10^{1}	7.2×10^{-1}
^{155}Eu	8.8×10^{-1}	5.7×10^{-2}
U	2.1×10^{-1}	1.4×10^{-2}
		Total curies = 3.5

[a]Less than analytical detection limit.

Note: Includes area 7.6 m (25 ft) from basin walls on all sides x 6.1 m (20 ft) average depth.

Dorian and Richards 1978.

Table 18. Contaminated Soil Column Underneath the 116-DR-9 (107-DR) Retention Basin.

0 to 3 ft below basin 1.7×10^5 ft^2 x 3 ft = 5.2×10^5 ft^3

Mass = 3.5×10^{10}g

3 to 10 ft below basin 1.7×10^5 ft^2 x 7 ft = 1.2×10^6 ft^3

Mass = 8.2×10^{10}g

Radionuclide	0 to 3 ft Average (pCi/g)	3 to 10 ft Average (pCi/g)	Total (Ci)
^{238}Pu	a	a	a
$^{239/240}$Pu	3.1×10^{-1}	3.4×10^{-1}	3.9×10^{-2}
^{90}Sr	2.5×10^{0}	3.2×10^{0}	3.5×10^{-1}
^{3}H	3.1×10^{0}	3.3×10^{0}	3.8×10^{-1}
^{152}Eu	9.6×10^{1}	2.4×10^{0}	3.6×10^{0}
^{60}Co	1.1×10^{2}	1.4×10^{0}	4.0×10^{0}
^{154}Eu	3.3×10^{1}	7.4×10^{-1}	1.2×10^{0}
^{134}Cs	a	a	a
^{137}Cs	1.2×10^{2}	8.6×10^{0}	4.9×10^{0}
^{155}Eu	4.2×10^{0}	1.9×10^{-1}	1.6×10^{-1}
U	3.0×10^{-1}	1.3×10^{-1}	2.1×10^{-2}

Total curies = 15

[a]Less than analytical detection limit.

Dorian and Richards 1978.

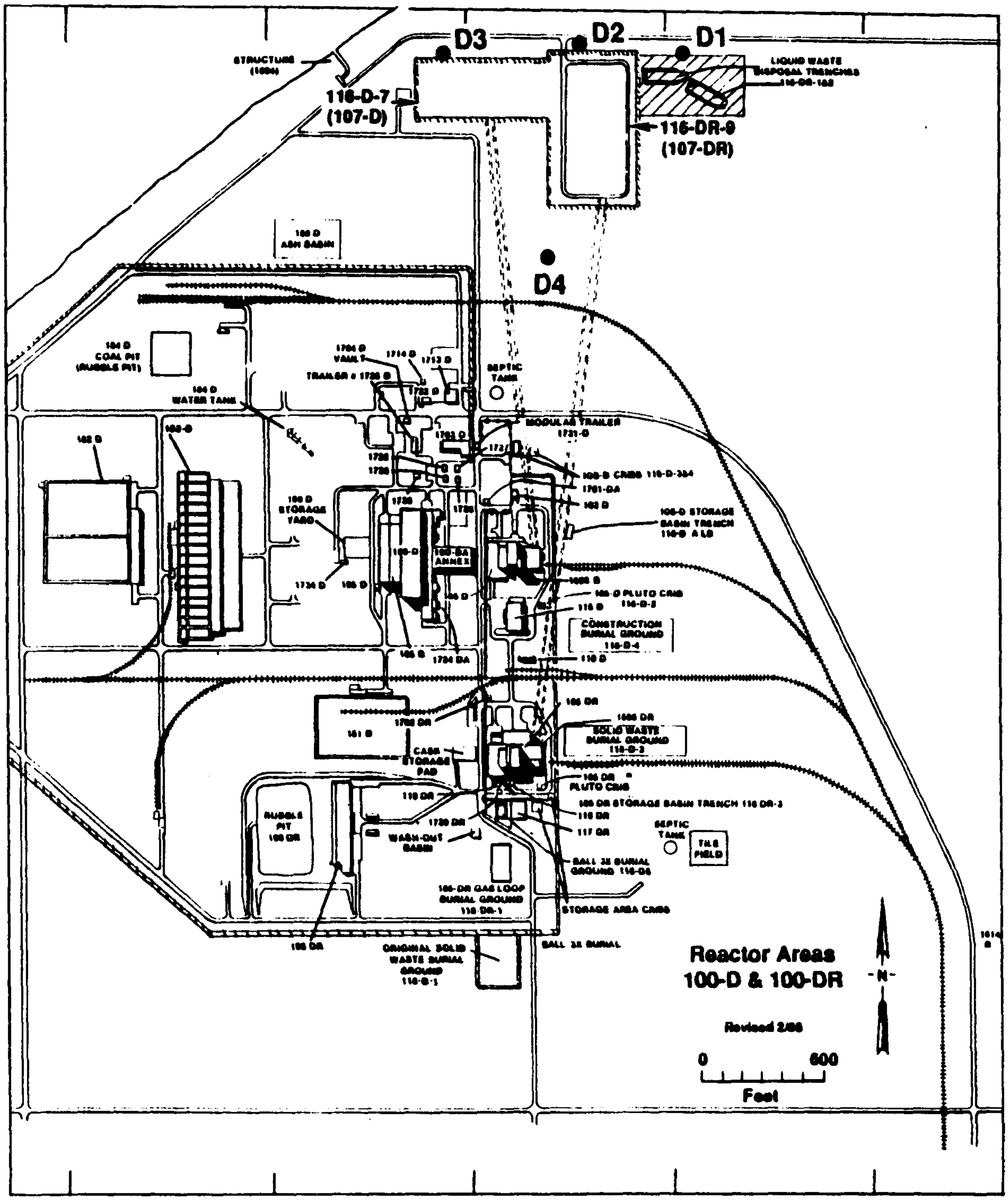


Figure 13. Surface Soil Sampling Locations at 100-D/DR Area.

- Cobalt-60
- Strontium-90
- Cesium-137
- Plutonium-238
- Plutonium-239/240.

Results of analyses from 1986 and average concentrations between 1981 and 1986 are presented in Table 19 (Jacques 1987). As indicated in this table, radionuclide concentrations in these samples are generally lower than the average values for the Hanford Site or off site.

3.1.3 Groundwater

Three monitoring wells in the 100-D/DR Area are routinely sampled as part of the site-wide chemical monitoring network (wells 199-D2-5, 199-D5-12, and 199-D8-3) (see Figure 6). Results of this monitoring indicate that groundwater under 100-DR-1 in the saturated sediments of the Hanford formation is contaminated with gross alpha, gross beta, nitrate, and hexavalent chromium (Cr^{+6}). In addition, sodium dichromate was used to control oxidation of aluminum parts during operation of the production reactors in the 100 Areas. Chromic acid was also used to decontaminate dummy fuel elements. Disposal of these materials to cribs and other liquid waste disposal facilities in the 100-D/DR and other 100 Area reactors has resulted in widespread hexavalent chromium contamination. The highest level of hexavalent chromium detected in the 100 Areas (1,690 μg/L) was found in well 199-D5-12 (PNL 1988c).

The known nature and extent of groundwater contamination in the vicinity of the 100-DR-1 operable unit will be discussed in greater detail in the 100-HR-3 operable unit work plan (in preparation).

3.1.4 Surface Water and Sediment

The known and suspected nature and extent of contamination in the Columbia River water column and sediment will be discussed in the 100-HR-3 operable unit work plan (in preparation).

3.1.5 Air

3.1.5.1 Background Air Quality. Background concentrations for airborne radionuclides have been measured at several distant communities in eastern Washington (Figure 14). The average values for these distant communities for 1987 are shown in Table 20.

3.1.5.2 Air Contamination. Concentrations of airborne radionuclides have been extensively monitored on and off the Hanford Site. Data for the 100 Areas are available from four monitoring stations: one each in the 100-K, 100-N, and 100-D Areas, and one at the 100 Area fire station. These monitoring locations are shown in Figure 14. The 1987 monitoring data are shown in Table 20.

Table 19. Radionuclide Concentrations Detected in Surface Soil at 100-D/DR Area.

Concentrations by location in 1986

Location	^{60}Co	^{90}Sr	^{137}Cs	^{238}Pu	$^{239/240}Pu$
D1	0.18	0.030	0.24	<0.00035	0.0020
D2	0.32	0.11	0.73	0.00067	0.013
D3	0.37	0.042	0.21	<0.000081	0.0035
D4	0.16	0.11	2.3	<0.00016	0.0048
Average	0.26	0.073	0.87	0.00032	0.0058
SD	±0.10	±0.043	±0.98	±0.00025	±0.0049
Hanford Site[a]	NR	0.42	2.3	NR	0.035
Offsite[a]	NR	0.26	0.56	NR	0.012

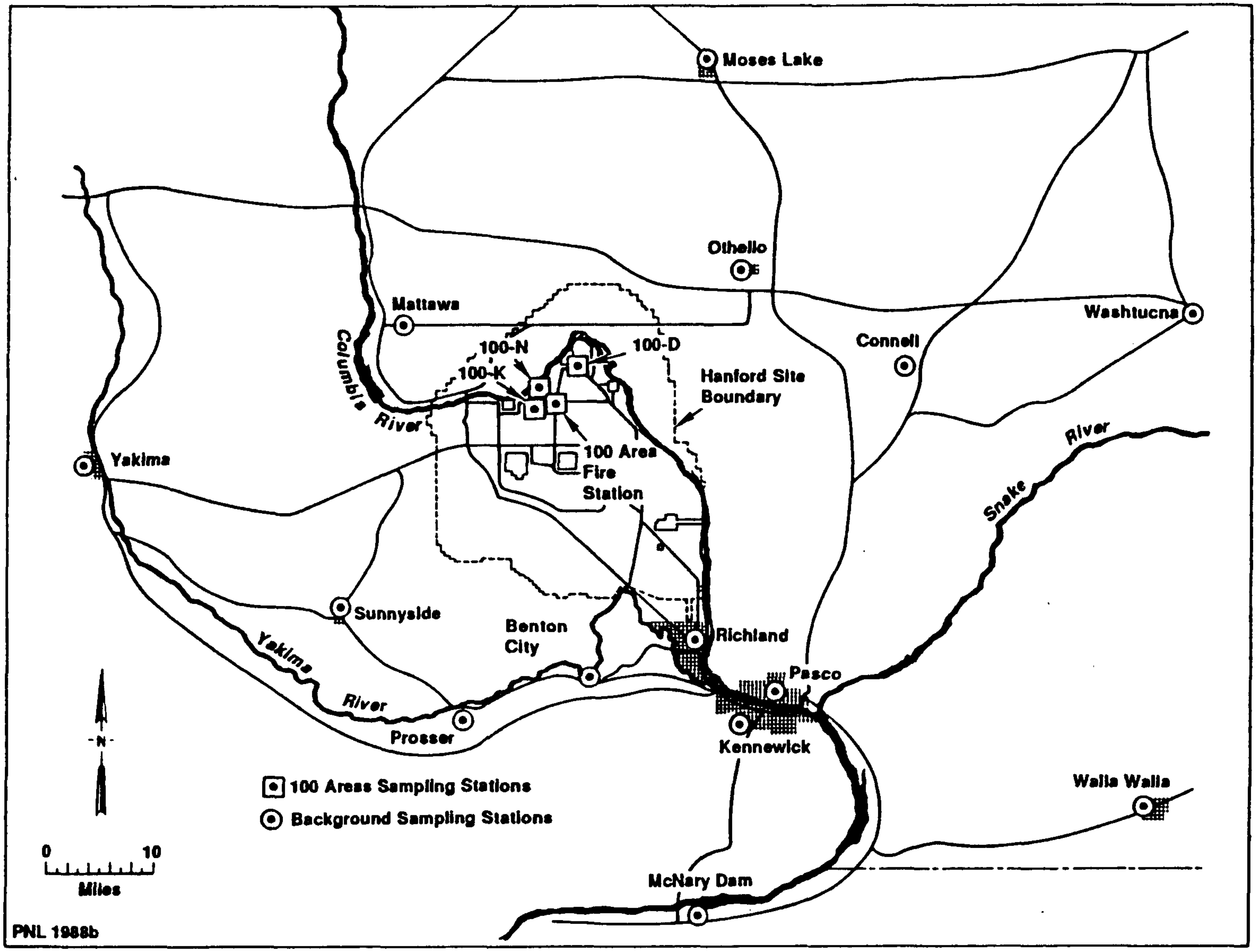
Average concentrations by year

Year	^{60}Co	^{90}Sr	^{137}Cs	^{238}Pu	$^{239/240}Pu$
1981	0.36	NR	0.40	NR	NR
1982	0.49	NR	0.32	NR	NR
1983	0.42	NR	0.17	NR	NR
1984	0.22	0.14	0.16	0.00014	0.0098
1985	0.24	0.056	0.27	0.00021	0.0030
1986	0.26	0.073	0.87	0.00032	0.0058

Note: Concentrations given in pCi/g dry weight.

Jacques 1987.

NR - Not reported.
SD - Standard deviation.
[a] - Average Hanford Site and offsite values obtained from Price 1986.



883-1736/13062

Figure 14. Air Sampling Locations.

Table 20. Airborne Radionuclide Concentrations for 1987, including Background Readings from Various Eastern Washington Communities.

Parameters	Location	Number of Samples	Concentration (pCi/m^3)[a] Maximum	Minimum	Average	2 standard errors of Average
Gross beta	100-K	26	7.0×10^{-2}	1.1×10^{-2}	2.6×10^{-2}	0.5×10^{-2}
	100-D	24	5.6×10^{-2}	1.2×10^{-2}	2.6×10^{-2}	0.5×10^{-2}
	100-N	26	6.0×10^{-2}	1.1×10^{-2}	2.5×10^{-2}	0.5×10^{-2}
	100 Fire Sta.	26	6.1×10^{-2}	0.9×10^{-2}	2.5×10^{-2}	0.5×10^{-2}
	Background[b]	155	5.5×10^{-2}	0.5×10^{-2}	2.4×10^{-2}	1.6×10^{-3}
Gross alpha	100-D	26	2.1×10^{-3}	0.2×10^{-3}	0.9×10^{-3}	0.2×10^{-3}
	Background[b]	52	1.5×10^{-3}	0.1×10^{-3}	0.7×10^{-3}	0.1×10^{-3}
^{3}H	100-N	12	8.2×10^{0}	0.0	2.3×10^{0}	1.4×10^{0}
	100-D	13	7.0×10^{0}	-0.3×10^{0}	1.5×10^{0}	1.1×10^{0}
	Background[b]	26	6.1×10^{0}	-1.0×10^{0}	2.2×10^{0}	0.8×10^{0}
^{90}Sr	Composite	4	0.7×10^{-4}	0.3×10^{-4}	0.4×10^{-4}	0.2×10^{-4}
	Background[b]	16	9.4×10^{-5}	1.9×10^{-5}	0.6×10^{-4}	0.2×10^{-4}
^{131}I	100-N	26	5.0×10^{-3}	-0.4×10^{-2}	0.1×10^{-2}	0.1×10^{-2}
	100-D	26	4.0×10^{-3}	-0.7×10^{-2}	0.1×10^{-2}	0.1×10^{-2}
	Background[b]	52	6.3×10^{-3}	-0.8×10^{-2}	-0.7×10^{-2}	0.1×10^{-2}
^{137}Cs	Composite	12	0.9×10^{-3}	-0.1×10^{-3}	0.4×10^{-3}	0.2×10^{-3}
	Background[b]	48	2.2×10^{-3}	-1.9×10^{-3}	0.3×10^{-3}	0.3×10^{-3}
U(total)	Composite	4	1.8×10^{-4}	0.1×10^{-4}	6.9×10^{-5}	8.5×10^{-5}
	Background[b]	4	7.1×10^{-5}	2.5×10^{-5}	4.7×10^{-5}	2.3×10^{-5}
^{238}Pu	Composite	4	0.4×10^{-6}	0.2×10^{-6}	0.3×10^{-6}	0.3×10^{-6}
	Background[b]	16	0.3×10^{-5}	-0.2×10^{-5}	0.3×10^{-6}	0.7×10^{-6}
$^{239/240}Pu$	Composite	4	1.0×10^{-6}	0.3×10^{-6}	0.6×10^{-6}	0.6×10^{-6}
	Background[b]	16	0.3×10^{-5}	-0.9×10^{-6}	0.3×10^{-6}	0.6×10^{-6}

PNL 1988b.

[a]Negative values are commonly encountered in environmental radiological testing because of the need to subtract instrument background from the measured values.

[b]Average from several distant communities shown in Figure 14 (Moses Lake, Washtucna, Walla Walla, McNary Dam, Sunnyside, and Yakima).

3.1.6 Biota

3.1.6.1 Terrestrial Biota.

3.1.6.1.1 Terrestrial Flora. Background concentrations of selected radionuclides in native vegetation have been measured at numerous offsite locations. Background vegetation sampling stations are the same stations as those used for background surface soil stations (see Figure 12). Average background vegetation concentrations are presented in Table 21.

Terrestrial vegetation radionuclide data from the 100-D Area, obtained in 1986, are also summarized in Table 21. Sample locations are the same as those for soil sampling (see Figure 13).

3.1.6.1.2 Terrestrial Fauna. No background terrestrial fauna data are available. Results of wildlife monitoring of pheasants and rabbits during 1987 from two locations in the 100 Areas are summarized in Table 22. Sample locations are shown on Figure 15. Median concentrations of ^{137}Cs in pheasants are within the ranges observed during previous years. Median values of ^{90}Sr (in bone) and ^{137}Cs (in muscle) from rabbits measured since 1982 are shown in Figure 16. The levels of ^{90}Sr in bone samples indicated that the rabbits had at some time consumed food or water contaminated with ^{90}Sr. However, the rabbits had not been eating or drinking contaminated materials recently, because muscle samples from the same animal contained low levels of ^{137}Cs (PNL 1988b).

The PNL collects muscle and bone samples from road-kill deer on the Hanford Site for radionuclide analysis. No samples have been collected in the 100 Areas in recent years.

3.1.6.2 Aquatic Biota. Existing information regarding contamination of aquatic biota in the Columbia River from releases of hazardous substances from the 100-DR-1 operable unit will be evaluated in the 100-HR-3 Work Plan being prepared.

3.2 POTENTIAL CONTAMINANT- AND LOCATION-SPECIFIC RELEVANT AND APPLICABLE STANDARDS

Corrective action at the 100-DR-1 operable unit is generally required to comply with federal and state environmental laws and promulgated standards, requirements, criteria, and limitations that are legally applicable or relevant and appropriate under the circumstances presented by the release or threatened release of hazardous substances, pollutants, or contaminants. This is referred to as compliance with applicable or relevant and appropriate requirements (ARARs). State ARARs must be met if they are more stringent than federal requirements.

Applicable requirements are those that are promulgated to specifically address contaminants, remedies, locations, or other site-specific circumstances. Relevant and appropriate requirements are those that, while not applicable as previously defined, are promulgated to address problems

Table 21. Radionuclide Concentrations Detected in Vegetation at 100-D/DR Area.

Concentrations by location in 1986					
Location	^{60}Co	^{90}Sr	^{137}Cs	^{238}Pu	$^{239/240}$Pu
D1	0.23	0.046	1.1	<0.0	0.00049
D2	0.47	0.050	0.81	<0.0	<0.00010
D3	0.19	0.051	0.88	<0.0	<0.00034
D4	0.20	0.44	4.1	<0.0	<0.00031
Average	0.27	0.15	1.7	<0.0	0.00031
SD	±0.13	±0.20	±1.6	±0.0	±0.00016
Hanford Site[a]	NR	0.36	0.062	NR	0.0016
Offsite[a]	NR	0.22	0.018	NR	0.00046

Average concentrations by year					
Year	^{60}Co	^{90}Sr	^{137}Cs	^{238}Pu	$^{239/240}$Pu
1981	1.2	NR	0.16	NR	NR
1982	0.11	NR	2.7	NR	NR
1983	0.095	NR	0.14	NR	NR
1984	0.21	0.28	1.7	0.0018	0.00058
1985	0.24	0.069	0.68	0.00012	0.00070
1986	0.27	0.15	1.7	0.0	0.00031

Note: Concentrations given in pCi/g dry weight.

Jacques 1987.

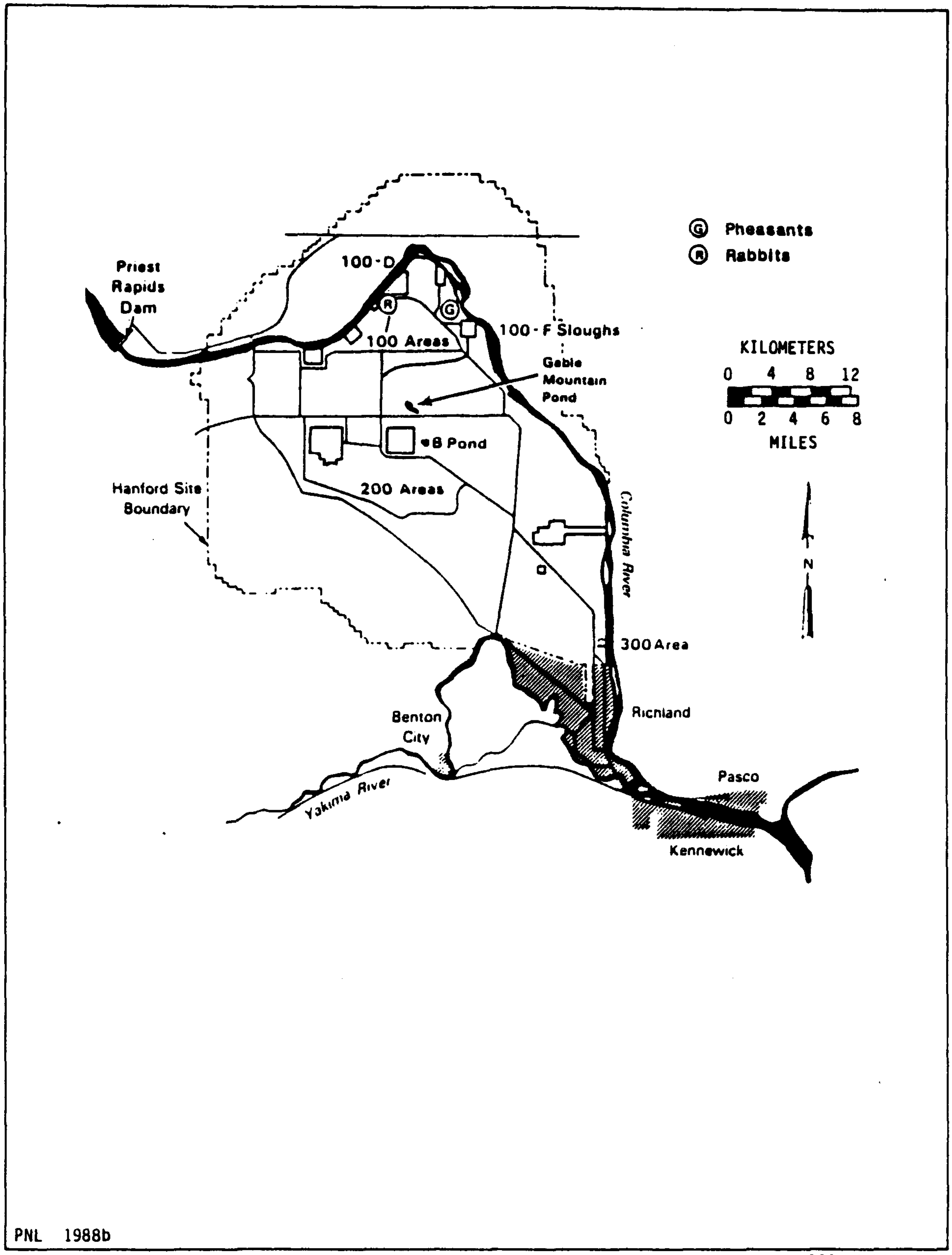
NR - Not reported.
SD - Standard deviation.
[a] - Average Hanford Site and offsite values obtained from Price 1986.

Table 22. Terrestrial Fauna Radionuclide Concentrations for the 100 Areas.

Sample description	Number of samples	Average concentration (pCi/g)	Two Standard deviations (pCi/g)
Pheasant--muscle[a]			
^{60}Co	9	0.006	0.013
^{137}Cs	9	0.003	0.017
Cottontail rabbit--bone[a]			
^{90}Sr	3	260	310
Cottontail rabbit--muscle[a]			
^{137}Cs	3	0.023	0.033

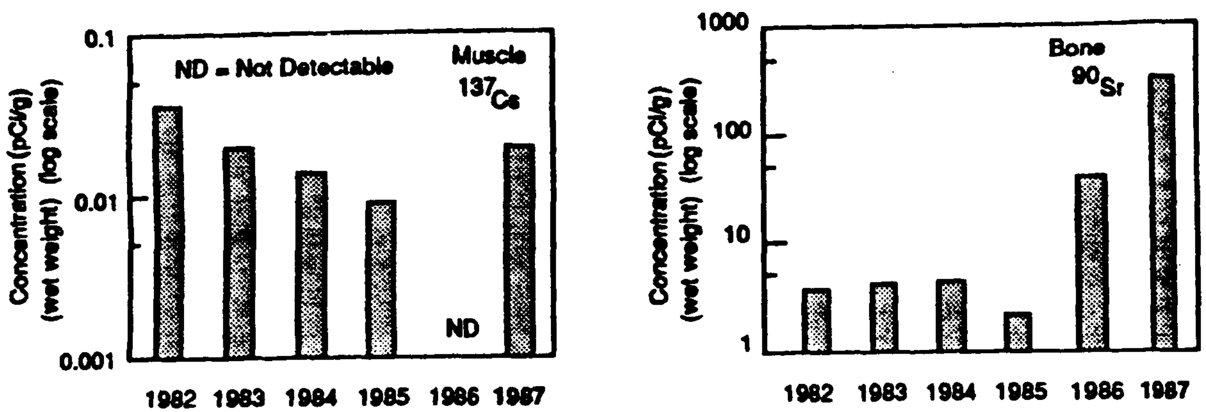
PNL 1988b.

[a]Based on 1987 data.



883-1736/13063

Figure 15. The 100 Area Terrestrial Fauna Sampling Stations.



PNL 1988b.

883-1736/13065

Figure 16. Median Concentrations of Strontium-90 (^{90}Sr) in Bone and Cesium-137 (^{137}Cs) in Muscle of Cottontail Rabbits in the 100-DR-1 Area, 1982 Through 1987.

sufficiently similar to those encountered at a site such that compliance with these requirements is prudent.

ARARs can be grouped into three types: contaminant-specific, location-specific, and action-specific. Potential contaminant- and location-specific ARARs are identified in this section. Potential action-specific ARARs will be identified as part of the CMS project implementation.

3.2.1 Contaminant-Specific ARARs

The only potentially applicable contaminant-specific ARARs identified for 100-DR-1 are air standards. Contaminant-specific ARARs pertinent to groundwater and surface water will be presented in the 100-HR-3 operable unit work plan being prepared. At this time there are no promulgated soil ARARs.

State air standards for radionuclides are promulgated under the authority of the Washington Nuclear Energy and Radiation Act (Ch. 70.98, Revised Code of Washington RCW), and set forth as regulations under Ch. 402-24, WAC "Standards for Protection Against Radiation." These regulations were derived from the federal standards set forth in 10 CFR Part 20 (NRC 1987).

Table 23 provides contaminant-specific air standards for the known and suspected waste radionuclides at 100-DR-1. At this time there are no promulgated ambient air standards for the types of nonradioactive waste constituents present at 100-DR-1.

Because each of the waste disposal facilities in 100-DR-1 either is located below the surface or has been covered with clean materials in the process of decommissioning, air standards are not anticipated to be pertinent under current conditions.

3.2.2 Location-Specific ARARs

Historical sites, buildings, and archaeological resources are required to be preserved by laws such as the Historic Sites, Buildings, and Antiquities Act (16 USC 461) and the National Historic Preservation Act (16 USC 470). No part of the 100-D/DR Area is known to have been designated as having historical value. Archaeological sites, however, are known to occur throughout the Hanford Site. Therefore, the existence and potential value of any archaeological resources within 100-DR-1 must be determined before any field investigation or corrective measure activities are initiated that would result in surface or subsurface disturbances.

The Endangered Species Act (16 USC 1531) and other federal fish and wildlife laws are applicable if a project activity would result in an adverse environmental impact to the critical habitat of an endangered species. No such species reside within 100-DR-1, and the overall impact from the project is expected to be one of environmental enhancement.

Table 23. Effluent Standards for Atmospheric Releases to an Unrestricted Area for Radionuclides Known to Occur at the 100-DR-1 Operable Unit.

Radionuclide	MPC[a] (pCi/m^3)
^{3}H	200,000
^{14}C	100,000
^{60}Co (insoluble)	300
^{63}N	2,000
^{90}Sr	30
^{134}Cs (insoluble)	400
^{137}Cs (insoluble)	500
^{152}Eu	400
^{154}Eu	100
^{155}Eu	3,000
^{235}U (insoluble)	4
^{238}U	3
^{238}Pu	0.07
^{239}Pu	0.06
^{240}Pu	0.06

10 CFR Part 20 (NRC 1987).

Note: The strictest standards are presented; therefore, all radionuclides are assumed to be in a soluble form, except as otherwise indicated.

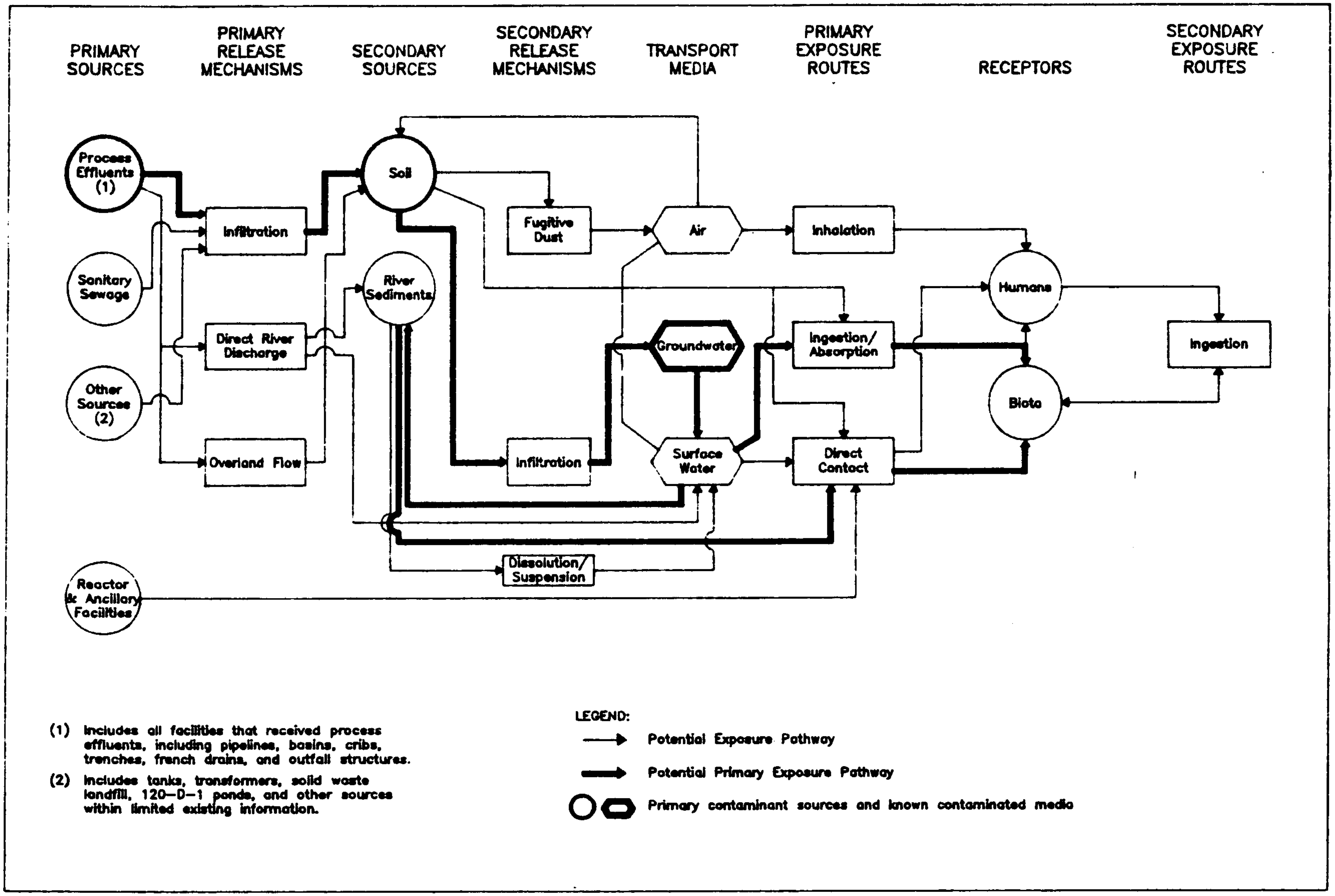
[a]Maximum permissible concentration.

3.3 POTENTIAL IMPACTS TO PUBLIC HEALTH AND THE ENVIRONMENT

3.3.1 Conceptual Exposure Pathway Model

Based on information presented thus far, a conceptual model of potentially significant contaminant exposure pathways for the 100-DR-1 operable unit was developed. The model is presented in Figure 17.

The purpose of the conceptual model is to present hypotheses of unit-specific contaminant exposure pathways. During the RFI, the conceptual model hypotheses are tested and refined in an iterative manner until the understanding of the operable unit is sufficient to support subsequent decisions regarding corrective measures. Performance/risk assessments and sensitivity analyses are two methods of testing and refining the models. Computer models that can be used are listed in Appendix A. By conducting the RFI in this manner, the project becomes more efficient, because the investigation is kept focused on unit-specific objectives.



8831736\WP\32847

Figure 17. Contaminant Exposure Pathway for the 100-DR-1 Operable Unit.

Each exposure pathway must contain the following (EPA 1986a):

- A contaminant source
- A contaminant release mechanism
- An environmental transport medium
- An exposure route
- A receptor.

3.3.1.1 Sources. Primary contaminant sources in 100-DR-1 include process effluent transfer, treatment, and disposal facilities, and the 118-D-6 (105-D) reactor building and reactor ancillary facilities. The significant sources, as indicated in Figure 17, are the process effluent facilities.

Once a release to the environment occurs, contaminants can be bound in soils and river sediments before being slowly re-released. These media thus serve as secondary contaminant sources.

Detailed information on each of the operable unit waste facilities and their associated contaminants is presented in Sections 2.1.4 and 3.1.1, respectively. A summary of the known extent of soil contamination at 100-DR-1 is contained within Section 3.1.2. Groundwater, surface water, and river sediments are addressed in the 100-HR-3 operable unit.

3.3.1.2 Release Mechanisms. Release mechanisms can be divided into primary and secondary categories. A primary release is one from a primary source; a secondary release is one that arises from a secondary contaminant source.

Process effluents at 100-DR-1 are known to have infiltrated the soils surrounding the various process effluent transfer, treatment, and disposal facilities. This effluent was also directly discharged into the Columbia River. Pipeline and retention basin leaks occurred that resulted in discharge to surface soils. Wastes from the sanitary sewage systems also infiltrated into underlying and adjacent soils. As indicated in Figure 17, the most significant of these primary release mechanisms at 100-DR-1 is infiltration, and the most substantial contributions are from process effluent wastes. The most significant release mechanism from the secondary soil sources is also infiltration to groundwater. Fugitive dust generation is also a potential secondary release mechanism for contaminated soils. However, most contaminated soil areas have been covered with clean soil.

Contaminated river sediments can be dispersed through bedload transport. Such contamination can also be leached, or contaminated particles resuspended, into the surface water column.

3.3.1.3 Environmental Transport Media. Infiltrating contaminants can eventually reach the groundwater, which, in turn, transports the material to the Columbia River. This is currently the predominant mode of contaminant transport at 100-DR-1. In the past, the water of the Columbia River transported contaminants that had been directly introduced into the river. Currently the river transports contaminants that have been received through groundwater discharge. Contaminated fugitive dust is transported by wind.

3.3.1.4 Exposure Routes. Receptors can be exposed to contaminants in one of three ways:

- Through inhalation of contaminants in the ambient atmosphere
- Through absorption of soil contaminants (for plants) or ingestion of contaminated materials and biota (for animals and humans)
- Through direct contact with contaminated sources or media.

3.3.1.5 Receptors. Receptors are organisms that have the potential for exposure to the released contaminants. Figure 17 divides this component of the pathway into terrestrial and aquatic biota and humans.

The most significant point of exposure for terrestrial biota is in the plant root zone, where flora could absorb buried contaminants. Terrestrial animals (especially burrowing animals) may be exposed by direct contact. The most critical exposure point in the aquatic environment is in the river sediments at groundwater discharge zones, where salmon eggs and fry have the potential to be in contact with contaminated groundwater.

Because there are no nearby residences, the most critical potential for human exposure to 100-DR-1 contaminants exists for onsite workers. Because most of the contamination is now buried beneath the ground surface, the workers who will have the greatest potential for exposure are those who will be involved in collecting environmental samples for this project and those who will be engaged in corrective measure activities for 100-DR-1.

3.3.1.6 Summary. The most significant primary sources of contaminant releases to the 100-DR-1 environment are the process effluent disposal facilities. While process effluents were once discharged directly into the Columbia River, the current mechanism of contaminant release is through infiltration into the underlying groundwater from contaminated soils near the facilities. This groundwater eventually discharges into the river, where it can contaminate the sediments and has the potential to impose adverse impacts upon local biota. Of particular concern are impacts to sensitive and economically important fauna, such as salmon eggs and fry.

3.3.2 Contaminant Characteristics

To evaluate the potential threat to public health and the environment from the 100-DR-1 operable unit, it is important to focus on those contaminants of greatest concern. One means by which this can be done is to look at those contaminants that are present in the greatest quantity. Table 24 presents a list and estimated quantities of chemicals and radionuclides known to have been either disposed of or detected during previous investigations at 100-DR-1. Other means of focusing attention on those contaminants that are most significant involve looking at those substances that are the most toxic, the most persistent, the most mobile, and the most likely to bioaccumulate. The contaminants of concern in Table 24 will be evaluated in detail, but will not be used to limit analytical parameters lists, which are referred to as parameters of interest.

3.3.2.1 Toxicity. The chemicals presented in Table 24 include organic and inorganic acids and soluble salts of other compounds that readily dissociate in the environment. Thus, this toxicity assessment considers the constituents that would occur in the environment after disposal, rather than the parent compound.

The constituents that would be present following dissociation of these compounds include sodium, sulfate, and chloride ions and chromium (VI) and copper. Only chromium (VI) and copper exhibit significant environmental or human toxicity that should be considered in the baseline risk assessment.

The oral reference dose (RfD) for chromium (VI) at the no-effect level is 5 μg/L. However, confidence in this RfD is low because of the small number of animals tested, the small number of parameters measured, and the lack of toxic effect at the highest dose tested. The primary drinking water standard is 50 μg/L (for total chromium). Chromium (VI) is also classified as an International Agency for Research on Cancer (IARC) Group 1 carcinogen based on inhalation exposure. However, there is no evidence that it is a carcinogen from oral exposure (EPA 1989). Chromium (VI) is toxic to aquatic organisms. Ambient water quality criteria for protection of freshwater organisms are: acute--16.0 μg/L and chronic--11.0 μg/L (EPA 1986b).

Copper has not been shown to have significant human toxicity. The EPA has not established an RfD or primary drinking water standard for copper (EPA 1989). The secondary drinking water standard is 1,000 μg/L. Copper is toxic to aquatic organisms. Ambient water quality criteria for copper are hardness dependent; values for the Columbia River are assumed to average 65 mg/L hardness. Based on this value for hardness, the criteria for the protection of freshwater aquatic organisms are: acute--12 μg/L and chronic--8.2 μg/L (EPA 1986b).

The potential exposure to any of the radionuclides included in Table 24 may be significant from the standpoint of toxicity. The dose response functions used by EPA to estimate radiation risks (linear and linear quadratic) presume that any exposure carries with it some associated excess cancer risk. Consequently, based on conservative, worst-case assumptions, the presence of and potential exposure to any nuclide or nuclides at greater than background concentrations is presumed to introduce some excess cancer risk that must be evaluated. In light of the additive effects of the various radionuclides, all of the isotopes listed in Table 24 must be considered in the baseline assessment of cancer risk.

3.3.2.2 Persistence. The persistent constituents presented in Table 24 include hexavalent chromium, copper, and radionuclides. Metals such as chromium and copper persist in the environment because they are not subject to biodegradation or chemical decomposition. Corrosive acids, bases, and salts, such as nitric acid, sodium hydroxide, and sodium nitrite, do not persist in the environment in their original form because they rapidly dissociate into their constituent ions once they come in contact with water. As discussed in Section 3.3.2.1, upon dissociation, the constituent ions often do not pose an environmental concern from a toxicity standpoint.

Table 24. Inventory of Chemicals Disposed of and Estimate of Radionuclides Remaining at the 100-DR-1 Operable Unit.

Chemical	Quantity disposed (kg)
Sodium dichromate	1,780
Sodium oxalate	2,000
Sodium sulfamate	2,000
Sodium formate	2,000
Hydrochloric acid	NA
Sulfuric acid	NA
Sodium hydroxide	NA
Copper sulfate	NA
Oxalic acid	NA
Radionuclide	**Inventory (Ci)[a]**
^{3}H	1.901
^{14}C	NA
^{60}Co	2.973
^{63}Ni	NA
^{90}Sr	0.893
^{134}Cs	0.00542
^{137}Cs	27.993
^{152}Eu	11.786
^{154}Eu	2.1117
^{155}Eu	0.5267
^{235}U	0.00053
^{238}U	0.06184
^{238}Pu	NA
^{239}Pu	0.08703
^{240}Pu	0.00967

Note: Information obtained from the Hanford Waste Information Data System (DOE-RL 1989a).

[a]Radionuclide inventory values are decayed through April 1, 1986. Does not include inventory of the 118-D-6 reactor buildings. No inventories are available from many of the facilities.

NA = Not available.

The environmental persistence of a radionuclide is in part directly related to the half-life of the particular isotope. The half-lives of the radionuclides present at 100-DR-1 are as follows:

Radionuclide	Half-life
^{3}H	12 yr
^{14}C	5,700 yr
^{60}Co	5 yr
^{63}Ni	92 yr
^{90}Sr	28 yr
^{134}Cs	2 yr
^{137}Cs	33 yr
^{152}Eu	13 yr
^{154}Eu	8 yr
^{155}Eu	5 yr
^{235}U	710,000,000 yr
^{238}U	4,400,000,000 yr
^{238}Pu	90 yr
^{239}Pu	24,000 yr
^{240}Pu	6,600 yr.

3.3.2.3 Mobility. The mobility of metals through the environment is highly dependent on the exact chemical form of the element, which in turn is dependent on environmental conditions. Because many metals bind ionically to soils or form insoluble precipitates, their environmental mobility is generally somewhat retarded. Hexavalent chromium is a mobile form of this metal. The constituent ions of corrosive compounds are often mobile, unless they combine with a metal to form an insoluble precipitate.

Metallic radionuclides, such as uranium and plutonium, generally have a retarded environmental mobility because of their chemistry. Other radionuclides, such as ^{3}H and ^{14}C, are much more mobile. Radionuclides and metals can have enhanced mobility by absorbing onto mobile colloids in groundwater flow systems.

3.3.2.4 Tendency to Bioaccumulate. Some contaminants have a tendency to accumulate in biological tissues if absorbed or consumed by organisms. Unitless bioconcentration factors for some of the contaminants found at 100-DR-1 are as follows (Cushing, et al. 1975):

Contaminant	Bioconcentration factor	
Cesium	0.3 to 16	(birds and mammals)
Cobalt	0.2 to 2	(birds and mammals)
Copper	200	(fish)
Chromium	16	(fish)
Hydrogen	0.6 to 1	(mammals)
Strontium	0.2 to 8	(mammals).

3.3.3 Contaminants of Concern

Table 25 contains a list of preliminary contaminant parameters of concern for the 100-DR-1 operable unit. This list was developed based on the types and quantities of wastes known to have been disposed of at the unit and the contaminant characteristics presented in Section 3.3.2. The list contains contaminant parameters for metals and radionuclides.

Table 25. Preliminary Contaminants of Concern for the 100-DR-1 Operable Unit.

gross alpha	Chromium	
gross beta	Copper	
gross gamma		
^{3}H	^{90}Sr	^{155}Eu
^{14}C	^{134}Cs	^{235}U
^{60}Co	^{137}Cs	^{238}U
^{63}Ni	^{152}Eu	^{238}Pu
	^{154}Eu	^{239}Pu
		^{240}Pu

3.3.4 Imminent and Substantial Endangerments

This discussion is based on known and suspected conditions at 100-DR-1, as presented previously in this document.

3.3.4.1 Public Health. Based on the existing environmental data discussed in Section 3.1 and the exposure pathways discussed in Section 3.3.1, the 100-DR-1 operable unit does not appear at this time to pose any imminent and substantial endangerment to public health.

The major health concern associated with 100-DR-1 would be that potentially posed to onsite workers during implementation of the RFI field investigations. The HSP (Attachment 2) specifies site control and personnel monitoring procedures that will ensure the health and safety of those involved with the field portions of the project.

3.3.4.2 The Environment. Existing information does not indicate that any imminent and substantial endangerment to the environment is being posed by 100-DR-1. The most sensitive point of exposure to environmental receptors appears to be to the early life stages of salmonids--eggs and fry--within the Columbia River sediments. The risk of these receptors will be evaluated in the 100-HR-3 investigation.

3.4 PRELIMINARY CORRECTIVE ACTION OBJECTIVES AND CORRECTIVE MEASURE ALTERNATIVES

The preceding information in this document has been used to develop the following corrective action objectives, general response actions, corrective measure technologies, and corrective measure alternatives. These preliminary determinations will be refined throughout the RFI/CMS as additional information about 100-DR-1 becomes available.

3.4.1 Corrective Action Objectives

Preliminary corrective action objectives, categorized by source or environmental medium, are presented in Table 26. The overall goal of each objective is to provide and ensure the protection of human health and the environment from the release or potential release of hazardous substances, pollutants, or contaminants from 100-DR-1. Corrective action objectives for groundwater, surface water and sediments, and aquatic biota will be set forth in the Work Plan for the 100-HR-3 operable unit (in preparation).

3.4.2 General Response Actions

Potentially appropriate general response actions for contaminant sources, soil, air, and terrestrial biota are identified in Table 27 for the 100-DR-1 operable unit. General response actions are classes of response measures that do not take specific technologies into account.

3.4.3 Corrective Measure Technologies

Potential medium-specific corrective measure technologies for each general response action identified for 100-DR-1 are presented in Table 28. Corrective measure technology categories are used in this table. Specific technologies and particular process options will be identified during implementation of the CMS.

3.4.4 Corrective Measure Alternatives

Medium-specific potential corrective measure technologies have been combined to form preliminary corrective measure alternatives for 100-DR-1. A range of such alternatives has been developed that includes the following:

- An alternative emphasizing waste treatment
- An alternative emphasizing waste containment
- An alternative emphasizing waste removal
- An institutional control alternative
- A corrective measure contingency plan/environmental monitoring alternative
- A no-action alternative.

These preliminary alternatives are presented in Table 29.

Table 26. Preliminary Corrective Action Objectives for the 100-DR-1 Operable Unit.

Environmental medium	Corrective action objectives
Source	Prevent or cease release of contaminants that harm or could harm public health or the environment.
Soil	For public health protection:
	Prevent ingestion and inhalation of, and direct contact with, contaminated soils.
	For environmental protection:
	Prevent migration of soil contaminants that would result in the contamination of other environmental media.
Air	For public health protection:
	Prevent inhalation of airborne contaminants.
Terrestrial biota	For public health protection:
	Prevent ingestion of contaminated biota.
	For environmental protection:
	Prevent adverse impacts on biota.

Table 27. Preliminary General Response Actions for the 100-DR-1. Operable Unit (Sheet 1 of 2)

ENVIRONMENTAL MEDIUM	GENERAL RESPONSE ACTIONS
Source	No action Long-term monitoring with contingency plans Institutional controls Containment Pumping Complete removal Partial removal Onsite treatment Offsite treatment In-situ treatment Storage Onsite disposal Offsite disposal
Soil	No action Long-term monitoring with contingency plans Institutional controls Containment Partial removal Onsite treatment Offsite treatment In-situ treatment Storage Onsite disposal Offsite disposal
Air	No action Long-term monitoring with contingency plans Institutional controls[a] Containment[a] Partial removal[a] Onsite treatment[a] Offsite treatment[a] In-situ treatment[a] Storage[a] Onsite disposal[a] Offsite disposal[a]

Table 27. Preliminary General Response Actions for the 100-DR-1. Operable Unit (Sheet 2 of 2)

ENVIRONMENTAL MEDIUM	GENERAL RESPONSE ACTIONS
Terrestrial Biota	No action Long-term monitoring with contingency plans Institutional controls[a] Containment[a] Partial removal[a] Onsite treatment[a] Offsite treatment[a] In-situ treatment[a] Storage[a] Onsite disposal[a] Offsite disposal[a]

[a] These actions are based on controlling releases of contaminants from soil or sources to air or terrestrial biota, not on direct treatment of air or terrestrial biota.

Table 28. Preliminary Corrective Measure Technologies for the 100-DR-1 Operable Unit (Sheet 1 of 2)

ENVIRONMENTAL MEDIUM	CORRECTIVE MEASURE TECHNOLOGIES
Source	Containment: capping; modification of existing containment structures.
	Pumping: liquid removal; dredging.
	Complete removal: liquid removal; dredging; removal of structures.
	Partial removal: liquid removal; dredging; removal of structures.
	Onsite treatment: solidification; physical treatment; chemical treatment.
	Offsite treatment: solidification; physical treatment; chemical treatment.
	In situ treatment: solidification; physical treatment; chemical treatment.
	Storage: temporary storage structures.
	Onsite disposal: landfilling.
	Offsite disposal: landfilling.
Soil	Containment: capping; vitrification; grouting
	Partial removal: soil excavation.
	Onsite treatment: physical treatment; chemical treatment.
	Offsite treatment: physical treatment; chemical treatment.
	In-situ treatment: permeable treatment beds; soil flushing.
	Storage: temporary storage structures.
	Onsite disposal: landfilling.

Table 28. Preliminary Corrective Measure Technologies for the 100-DR-1 Operable Unit (Sheet 2 of 2)

ENVIRONMENTAL MEDIUM	CORRECTIVE MEASURE TECHNOLOGIES
Soils (cont.)	Offsite disposal: landfilling.
Air[a]	Containment: capping.
	Partial removal: soil excavation.
	Onsite treatment: physical treatment; chemical treatment.
	Offsite treatment: physical treatment; chemical treatment.
	In-situ treatment: permeable treatment beds; soil flushing.
	Storage: temporary storage structures.
	Onsite disposal: landfilling.
	Offsite disposal: landfilling.
Terrestrial Biota[a]	Containment: capping.
	Partial removal: soil excavation.
	Onsite treatment: physical treatment; chemical treatment.
	Offsite treatment: physical treatment; chemical treatment.
	In-situ treatment: permeable treatment beds; soil flushing.
	Storage: temporary storage structures.
	Onsite disposal: landfilling.
	Offsite disposal: landfilling.

[a]Corrective measure technologies for air and terrestrial biota ensure that corrective measures will be implemented on the source of the contamination (sources or soils) of those media.

Table 29. Preliminary Corrective Measure Alternatives for the 100-DR-1 Operable Unit.

Waste treatment alternative:	completely remove waste and contaminated sediments; demolish remaining structures and stabilize onsite; physically treat contaminated soils beneath facilities found to have released contaminants.
Waste containment alternative:	demolish remaining structures and stabilize onsite; cap, vitrify or grout facilities found to have released contaminants into the underlying soils.
Waste removal alternative:	completely remove waste and contaminated soil beneath and around the operable unit waste facilities, backfilling these areas with clean fill material; dispose of contaminated materials in an approved landfill on the Hanford Site; demolish remaining structures and stabilize onsite.
Institutional control alternative:	maintain or enhance existing site access controls at the operable unit to prevent exposure to contaminants by the public.
Environmental monitoring/ contingency plan alternative:	continue to monitor the operable unit environment to ensure that public health and the environment are not threatened; have a contingency plan for corrective measures developed in the event that the operable unit releases do become a threat.
No action alternative:	take no further action.

4.0 WORK PLAN RATIONALE

The preceding chapters discuss the overall goals and process for the RFI/CMS, describe the operable unit and its surroundings, and define a conceptual contaminant exposure pathway model for 100-DR-1. This chapter specifies data quality objectives (DQOs) for the RFI/CMS and discusses the approach that will be used to gather and process the information required to satisfy the project goals.

4.1 DATA QUALITY OBJECTIVES

Data quality objectives are qualitative and quantitative statements that specify the quality of the data required to support Agency decisions during corrective action response activities. They are typically identified during project scoping and refined in the sampling and analysis plans. The objectives are based on the answers to specific questions about a corrective action.

- Who will use the data?
- Why are the data required?
- What types of data are needed?
- How much data are necessary?
- How good must the data be?

These needs are specified, to the extent practicable, to provide objectives that will keep the RFI/CMS focused on project goals. Table 30 provides a summary of DQOs by environmental medium. The groundwater, surface water, sediments, and aquatic biota media will be addressed in the 100-HR-3 Work Plan (in preparation).

4.1.1 Data Users and Uses

Data users can be grouped into two general categories: primary and secondary. Primary data users are those individuals directly involved in performing the RFI/CMS project:

- The DOE, EPA, and Ecology remedial project managers
- The EPA and Ecology unit managers
- The RFI and CMS coordinators
- The technical contributors.

Secondary data users are those individuals who rely mainly on outputs from the RFI/CMS to support their activities. Secondary data users also have the opportunity to provide inputs to the primary data users. Inputs may be given during the report review process and through community relations activities. Secondary data users include the following:

- The Secretary of the DOE
- The Regional Administrator of the EPA

Table 30. Data Quality Objectives Summary for the 100-DR-1 Operable Unit. (Sheet 1 of 3)

Environmental media	Data uses	Data types	Data quantity[a]	Data quality/ Analytical level[b]
Source	Site characterization Health and safety Evaluation of alternatives Design of alternatives Monitoring during corrective measures implementation	Source locations	Operable unit topographic map showing facility locations to be developed; additional plans and reports to be searched and reviewed; geophysical surveys near structures	Third order precision and accuracy; 0.5-m (2-ft) elevational contours; data search not applicable; Level I
		Types of waste containment	Sufficient data exist	Not applicable
		Integrity of waste containment structures	Additional plans and reports to be reviewed; geophysical surveys, soil gas surveys, surface radiation surveys, borehole and test pit sampling at structures	Levels I, II, III, IV, V
		Nonwaste-related engineered structures	Sufficient data exist	Not applicable
		Facility security	Sufficient data exist	Not applicable
		Discharge points	Operable unit topographic map showing facility locations to be developed; additional plans and reports to be searched and reviewed; geophysical surveys near structures	Third order precision and accuracy; 0.6-m (2-ft) elevational contours; not applicable; Level I
		Waste types	Additional plans and reports to be reviewed; soil gas and radiation surveys, borehole and test pit sampling and analysis and source sampling and analysis at waste facilities	Levels I, II, III, IV, V

Table 30. Data Quality Objectives Summary for the 100-DR-1 Operable Unit. (Sheet 2 of 3)

Environmental media	Data uses	Data types	Data quantity[a]	Data quality/ Analytical level[b]
Source (cont.)	Site characterization Health and safety Evaluation of alternatives Design of alternatives Monitoring during corrective measures implementation	Waste quantities	Source sampling and analysis, borehole and test pit sampling and analysis at waste facilities	Levels III, IV, V
		Waste concentrations	Source sampling and analysis, borehole and test pit sampling and analysis at waste facilities	Levels III, IV, V
		Waste properties	To be further assessed in the baseline risk assessment	Documented scientific information
Soil	Site characterization Evaluation of alternatives Risk assessment Design of alternatives Monitoring during corrective measures implementation Health and safety	Soil types (classification)	One analysis per boring per geological unit	c
		Water holding capacity	Sufficient data exist	Not applicable
		Biological activity and nutrient conditions	Sufficient data exist	Not applicable
		Soil phase mineralogy	One analysis per boring per geologic unit	c
		Engineering properties[d]	One sample per boring per geologic unit	c
		Permeability	One determination per boring per geologic unit	c
		Porosity	One determination per boring per geologic unit	c
		Moisture Content	One determination per boring per geologic unit	c
		Soil Quality (contaminant chemistry and pH)	Dependent on contaminant distribution results	I, II, III, IV, V
		Leachability	Dependent on contaminant distribution results	c

Table 30. Data Quality Objectives Summary for the 100-DR-1 Operable Unit. (Sheet 3 of 3)

Environmental media	Data uses	Data types	Data quantity[a]	Data quality/ Analytical level[b]
Soil (cont.)		Adsorptability	Dependent on contaminant distribution results	c
		Cation exchange capacity	One analysis per boring per geologic unit	c
		Lithology and mineralogy	Geologic log of each boring and well	c
		Geologic unit thickness	One additional deep well	c
		Geologic unit areal extent	Surficial map of operable unit	c
		Particle size and sorting	One analysis per boring per geologic unit	c
		Geologic structure	Sufficient data exist	Not applicable
Air	Site characterization	Precipitation	Sufficient data exist	Not applicable
	Health and safety	Temperature	Sufficient data exist	Not applicable
	Risk assessment	Wind velocity and direction	Sufficient data exist	Not applicable
	Evaluation of alternatives	Barometric pressure	Sufficient data exist	Not applicable
	Design of alternatives	Evaporation rate	Sufficient data exist	Not applicable
	Monitoring during corrective measures implementation	Atmospheric stratification and inversions	Sufficient data exist	Not applicable
		Magnitudes and frequencies of extreme weather events	Sufficient data exist	Not applicable
		Air quality	Sufficient data exist	Not applicable
		Relative humidity	Sufficient data exist	Not applicable
Terrestrial biota	Site characterization	Flora	Operable unit survey to be performed	c
	Risk assessment			
	Evaluation of alternatives	Fauna	Operable unit survey to be performed	c
	Design of alternatives			
	Monitoring during corrective measures implementation	Critical habitats	Sufficient data exist	Not applicable
		Biocontamination	Sufficient data exist	Not applicable
		Land-use characteristics	Sufficient data exist	Not applicable
		Water-use characteristics	Sufficient data exist	Not applicable

[a]Specific data quantities are delineated in the Field Sampling Plan.
[b]See Table 31 for a description of analytical levels suitable for this project.
[c]To be developed in test method procedure.
[d]Engineering properties include grain-size distribution, consolidation, and density.

- The Director of Ecology
- Other federal and state agencies
- Members of the potentially impacted community
- Special interest groups
- The general public.

Because of the general nature of this category of DQO's, data users are not identified in Table 30.

Data generated during the RFI generally are put to use in one or more of the following categories:

- Site characterization
- Health and safety
- Risk assessment
- Evaluation of alternatives
- Design of alternatives
- Monitoring during corrective measures implementation.

Each of these categories of data use is discussed in the following sections in further detail. Table 30 gives an indication of how data gathered on each environmental medium will be applied in the context of these categories.

4.1.1.1 Site Characterization. Site characterization refers to the determination and evaluation of the physical and chemical properties of the site, in this case the 100-DR-1 operable unit. Characterization also includes the development and refinement of the conceptual contaminant exposure pathway model and evaluation of the nature and extent of contamination.

4.1.1.2 Health and Safety. To ensure the health and safety of workers involved in the RFI/CMS field activities, data are collected on an activity-specific basis. This type of ongoing monitoring data is used--in conjunction with proper safe working practices and use of personal protection, as appropriate--to prevent onsite workers from being exposed to harmful amounts of contaminants. These data are also used to determine if there are any immediate concerns for offsite worker and residential populations. The specific data needs for this category, and methods to be used to satisfy them, are addressed in the HSP (Attachment 2).

4.1.1.3 Risk Assessment. Data collected to conduct the baseline risk assessment include input parameters for various performance assessment models, site characteristics, and contaminant information required to evaluate the threats to human and environmental receptors posed by releases of hazardous substances from 100-DR-1. These needs usually overlap with site characterization needs; however, higher-level quality control is often needed for risk assessment purposes.

4.1.1.4 Evaluation of Alternatives. Information used to evaluate corrective measure alternatives during the CMS includes site characteristics and engineering data required for the development, screening, and detailed evaluation of such alternatives and cost estimates. Sufficient information is needed only for feasibility-level designs.

4.1.1.5 Design of Alternatives. Once an alternative is selected for implementation, much of the data collected during the RFI/CMS can be used for the final engineering design. As a specific RFI/CMS objective, collection of information for use in the detailed, final design is often not cost effective. It is often more effective to gather such specific information after the modification of the RCRA permit, during a predesign investigation.

4.1.1.6 Monitoring During Corrective Measures Implementation. The RFI/CMS data can be used to establish a pre-implementation baseline data set. Environmental monitoring, after implementation of the selected corrective measure, can be performed to allow for comparisons with the baseline data to evaluate the effectiveness of the corrective measure. The RFI/CMS data can also be consulted to determine the needs and best methods for any post-implementation monitoring that may be needed.

If the selected corrective measure has the potential to cause adverse environmental impacts during the construction or operations phases, monitoring will be essential. Obtaining information during the RFI/CMS to specifically compile a baseline is not, however, an appropriate project objective. Sufficient information will be generated to establish contaminant-specific action levels on which corrective measures implementation monitoring efforts can be focused.

4.1.2 Data Types

The types of data needed to satisfy the project goals are discussed in the following sections by medium. Table 30 summarizes the types of data required under each of the following categories.

4.1.2.1 Source Data. The types of source data required to perform the RFI/CMS are as follows (EPA 1988a):

- Facility characteristics
  - Source locations
  - Types of waste containment
  - Integrity of waste containment structures
  - Nonwaste-related engineered structures
  - Facility security
  - Discharge points
- Waste characteristics
  - Waste types
  - Waste quantities
  - Waste concentrations
  - Waste properties.

4.1.2.2 Soil Data. Soil data types and geological data needed for the RFI/CMS include the following (EPA 1988a):

- Soil type(s) (classified as outlined in WHC-EII 9.1 - Geologic Logging)
- Water holding capacity
- Biological activity and nutrient conditions
- Soil phase mineralogy
- Engineering properties (grain-size distribution, consolidation, and density)
- Permeability
- Porosity
- Moisture content
- Soil quality (contaminant chemistry and pH, including background conditions)
- Leachability
- Adsorptability
- Cation exchange capacity
- Lithology and mineralogy
- Geological unit thickness and areal extent
- Particle size and sorting
- Geological structure.

Information on soil physical characteristics and engineering properties is needed to aid in estimation of infiltration and retardation of leachates and the release of gaseous contaminants, and to aid in the selection of corrective measures.

4.1.2.3 Groundwater Data. Data types needed to characterize the groundwater beneath the operable unit will be discussed in the 100-HR-3 Work Plan (in preparation). Data types recommended by regulatory guidance include the following (EPA 1988a):

- Direction of flow
- Rate of flow
- Rate of recharge and discharge
- Location of discharge areas
- Aquifer ability to transmit water
- Groundwater quality (pH, total dissolved solids, contaminant concentrations).

4.1.2.4 Surface Water and Sediment Data. Data types needed to characterize the surface water and sediment adjacent to and immediately downstream of 100-DR-1 will be discussed in the 100-HR-3 Work Plan (in preparation). Data types recommended by regulatory guidance include the following (EPA 1988a):

- Drainage patterns
- Surface water bodies
- Surface water/groundwater relationships
- Surface water quality (pH, temperature, total suspended solids, suspended sediments and specific contaminant concentrations).

4.1.2.5 Air Data. The types of atmospheric data needed to perform the RFI/CMS are as follows (EPA 1988a):

- Precipitation
- Temperature
- Wind velocity and direction
- Barometric pressure
- Evaporation rate
- Atmospheric stratification and inversions
- Magnitudes and frequencies of extreme weather events
- Air quality (including background conditions)
- Relative humidity.

4.1.2.6 Biological Data. The types of biological and ecological data required for the RFI/CMS are as follows (EPA 1988a):

- Potentially impacted flora and fauna
- Presence of critical habitats
- Biocontamination (including background conditions)
- Land-use characteristics
- Water-use characteristics.

4.1.3 Data Quantity

The following is a conceptual discussion of the quantities of data that must be obtained during the initial phase of the RFI for 100-DR-1. By evaluating data as they become available, phasing the RFI/CMS, and providing for close interaction between the RFI and CMS coordinators, data quantity adequacy can be continually assessed, and the scope of the initial phase of the RFI can be altered as required. The sampling program will be phased, progressing from field screening techniques to more-detailed intrusive field sampling and analysis programs. Areas of concern identified will then be targeted for additional sampling as necessary.

If additional data needs are identified late in the first RFI phase, additional characterization activities can be scheduled during the treatability investigation. The RFI is terminated only when a sufficient amount of information is available to allow for the completion of the CMS.

4.1.3.1 Source Data. Waste facility types, the security of the facilities, and nonwaste-related engineered structures for 100-DR-1 are known in most instances. This information is presented in Sections 2.1.4 and 2.1.5. Waste types, quantities, and concentrations are not sufficiently well known for purposes of the RFI/CMS. The available information is contained in Section 3.1.1. In general, known contaminants include radionuclides, chromium, and copper. In addition, volatile organic compounds may be associated with fuel and solvent handling facilities and PCBs with certain electrical facilities. The presence of other hazardous substances is not known and must be determined in the RFI. The following list identifies specific information needs. Specific quantities of data for the source facilities are defined in the Field Sampling Plan.

- The locations of some operable unit facilities and engineered discharge points must be determined more precisely. A topographic baseline map of 100-DR-1, with 0.6-m (2-ft) elevational contours and third-order accuracy and precision, must be developed.
- The 116-D-1A and 116-D-1B fuel storage basin trenches, 116-DR-1 and 116-DR-2 liquid waste disposal trenches, 116-D-5 cushion corridor French drain, and 116-D-9 reactor confinement seal drainage pit must be sampled to determine the nature and extent of contamination.
- The location and contamination levels of the 116-D-2 pluto crib must be established.
- The locations and levels of contamination in the process effluent pipelines and the surrounding soils must be determined.
- The areas adjacent to the 116-D-7 and 116-DR-9 retention basins must be analyzed to determine the location and extent of contamination.
- The extent of contamination in the five sludge disposal trenches must be determined.
- The 116-D-5 and 116-DR-5 outfall structures must be sampled for potential contamination.
- The presence and levels of contamination in the discharge pipelines to the Columbia River must be determined (land portions only).
- The 116-D-3 and 116-D-4 (108-D) cribs #1 and #2 must be sampled to determine the nature and extent of contamination.
- The locations and the presence (or absence) of contamination at three septic tanks (1607-D2, 1607-D4, 1607,D5, and the tank located at Hanford Site coordinates N93050 W52850) and their associated pipelines and sanitary tile fields need to be determined.
- The nature and extent of shop waste contamination in the 120-D-1 (100-D) ponds must be determined.
- The presence (or absence) of contamination at the various existing support facilities must be established.
- The area around the 130-D-1 (1716-D) underground gasoline storage tank must be sampled for petroleum hydrocarbons and lead based on the results of the tank removal program in July 1989.

- The waste acid reservoir and associated sump west of the 186-D demineralization building must be located and sampled.

- The underground fuel oil tank west of the 184-DA steam generating building must be located, and the surrounding soils must be sampled; the tank is scheduled for removal in 1990.

- The location of the demolished above-ground diesel fuel oil tank (166-D) and associated distribution lines needs to be determined to sample soils for possible petroleum hydrocarbon contamination.

- The location of the removed sodium dichromate tanks must be determined, and any contamination must be identified.

- The location and boundaries of the 126-D-2 solid waste landfill next to the 184-D powerhouse must be determined, and the site must be sampled for the presence or absence of contamination.

- The location of burial grounds No. 4A, 4B, and 18 must be confirmed, and the levels of contamination must be established.

- The locations of numerous transformers and electrical switching equipment must be sampled for past PCB contamination of soils.

- Several existing and demolished contaminary ancillary facilities must be sampled for contamination.

4.1.3.2 Geologic Data. The geology of the 100-DR-1 operable unit is not sufficiently well known to allow the CMS to proceed. Additional geologic data will be obtained by surface geologic mapping and by collection of soil data during this project and collection of soil data from wells during the RFI for 100-HR-3. One well for 100-HR-3 should be drilled to bedrock in the 100-DR-1 area. The data obtained will be evaluated and incorporated into the project; beyond that, no specific geologic data-gathering activities are required.

4.1.3.3 Soil Data. Information on holding capacity, biological activities, and nutrient conditions, or sufficient estimations of these parameters, which are adequate for this phase of the study, can be obtained from existing Hanford Site literature or from nearby federal and county agricultural agencies. Additional soil data will also be gathered during the soil sampling tasks.

Because of the nature of facility types and operations, the flat ground surface at 100-DR-1, and the porous nature of the soils, soil contamination is expected to be confined to areas directly underneath or adjacent to the waste containment or disposal structures. Atmospheric releases of contamination via the 132-D-4 reactor exhaust stack and effluent spills from the process pipelines are two release events that could have extended the limits of soil contamination.

Because radionuclides were a major group of contaminants associated with these two releases, the areal extent of surface radiation contamination at 100-DR-1 needs to be determined to define surface soil contamination boundaries. Once the horizontal extent of soil contamination is defined, the vertical extent of such contamination needs to be determined at each waste facility and at any other areas found to be contaminated. Hydrogeologic data such as porosity and permeability will also be obtained during the soil sampling task. These data will be coordinated with the 100-HR-3 Operable Unit RFI/CMS (which starts at the groundwater interface).

For surface and near-surface soils, data are needed to determine the nature and extent of contamination around the various sources in the 100-DR-1 operable unit, to determine whether exposure pathways exist, and to evaluate corrective measure alternatives. For deeper vadose zone soils, information on the nature and extent of contamination is needed to determine potential migration to groundwater for risk assessment and for evaluation of alternatives. Vadose zone characteristics are needed to determine the flux rate of contaminants from the vadose zone to groundwater, to assess potential migration of compounds, to evaluate hydraulic barrier systems, and to evaluate corrective measure alternatives and corrective measure design.

4.1.3.4 Groundwater Data. These data will be gathered during the RFI for 100-HR-3.

4.1.3.5 Surface Water and Sediment Data. These data will be gathered during the RFI for 100-HR-3.

4.1.3.6 Air Data. Climatological data are available from the Hanford Meteorological Station and nearby wind towers in the 100 Areas. These stations are close enough to allow for a sufficient climatological description of 100-DR-1 conditions. Meteorological data need to be compiled to obtain an up-to-date climatic summary for 100-DR-1.

Past ambient-air-quality sampling and analysis have not demonstrated the potential for adverse impacts to air quality. Therefore, unless a radiation survey of 100-DR-1 indicates abundant surface contamination with fugitive dust generation potential, no further air-quality investigation is needed. Any air monitoring required for occupational health protection during field activities that involve potential exposures to buried contaminants is addressed in the HSP (Attachment 2).

4.1.3.7 Biological Data. Because of the nature of the division between the 100-DR-1 and 100-HR-3 operable units, the 100-D Area biology is divided into terrestrial and aquatic realms.

4.1.3.7.1 Terrestrial Biologic Data. The nature of the terrestrial environment at 100-DR-1 is generally well known (see Chapter 2.2.6). Additional information verifying major species composition and feeding relationships amongst such species would be useful. A more detailed description in these terms can be used to determine potential terrestrial indicator species and ecological indicators that could be useful in future long-term monitoring efforts.

The EPA (1988c) determined an absence of critical habitat in the 100-DR-1 vicinity. However, there is a grove of trees along the Columbia River to the northeast of operable unit that provides prime roosting habitat for wintering eagles, and the river itself serves as a major foraging habitat for this species. The State of Washington regards both such habitats as critical; therefore, further delineation of these and other potential critical habitats is required.

Because essentially all of 100-DR-1 contamination is now below ground or within buildings, there is no need at this time to conduct a terrestrial biocontamination investigation. The fact that deep-rooted vegetation can take up contamination is well known, and DOE-RL has instituted control measures to eliminate this as a significant exposure pathway. However, because plant cover can affect the amount of precipitation infiltrating to groundwater, studies to obtain adequate plant cover data to assist in risk assessment and contaminant transport analysis will be coordinated with the 100-HR-1 and 100-HR-3 operable unit studies.

Sufficient information exists on the restricted nature of land use in the vicinity of 100-DR-1 (see Chapter 2.2.6.4).

4.1.3.7.2 Aquatic Biologic Data. These data, including water-use characteristics, will be gathered during the RFI for 100-HR-3.

4.1.4 Data Quality

The EPA has devised a classification of analytical levels for contaminant data. The classification provides for data of better quality as the scale increases (EPA 1987). Level I consists of field screening methods; Level II entails more advanced onsite analytical techniques; Level III covers standard laboratory procedures; Level IV consists of EPA contract laboratory program procedures; and Level V contains specially developed procedures where standard methods are not available or where a high degree of analytical sensitivity is required. As data quality goes up on this scale, costs and turnaround times also increase substantially. Table 31 describes analytical levels to be used for the 100-DR-1 RFI/CMS.

In addition to appropriate analytical levels, other important factors to be used in defining data quality needs include data uses, contaminants of concern, level of concern (the concentration range above which some action may need to be taken), detection limit requirements, and critical samples needed to satisfy sampling and analysis objectives. The precision, accuracy, representativeness, completeness, and comparability (PARCC) parameters are indicators of data quality. Ideally, the end use of the measurement data should define the necessary PARCC parameters. Detection limits, precision levels, and accuracy guidelines specific to individual analytical methods are discussed further in Section 3 of the QAPP.

All laboratory analyses will be performed by a laboratory capable of generating results of a suitable quality for this project. The sampling equipment and sampling techniques selected for this project will be those that are proven to be effective in controlling errors due to sampling.

Table 31. Analytical Levels to be Used for the 100-DR-1 RFI/CMS

Level	Description[a]
I	Field Screening will be performed using portable instruments during all field sampling activities. This screening is needed to monitor radiation for worker protection and for health and safety monitoring of other hazardous substances. The field screening will also provide an indication of contamination that may be used for selecting samples for laboratory analysis. Radiation detectors and organic vapor monitors will be used for Level I screening.
II	Field analysis using a portable gas chromatograph will be performed for soil gas samples to determine the presence, tentative identification and quantification of volatile organic compounds. Additional Level II field or laboratory techniques such as X-ray fluorescence may also be used during the Phase II soil boring program to provide cost effective and timely analyses for determining the extent of contamination. Other potential techniques that may be useful for field analysis will be evaluated based on the nature of contamination determined from Phase I soil borings and full laboratory analysis.
III	Laboratory analyses using standard EPA methods will be the normal level of analyses (for nonradionuclides) conducted after the nature of contamination has been defined for each facility. For example, Level III will be used during the Phase II borings to determine the extent of contamination. The specific analyses required will be based on the nature of contamination determined from the initial source sampling such as the Phase I boring program. The numbers of samples requiring Level III analysis may be reduced if suitable Level I or II screening techniques are available for the contaminants of interest.
IV	Contract Laboratory Program (CLP) Routine Analytical Services (RAS) equivalent procedures (including documentation and validation) will be used for the initial source sampling analyses to determine the nature of contamination at each facility where there is some question as to what may have been disposed. During initial source characterization, analyses will be conducted for the full Target Compound List (TCL) and Target Analyte List (TAL). During subsequent phases of the investigation to determine the extent of contamination, Level IV equivalent procedures will be conducted on 20% of the samples for the specific parameters of interest identified at each facility. This will provide a quality assurance check on the routine Level III analyses that will be conducted.
V	Level V analyses will be conducted for radionuclides and for other parameters where analysis must be conducted in a hot cell due to radioactivity.

[a]Soil boring program phases are described in Section 5.3.3.4.

4.2 WORK PLAN APPROACH

The approach for obtaining the data needed for the 100-DR-1 RFI/CMS is to proceed in a logical, iterative manner to optimize efficiency and cost effectiveness. The approach includes: continued evaluation of existing data and use of relevant data obtained from other Hanford research (including the 100-HR-1 and 100-HR-3 RFI/CMSs), geophysical investigations and initial sampling at some facilities to better define potential sources of contamination, a phased soil sampling program to determine first the nature and then the vertical and lateral extent of contamination, and a focussed biological investigation.

Additional efforts are needed to gather any existing data that may be available but were not obtained during work plan development to scope the investigations that may be required. Information obtained from the 100-HR-1 and 100-HR-3 investigations and other Hanford research will be evaluated as available, and relevant information, such as soil background quality, will be used for this project. In addition, techniques used in these investigations will be evaluated to determine whether any modifications are required for this project.

Initial field investigations will focus on defining locations of facilities and conducting general surveys and limited sampling to define potential sources of contamination. Geophysical techniques such as ground penetrating radar and electromagnetic induction/magnetometer surveys will be conducted to determine subsurface anomalies and facility locations. A radiation survey (Level I) will be conducted and soil gas surveys (Level II) will be used to determine the presence of radioactive and volatile organic contamination respectively. A video camera survey will be conducted of underground pipelines, and sludges from septic tanks and pipelines will be sampled.

Shallow boreholes will initially be used to define the nature of soil contamination where it is not defined by source sampling and analysis or test pit sampling and analysis. Samples from these borings will be analyzed for the full suite of radionuclides likely to be present in the operable unit. In addition, analyses will be conducted for the entire CERCLA target compound list (TCL) of organic compounds and the target analyte list (TAL) or inorganics. Radionuclide analysis will be Level V and CERCLA TCL and TAL analysis will be conducted using Level IV equivalent procedures. The boreholes will be temporarily capped until results of the analysis are completed and the list of target contaminants has been defined. Once the list of target contaminants has been defined, the borings will be deepened to about 3 m (10 ft) above the water table to determine the vertical extent of contamination. Samples to determine the depth of contamination will be analyzed only for those contaminants detected in the shallow boring program. Organics and inorganics will be analyzed by standard EPA Level III methods, unless the analysis must be conducted in a hot cell due to radioactivity. Hot cell analyses for organics or inorganics for these samples and radionuclide analyses will be Level V. In addition, 20% duplicate samples will be analyzed using Level IV equivalent procedures for quality assurance. Additional deep borings will be drilled and sampled to determine the lateral extent of contamination.

Deep boreholes to 3 m (10 ft) above the water table will be initially drilled to define the depth of soil contamination at facilities where source sampling and analysis and/or test pit sampling and analysis has been performed. Samples will be analyzed for those contaminants detected in the source and/or test pit sampling programs. Organics and inorganics will be analyzed by standard EPA Level III methods, unless the analysis must be conducted in a hot cell due to radioactivity, requiring Level V. At least 20% duplicate samples will be analyzed using Level IV equivalent procedures. Additional borings will be drilled to determine the lateral extent of contamination.

4.2.1 Investigation Methodologies

The initial phase of the RFI will include the following integrated subcomponent investigational tasks:

- Source investigation
- Geological investigation
- Soil investigation
- Air investigation
- Terrestrial biological investigation.

Each task is briefly outlined in the following sections. Specific RFI Phase II activities will be determined later in the project. These needs, which could include additional operable unit characterization activities, will be spelled out in the CMS Phase I and/or II reports.

4.2.1.1 Source Investigation. Subtasks to be performed during the source investigation include the following:

- A source data compilation to locate and review any additional plans and reports and to interview former operational personnel

- The preparation of a 100-DR-1 topographic base map to precisely define the locations of sources and, subsequently, sampling stations

- An electromagnetic induction/magnetometer survey to locate the positions of (1) the septic tanks and tile fields, (2) the waste acid reservoir near the 186-D building, (3) the underground fuel oil tank west of the 184-DA building, (4) various pipelines and other subterranean structures at various support facilities, (5) the salt dissolving pit, (6) the 116-D-2 pluto crib, (7) the 126-D-2 solid waste landfill, and (8) burial grounds 4A, 4B, and 18

- A ground-penetrating radar survey to locate the 116-DR-5 outfall structure, the septic tanks and tile fields, the 116-D-2 pluto crib, and the boundaries and depth of the 126-D-2 solid waste landfill

- A soil gas survey in areas where petroleum products or solvents were used
- A television scan of the process effluent lines
- Sampling and analysis of areas where source terms are uncertain or unconfirmed.

Investigation of each facility's integrity as a potential source of contamination will be performed under the soil investigation.

4.2.1.2 Geological Investigation. The geological investigation will include surface geologic mapping and collection of geological data generated during the 100-DR-1 soil investigation and the 100-HR-3 groundwater investigation, as available.

4.2.1.3 Soil Investigation. The soil investigation will include the following:

- A surface radiation survey of the entire 100-DR-1 area and a background plot to determine the areal extent of contamination
- A background soil characterization subtask coordinated with 100-HR-3 background sampling
- A test pit sampling and analysis subtask to determine the nature and extent of potential sources of near-surface contamination
- A borehole sampling and subsequent soil analysis subtask to determine the nature and vertical extent of contamination attributable to specific 100-DR-1 waste facilities and to collect data for vadose zone flow and transport calculations.

4.2.1.4 Air Investigation. The 100-DR-1 air investigation will consist of a meteorological data compilation subtask.

4.2.1.5 Terrestrial Biologic Investigation. The biological investigation for the operable unit will consist of an onsite, terrestrial biologic survey. This survey will determine the presence within, and use of, the 100-DR-1 habitat by any endangered, threatened, economically important, or significant human food chain component species.

4.2.2 Data Evaluation Methodologies

During the RFI, data will be evaluated as soon as they become available. This will allow the data to be used in rescoping and focusing the RFI/CMS, as appropriate. The data evaluation task will provide summaries and interpretations of the collected information that will be used to verify contaminant-specific ARARs, develop the baseline risk assessment, perform the CMS, and complete the RFI report.

Contaminant data for each environmental medium will be plotted to facilitate the understanding of the areal or volumetric extent of contamination. Statistical comparisons with background conditions will be performed to determine which contaminants attributable to 100-DR-1 are present in elevated concentrations. Several computer models and codes are available at the Hanford Site for the analysis of contaminant transport and environmental exposures. Appendix A provides a list of these models and codes.

Once the list of contaminants of concern for 100-DR-1 is well defined, a task will be undertaken to verify contaminant- and location-specific ARARs for 100-DR-1. Regulatory agency participation in this task will be important.

A separate task for the development of the baseline risk assessment will be established. This will include the subtasks of contaminant identification, exposure assessment, toxicity assessment, and risk characterization.

The development, screening, and evaluation of corrective measure alternatives in the CMS will be performed using RFI data in conjunction with standard costing and technical procedures, knowledge of prior technical applications, the results of performance analyses, and engineering judgement.

4.2.3 Integration of the RCRA Facility Investigation and the Corrective Measures Study

The RFI and CMS will proceed concurrently and interactively. The RFI results allow for the assessment of alternatives in the CMS, and the CMS results focus and define the data needs for the RFI. This process is illustrated in EPA (1988a). The tasks developed for each phase of the project, along with their corresponding subtasks and activities, are discussed in detail in Chapter 5.0.

4.2.4 Integration of 120-D-1 Ponds Closure Plan with RFI/CMS Activities

Closure plan development for the 120-D-1 Ponds is linked to the RFI/CMS work for the rest of the 100-DR-1 operable unit to ensure that work for both is done efficiently and timely.

4.2.5 Community Relations

The community relations program for the operable unit, discussed in the Community Relations Plan (Attachment 5), will be the formal mechanism for incorporating the concerns of secondary data users. Final RFI and CMS reports will be made available for formal review and comment. The community relations program will ensure that all comments and concerns received are adequately and appropriately addressed before the selection of a final remedy.

This page left intentionally blank.

DO NOT MICROFILM
THIS PAGE

5.0 RCRA FACILITY INVESTIGATION/CORRECTIVE MEASURES STUDY TASKS

This chapter describes the various tasks to be implemented during the course of the project. The specified tasks are designed to provide information to meet the DQO's identified in Chapter 4.0. Detailed information on sampling locations and frequencies and sample designation is presented in the Field Sampling Plan (Attachment 1a). Equipment and procedures needed to carry out investigation tasks are referenced in the Field Sampling Plan (Attachment 1a) and the Quality Assurance Project Plan (Attachment 1b). Environmental monitoring requirements for ensuring the health and safety of onsite investigators are described in the Health and Safety Plan (Attachment 2).

It may be necessary to update this chapter during the course of the project. Depending on the results of certain tasks, others may need to be created, supplemented, or deleted. As such, this portion of the Work Plan and the associated attachments are meant to function as a living document. Revisions will be made and distributed, as appropriate.

5.1 PROJECT MANAGEMENT

Project management is needed throughout the course of the RFI/CMS to direct and document project activities and to secure the data and evaluations generated. The initial project management activity will be to assign individuals to roles established in the Project Management Plan (Attachment 3). Other tasks that will occur throughout the RFI/CMS include the following:

- Task 1--General Management
- Task 2--Meetings
- Task 3--Cost Control
- Task 4--Schedule Control
- Task 5--Data Management
- Task 6--Progress Reports.

Each of these tasks is described in the following sections in further detail.

5.1.1 Task 1--General Management

This task includes the day-to-day supervision of, and communication with, project staff and subcontractors. Throughout the project, daily communications between office and field personnel are required, along with periodic communications with subcontractors, to assess progress and to exchange information.

5.1.2 Task 2--Meetings

Meetings will be held, as necessary, with members of the project staff, subcontractors, regulatory agencies, and other appropriate entities to communicate information, assess project status, and resolve problems.

A kickoff meeting will be held with appropriate project personnel; project staff meetings will be held weekly. Operable unit project coordinators for this and other operable units will meet on a weekly basis to share information and to discuss progress and problems. The frequency of other meetings will be determined based on need and on schedules published in the Action Plan.

5.1.3 Task 3--Cost Control

Project costs will be regularly tracked. Labor, other direct costs, and subcontractor expenses will be tracked weekly. The budget tracking activity will be computerized and will provide the basis for invoice preparation and review.

5.1.4 Task 4--Schedule Control

Scheduled milestones will be tracked weekly for each task of each phase of the project.

5.1.5 Task 5--Data Management

The project file will be kept organized, secured, and accessible to the appropriate project personnel. All field reports, field logs, health and safety documents, quality assurance/quality control (QA/QC) documents, laboratory data, memoranda, correspondence, and reports will be logged into the file upon receipt or transmittal. This task is also the mechanism for ensuring that data management procedures documented in the Data Management Plan (Attachment 4) are carried out appropriately.

5.1.6 Task 6--Progress Reports

Quarterly progress reports will be prepared, distributed to the appropriate personnel and entities (project and unit managers, coordinators, contractors, subcontractors, etc.), and entered into the project file. These reports will summarize the work completed, present data generated, and provide evaluations of the data as they become available. Progress, anticipated problems and recommended solutions, upcoming activities, key personnel changes, status of deliverables, and budget and schedule information will be included.

5.2 COMMUNITY RELATIONS

Community relations activities will occur throughout the course of the RFI/CMS. These activities are specified in the Community Relations Plan (Attachment 5).

5.3 RFI PHASE I--OPERABLE UNIT CHARACTERIZATION

To satisfy the data needs and DQOs specified in Chapter 4.0, the following tasks will be performed during the first phase of the RFI:

- Task 1--Source Investigation
- Task 2--Geologic Investigation
- Task 3--Soil Investigation
- Task 4--Air Investigation
- Task 5--Terrestrial Biologic Investigation
- Task 6--Data Evaluation
- Task 7--Verification of Contaminant- and Location-Specific ARARs
- Task 8--Baseline Risk Assessment
- Task 9--RFI Phase I Report: Preliminary Operable Unit Characterization Summary.

The tasks, and their component subtasks and activities, are outlined in the following sections. Sufficient information is provided on each task to allow estimation of the project schedule (see Chapter 6.0) and costs. Details regarding specific sampling objectives, locations, and frequencies are provided in the Field Sampling Plan (Attachment 1a). Sampling analytical procedures are referenced in the Quality Assurance Project Plan (Attachment 1b).

5.3.1 Task 1--Source Investigation

The source investigation for the 100-DR-1 is composed of eight subtasks:

- Task 1a--Source Data Compilation
- Task 1b--Topographic Base Map Development
- Task 1c--Electromagnetic Induction/Magnetometer Survey
- Task 1d--Ground-Penetrating Radar Survey
- Task 1e--Soil Gas Survey
- Task 1f--Process Effluent Pipelines and Discharge Pipelines Integrity Assessment
- Task 1g--Sampling and Analysis.

These subtasks will be conducted in a logical staged approach to identify sources, locations, and potential contamination associated with each facility. Additional activities described under Task 3--Soil Investigation, will be conducted to define the nature and extent of contamination. As described in the following subtasks, not all activities will be conducted at each facility.

5.3.1.1 Task 1a--Source Data Compilation. The source data compilation subtask will consist of gathering additional existing information on 100-DR-1 facilities.

An attempt to obtain additional information will be made through a further review of engineering plans and reports and interviews of former employees. Types of information still needed for several of the 100-DR-1 facilities include location, function or use, period of operation, and types of radiological or hazardous materials generated, used, or disposed of. Facilities where additional information of this type is required include the following:

- The 116-D-2 pluto crib
- Discharge pipelines to Columbia River
- The 108-D office building and decommissioning station
- The 1714-D solvent storage building
- The 1734-D cylinder storage building
- The 1722-D equipment development lab
- The 195-D vertical rod safety test tower
- The 1713-D instrument and electrical development lab
- The 186-D demineralization building
- Waste acid reservoir
- Sodium dichromate tanks
- Burial grounds 4A, 4B, and 18
- Electrical facilities
- Paint shop
- 132-D-4 stacks
- Salt dissolving pit.

This information will be used to focus the scope of subsequent tasks. If additional information is unavailable, locations of facilities will be determined through geophysical methods described in Tasks 1c and 1d. In addition, an attempt will be made to collect data on the types of herbicides and solvents stored in the 103-D building, the disposal location for the 117-D filters, the types of hazardous wastes stored in the 189-D building, and the waste handling procedures at support facilities. The nature and extent of contamination will be determined by Task 1g, Sampling and Analysis, and Task 3, Soil Investigation, as described below.

5.3.1.2 Task 1b--Topographic Base Map Development. A topographic base map will be developed at a scale that will allow precision needed to show elevation contours at 0.6 m (2 ft) intervals. The National Geodetic Survey coordinate system will be used. Facilities shown in Figure 5 will be included on the topographic map, incorporating any modifications necessitated by sampling defined in previous or latter tasks, and the geodetic survey information. In addition, existing groundwater monitoring well and air monitoring station locations will be identified on the topographic map.

The boundaries of the map will extend 100 m (330 ft) beyond the operable unit boundary. The map will be prepared with third-order precision and accuracy. Periodic updates of the map will be necessary to incorporate information from other RFI/CMS subtasks.

Horizontal control will also be provided for sampling points and grids established for completing the following tasks:

- Task 1c--Electromagnetic Induction/Magnetometer (EMI/MAG) Survey
- Task 1d--Ground-Penetrating Radar Survey
- Task 1e--Soil Gas Survey
- Task 3a--Surface Radiation Survey.

Horizontal control will be established on two points at each grid location required for these surveys. The horizontal plane survey accuracy will be ± 0.3 m (1 ft). Relative coordinates for the remainder of the grids will be obtained by using a tape and compass traverse or Global Positioning Satellite (GPS) instrument and electronic distance measuring instrument tied to these reference points. Adequate vertical control will be provided by the topographic base map.

Locations of soil borings conducted during Task 3 will be surveyed for both horizontal coordinates and vertical elevations. The horizontal plane survey accuracy will be ± 0.3 m (1 ft). The vertical plane survey must be accurate to ± 0.03 m (0.1 ft). The elevation will be obtained at the ground surface of the borehole locations.

5.3.1.3 Task 1c--Electromagnetic Induction/Magnetometer Survey. The electromagnetic induction/magnetometer survey consists of two activities:

- Task 1c-1--Magnetometer Survey
- Task 1c-2--Electromagnetic Induction Survey.

Magnetometer surveys are designed to detect ferro-nickel metallic objects buried beneath the surface. Magnetometer surveys are used in conjunction with EMI to further define buried objects; e.g., septic tank fields will often show on an EMI survey, but will not show up on a MAG survey. Buried aluminum or other nonferrous material can also be determined by conducting both surveys. Screening surveys using EMI and MAG are cost-effective methods of reducing and defining areas for further investigation.

The EMI surveys measure the electrical conductivity of subsurface materials. Variations in conductivity may be caused by changes in soil moisture content, the presence of ionic species, or the presence of metallic objects. While above-ground interferences may mimic subsurface features, these can be filtered or accounted for. The EMI survey will be used to screen large areas for possible contamination and to precisely locate buried facilities. Areas identified as potentially contaminated will be marked for further investigation in the Task 3 soil investigation.

5.3.1.3.1 Task 1c-1--Magnetometer Survey. A magnetometer survey will be conducted on grids established for the EMI survey. A fluxgate magnetometer will be used. Azimuthal readings will be taken where anomalous readings are encountered to attempt to define geometry of the anomaly.

5.3.1.3.2 Task 1c-2--EMI Survey. An EMI survey will be conducted over the entire area of the following facilities, as shown in Figures 1 through 3 in the Field Sampling Plan (Attachment 1a):

- Septic tanks 1607-D2, 1607-D4, 1607-D5, and the septic tank located at N93050 and W52850, and associated tile fields
- The 116-D-2 pluto crib
- Waste acid reservoir
- Underground fuel oil tank west of the 184-DA steam-generating facility
- Buried fuel oil pipeline associated with the 166-D aboveground fuel oil tank
- Buried process effluent pipelines
- Buried discharge pipelines to the Columbia River
- The 126-D-2 solid waste landfill
- Burial grounds 4A, 4B, and 18
- Salt dissolving pit.

The survey will be conducted on a grid established over the designated facilities, using a Geonics* EM31 or equivalent. Anomalies will be identified in the field by staking and flagging the locations of occurrence.

5.3.1.4 Task 1d--Ground-Penetrating Radar Survey. Ground-penetrating radar is an effective tool for detecting subsurface irregularities such as buried objects. The ground-penetrating radar survey will be conducted along the transects established to determine the location of the following facilities:

- Septic tanks and tile fields
- Boundaries and depth of the 126-D-2 solid waste landfill
- Waste acid reservoir (if not previously located)
- 116-D-2 pluto crib
- 116-DR-5 outfall structure.

---

*Geonics is a trademark

This information will be used to identify locations for additional investigations described in Task 1g--Sampling and Analysis and Task 3--Soil Investigation.

Grids will be established over the surface of areas to be surveyed by ground-penetrating radar by tape and compass traverse from horizontal control points provided in Task 1b. The GPR survey will then be conducted along the transects established.

5.3.1.5 Task 1e--Soil Gas Survey. A soil gas survey will be conducted in the areas where petroleum products or solvents were stored or used. The survey will test for both halogenated and non-halogenated volatile organic compounds. The areas covered by the soil gas survey include the following areas:

- The 103-D fuel element storage building
- Sewer lines, septic tanks, and tile fields
- The 1713-D instrument and electrical development lab
- The 1714-D solvent storage building
- The 1715-D oil and paint storage
- The 1716-D gas station
- The 1722-D equipment development lab
- Underground fuel oil tank west of the 184-DA building
- The 166-D fuel oil tank
- The 126-D-2 solid waste landfill
- Burial grounds 4A, 4B, and 18
- Paint shop (west of 182-D reservoir).

The area of coverage for the soil gas survey will include any associated underground pipelines. Probes will be installed from 1-m to 2-m (3-ft to 6-ft) deep in backfill around the buried tanks and pipelines, and other relatively small facilities on about 7.6-m (25-ft) centers. Probes will be installed in the area of the 126-D-2 solid waste landfill and burial ground 4A in a grid pattern on about 15-m (50-ft) centers. Probes will be installed around the perimeter of existing structures on about 7.6-m (25-ft) centers. The extent of contamination will be determined by installing additional probes until no detectable contamination is found in two adjacent probes bounding the area. Section 2.5.5 of the FSP describes equipment and analysis to be conducted for the soil gas survey.

Areas of contamination detected during the soil gas survey may be sampled during Task 3, as needed, to define the vertical extent of the contamination.

5.3.1.6 Task 1f--Process Effluent Pipelines and Discharge Pipelines Integrity Assessment. This task will analyze the location and severity of the cracks in the three process effluent pipelines and land portions of the discharge pipelines. This information will be used in determining locations for sampling in Task 1g and soil sampling to be performed under Task 3, as well as aiding in the determination of the extent of soil contamination in the vicinity of the pipelines. This task comprises two subtasks:

- Task 1f-1--Review of Results and Procedures of 100-HR-1 Operable Unit RFI/CMS Pipeline Assessment
- Task 1f-2--Inspection of Pipelines.

5.3.1.6.1 Task 1f-1--Review of Results and Procedures of 100-HR-1 Operable Unit RFI/CMS Pipeline Assessment. It has been assumed, in developing this Work Plan, that the 100-HR-1 pipeline assessment will have been completed prior to the initiation of the 100-DR-1 pipeline integrity assessment. Contingencies in the event that the 100-HR-1 pipeline assessment is not completed prior to the initiation of the 100-DR-1 assessment are discussed in the Field Sampling Plan. Results of the 100-HR-1 pipeline assessment for gaining access to the pipelines, types of remote cameras, camera-bracing systems, and survey control for tracking the horizontal position and direction of the camera will be evaluated to determine effectiveness. Modifications to procedures will be made as required.

5.3.1.6.2 Task 1f-2--Inspection of Pipelines. The entire interior circumference of the process effluent pipeline will be inspected using the system selected in Task 1f-1. The image of the pipe interior will be monitored during the inspection and will be recorded on videotape. The position of all cracks or other faults will be noted and identified in the field for the process effluent pipelines by staking and flagging. Once the severity of cracks and faults is identified under this subtask, the number and location of soil samples to be taken under Task 3 can be determined.

5.3.1.7 Task 1g--Sampling and Analysis. This task includes sampling and analysis of potential waste sources for which borings (see Task 3) are not currently planned. Sampling will be conducted for liquids, sludges, and some building materials to determine the presence of hazardous/radioactive materials. Borings may subsequently be conducted at some of these waste sources if they are needed to determine the vertical extent of any contamination found.

5.3.1.7.1 Sampling Locations. Samples will be taken from the following facilities:

- Process effluent pipelines
- Discharge pipelines to the Columbia River
- The 103-D fuel element storage building
- Septic tanks 1607-D2, 1607-D4, 1607-D5, and the septic tank at Hanford Site coordinates N93050 and W52850
- The 120-D-1 (100-D) ponds
- The 1724-DA underwater test facility
- The 132-D-4 reactor exhaust stack
- Electrical facilities (e.g., transformers, capacitors).

Process Effluent Pipelines. This subtask will sample the sludge that has been deposited from the process effluent stream in each of the three process effluent pipelines. As discussed in Section 3.1.1.2, there is the potential that radionuclides will be found in these pipelines. Task 1f (integrity assessment) will indicate to some extent the amounts of accumulation of sludge and will help set the criteria for sampling locations and frequency. Part of this subtask will be to review methods for accessing and sampling the pipelines.

Discharge Pipelines to the Columbia River. Sludge samples will be taken from the land portions of the discharge pipelines at locations determined after Task 1f has been completed. Since the discharge lines were used to discharge process effluents from the 116-D-7 and 116-DR-9 retention basins, contamination would be a result of the substances determined to be present in the process wastewater from the D and DR reactors. Effluent was supposed to have undergone thermal and radioactive decay in the retention basins before being discharged to the river.

Knowledge of the presence and extent of any contamination is needed to evaluate corrective measure alternatives for the pipelines. Sampling methods, as well as how the pipeline will be accessed, will be reviewed as part of this subtask.

103-D Fuel Element Storage Building. Signs posted on this building indicate that it has been used to store solvents and herbicides. Initially an inspection will be conducted of the building for physical or visual evidence of any spills or leaks. An organic vapor analyzer will be used to monitor for the presence of volatile organic compounds. Four randomly located wipe samples will be obtained from the concrete floor of the building and at all locations with visible contamination. Soil samples immediately underneath the floor will be sampled after excavating through the concrete floor if the wipe samples indicate the presence of significant amounts of hazardous substances.

Septic Tanks 1607-D2, 1607-D4 and 1607-D5, and Septic Tank at N93050 and W52850. This subtask will sample the sludge found in the bottom of the tanks to determine whether there were any hazardous or radioactive contaminants disposed of into the drains that connect to the septic system. If the sludge is found to contain harmful amounts of hazardous or radioactive substances, then the soil beneath the septic tanks will be sampled during Task 3 (soil sampling).

Access to the sludge in the septic tanks will be conducted through the cleanout ports. One sample from each septic tank will be collected and sent for laboratory analysis. All sample locations and elevations will be surveyed upon completion of the sampling activity.

120-D-1 (100-D) Ponds. The north 120-D-1 (100-D) Pond will be sampled initially with a hand auger for analysis. The south pond will be sampled with a coring sampler if water is still in the pond. Samples will be obtained at four locations at the sediment surface and at 1-m (3-ft) in each of the ponds. One sample location in each pond will be at the influent where insoluble or quickly precipitated compounds would be expected in highest concentrations. The other three sample locations in each pond will be selected randomly. The parameters to be analyzed for in sediments collected in the 120-D-1 (100-D) Ponds are based on the following:

- Potential for release of various types of effluents that were not previously documented
- Reported releases of corrosive materials
- Numerous effluent sources that could have potentially contributed small or undetected releases of wastes.

A two-stage sampling program may be conducted as part of Task 1g to determine mean values of contaminant parameters with a certain degree of confidence and precision relative to soil background. Deep boring and sampling will be conducted as described in Task 3 if contamination is detected in any of the samples collected at 1-m (3-ft).

The 120-D-1 (100-D) Ponds will be evaluated to yield information about the inventory of hazardous waste that is in the soil and sediments. Data generated by that effort will be used in decisions regarding future sampling efforts and selection of options for closure of the facility. A separate closure plan will be prepared for the 120-D-1 Ponds, which will be integrated with the corrective measures developed for the rest of the operable unit.

1724-DA Underwater Test Facility. Samples for analysis will be taken of both the sediment and liquid surfactant present in this facility. Nonhazardous and nonradioactive substances were used in conjunction with this facility. However, if contamination is found, soil beneath the structure would be sampled as part of Task 3 (soil sampling).

132-D-4 Reactor Exhaust Stack. A radiation survey for alpha, beta, and gamma radiation will be conducted in the interior of the stack, using a portable, laboratory-quality alpha detector and sodium iodide beta/gamma detector that reads in counts per minute. At least five randomly located wipe samples within the interior of the stack will be collected for laboratory analysis.

Electrical Facilities. Surface soils around the areas where transformers, switches, and capacitors have been stored will be visually examined for evidence of leaks. Soil samples will be obtained of any visibly tained soils for analysis of PCBs.

5.3.1.7.2 Sample Analysis. Samples obtained for laboratory analysis will be analyzed using contract laboratory program protocols. Sample parameters selected for laboratory analysis are listed in Tables 1 and 2 in the Field Sampling Plan.

5.3.2 Task 2--Geological Investigation

The 100-DR-1 geological investigation will characterize the geology of unconsolidated sediments and bedrock to evaluate their influence on the following:

- Aquifers
- Release and movement of contaminants
- The geologic engineering aspects of operable unit corrective action.

The geologic data required include regional geology and the geology of unconsolidated deposits and bedrock at 100-DR-1. Information on bedrock geology will be obtained from wells drilled for the 100-HR-3 RFI/CMS.

Sufficient data are currently available on the regional geology and structure of the Hanford Site, and no further work will be required; however, the 100-D/DR Area has not been subjected to a direct and thorough geologic characterization. Much of the detail on the 100-D/DR Area geology, as presented in Section 2.2.2, is derived from information available from the nearby 100-H and 100-N Areas. While it may be appropriate to assume that the geologic settings of the two areas are similar, the validity of the assumption must be tested during the RFI Phase I. The geologic investigation for the 100-DR-1 operable unit will consist of compilation of pertinent existing geologic data, surface geologic mapping, and collection of data from other field activities scheduled to occur during this project and the 100-HR-3 RFI/CMS.

The following types of geologic data are needed on surface, near-surface, and vadose zone soils:

- Thickness and areal extent of geologic units
- Lithology
- Mineralogy
- Particle size and sorting.

All of the borings drilled for this Work Plan will be drilled within the vadose zone. However, any deep wells to bedrock that are drilled within the 100-DR-1 operable unit for the 100-HR-3 groundwater study will be geologically logged, and bedrock data will be collected, including lithology, mineralogy, and the presence of discontinuities, such as joints or fractures.

There are four subtasks established to gather geologic data:

- Task 2a--Compilation of Existing Data
- Task 2b--Surface Geologic Mapping
- Task 2c--Collection of Geological Data Obtained Under the Task 3 Soil Investigation, including borehole geologic and geophysical logging
- Task 2d--Collection of Geological Data Obtained Under the 100-HR-3 RFI Phase I Groundwater Investigation.

5.3.2.1 Task 2a--Compilation of Existing Data. Existing data on regional and site-specific geology and structure will be compiled. This task will focus on the collection of existing geologic literature, maps, and borehole geologic and geophysical logs.

5.3.2.2 Task 2b--Surface Geologic Mapping. Surface geologic mapping will be carried out to identify the types and areal extent of surficial deposits in the operable unit.

5.3.2.3 Task 2c--Collection of Geologic Data Obtained Under the Task 3d Soil Investigation. Task 3d of the 100-DR-1 Phase I RFI will consist, in part, of obtaining vadose zone samples in and around waste facilities located throughout the operable unit. The geologic and geophysical borehole logs and physical analytical results generated during Task 3d will be relevant in interpreting 100-DR-1 geology. This subtask consists of gathering such information for subsequent geological evaluation under Task 6b.

5.3.2.4 Task 2d--Collection of Geologic Data Obtained Under the 100-HR-3 RFI Phase I Groundwater Investigation. The groundwater investigation conducted during the 100-HR-3 RFI/CMS will include the installation of monitoring wells in the 100-D/DR Area. The geologic borehole logs from these wells, particularly the deep wells, and physical analytical results generated from these wells will be relevant in interpreting the operable unit geology. This subtask consists of gathering such information for subsequent geologic evaluation under Task 6b.

5.3.3 Task 3--Soil Investigation

A soil investigation will be performed to determine the extent of contamination that occurred in surface, near-surface, and vadose zone soils as a result of waste handling and disposal practices at the 100-DR-1 operable unit. Documented leaks occurred in the process effluent pipelines, as well as in the retention basins. Specific structures were designed to function as percolation basins, with the soil absorbing radioactive constituents. While contamination is expected to be concentrated primarily underneath containment or transport facilities, the investigation will not be limited to those areas. In addition to identifying the nature and extent of contamination of surface, near-surface, and vadose soils to determine whether exposure pathways exist and to evaluate corrective measure alternatives, the soil investigation will identify vadose zone characteristics to estimate flux, velocity, and contaminant movement for input to the vadose zone transport models for the risk assessment and for the evaluation of corrective measure alternatives.

The soil investigation consists of four subtasks:

- Task 3a--Surface Radiation Survey
- Task 3b--Background soil characterization coordination with 100-HR-3
- Task 3c--Test Pit Soil Sampling and Analysis
- Task 3d--Borehole Soil Sampling and Analysis.

5.3.3.1 Task 3a--Surface Radiation Survey. Surface contamination will be detected by using portable (vehicle-mounted or hand-held, as appropriate), laboratory-quality alpha detector and a sodium-iodide beta/gamma detector that reads in counts per minute. The survey will identify any currently unknown areas of surface radiation contamination.

The plot established for the 100-HR-1 RFI/CMS will be used for determining background surface radiation levels. This background radiation survey will be conducted on land surfaces east of the D reactor operable unit boundary. A grid will be established at about 7.6-m (25-ft) intervals.

Within the operable unit boundary, the ground will be surveyed along transects at a minimum of about 7.6-m (25-ft) intervals to determine the extent of elevated radiation. Areas with radiation statistically greater than background results will be staked and flagged for the geodetic survey under Task 1b and for more detailed soil inspection under Task 3.

5.3.3.2 Task 3b--Background Soil Characterization Coordination with 100-HR 3. For logistical reasons, 100-DR-1 soil background samples will be obtained during the installation of ground water monitoring wells for 100-HR-3. At least 50 discrete vadose zone samples allocated among at least five boreholes will be collected. Sampling will be at 1.5-m (5-ft) intervals and at any changes in the lithology to a depth of approximately 3 m (10 ft) above the expected maximum groundwater level. These samples will be analyzed for 100-DR-1 parameters of interest (see Table 3 in the Field Sampling Plan). It is important that coordination between 100-DR-1 and 100-HR-3 be conducted to ensure that these data, essential to the 100-DR-1 soil investigation, are appropriately collected during, and received from, 100-HR-3. If the 100-HR-3 investigation is delayed, background borings will be drilled specifically for the 100-DR-1 operable unit.

5.3.3.3 Task 3c--Test Pit Soil Sampling and Analysis. This subtask will determine the nature and extent of near-surface contamination identified as a result of Task 1 source sampling. Test pits will be excavated only in areas where shallow, nonradioactive contamination is suspected. They will be used to quickly confirm the presence of contamination prior to the installation of a boring program. Facilities to be evaluated by test pits, depending upon the results of Task 1, include septic tanks and sewer pipelines, gas and fuel oil tanks and pipelines, some support facilities and existing ancillary facilities, the rubble-filled 126-D-2 landfill, and soils potentially contaminated with PCBs.

This subtask is subdivided into four activities, each of which will be conducted separately:

- Task 3c-1--Mobilization
- Task 3c-2--Test Pit Sampling
- Task 3c-3--Soil Sample Analysis
- Task 3c-4--Test Pit Abandonment.

5.3.3.3.1 Task 3c-1--Mobilization. Before conducting test pit investigations, a file and field survey of all proposed test pit sites will be conducted to ensure that no significant archaeological resources are disturbed during implementation of the subtask. Coordination with the heavy equipment operator will also be required.

5.3.3.3.2 Task 3c-2--Test Pit Sampling. The locations of test pits will depend on the nonradioactive anomalies identified in the Task 1 source investigation. Test pits will be excavated in the 126-D-2 solid waste landfill in the former 184-D coal storage area, septic tanks, sanitary sewer pipelines, fuel oil tanks and pipelines, and other facilities, as required, at anomalies identified by the Task 1d--Ground-Penetrating Radar Survey that may represent buried drums, and at anomalies identified by the Task 1e--Soil Gas Survey. Test pits will also be excavated at locations where nonradioactive contamination is identified as a result of Task 1g sampling.

The test pits will be excavated with a backhoe or similar bucket-equipped heavy equipment that will permit excavation to a depth of up to 1.2 m (4 ft). The final depth will be determined based on conditions encountered at each facility, including evidence such as visible discoloration or odor. A disturbed soil sample will be collected from the bucket of the backhoe. Test pits will be sampled at 0.3-m (1-ft), 1-m (3-ft) and up to 1.2-m (4-ft) depths from the ground surface. Test pit sampling, including measures to prevent migration of contamination during excavation and sampling, will be conducted in accordance with EII 5.2 "Soil and Sediment Sampling" (WHC 1989c). The test pits and all field samples will be screened with hand-held instruments for radiation and volatile organic compounds. No personnel will be permitted to enter a test pit.

If contaminants are identified in soil samples, the vertical extent of contamination will be investigated in the boring program described in Chapter 4.0 of the Field Sampling Plan.

5.3.3.3.3 Task 3c-3--Soil Sample Analysis. Soil samples obtained for laboratory analysis will be analyzed using contract laboratory program protocols. Sample parameters will be based on the parameters identified in Task 1. Analytical procedures and analytical levels are discussed in Chapters 3.0 and 7.0 of the Quality Assurance Project Plan.

5.3.3.3.4 Task 3c-4--Test Pit Abandonment. Test pits will be backfilled and properly compacted after sampling has been completed according to EII 5.2, Appendix F, "Soil and Sediment Sampling" (WHC 1989c). Backfill will be covered with clean soil and graded to the original contour as necessary. Procedures for decontamination of the excavation equipment are addressed under the procedures described in EII 5.4, "Decontamination of Drilling Equipment."

5.3.3.4 Task 3d--Borehole Soil Sampling and Analysis. This subtask will characterize the type and extent of soil contamination at areas of known and suspected contamination. This characterization is designed to supplement the existing data base in areas that have been partially characterized, to provide background soils data for use in the assessment of soil contamination, to provide data in areas of known but uncharacterized contamination, and to provide information on the physical characteristics of the soils.

This subtask is divided into five activities, each of which will be conducted separately:

- Task 3d-1--Mobilization
- Task 3d-2--Borehole Soil Sampling
- Task 3d-3--Soil Sample Storage and Cuttings Disposal
- Task 3d-4--Soil Sample Analysis
- Task 3d-5--Borehole Abandonment.

5.3.3.4.1 Task 3d-1--Mobilization. Matters to be addressed in the mobilization activity include an evaluation of drilling and soil sampling methodologies, evaluation of archeological resources within 100-DR-1, and coordination with the drilling subcontractor.

Before proceeding with the installation of the soil boreholes, existing drilling and soil sampling methodologies that are approved for use at the Hanford Site will be evaluated to select the respective methods that are most efficient and effective. If liquids are present in the septic tanks, they will be removed and stored pending the outcome of sludge analysis in Task 1g. Proper methods of disposal of the liquids will be determined from the results of those analyses. At this time it is assumed that cable tool drilling methods will be employed at 100-DR-1.

A file and field survey of all proposed drilling sites will be conducted to ensure that no significant archeological resources are disturbed. Coordination with the drilling subcontractor will occur to prepare for the upcoming drilling activities. This will include an operable unit visit to determine any special measures that need to be taken to provide drilling rig access to the waste management units.

5.3.3.4.2 Task 3d-2--Borehole Soil Sampling. Objectives of borehole soil sampling include characterization of background conditions by background soil borings, characterization of contaminated soils associated with specific 100-DR-1 waste facilities, characterization of soils potentially contaminated as determined by the EMI, MAG, ground-penetrating radar, soil gas, and surface radiation surveys, and determination of the physical characteristics of the soils. Vadose zone concentration profiles below cribs and other waste disposal facilities will be compared with background conditions.

For cost effectiveness, the soil boring program will be conducted in phases to reduce the number of parameters to be analyzed. The soil boring program is described in detail in Chapter 4.0 of the Field Sampling Plan, which includes maps showing proposed boring locations and a table describing the locations, sample intervals and depths, parameters for analysis, and preferred drilling methods for specific operable unit facilities. Soil parameters to be collected include:

- soil characteristics (type [classification], soil phase mineralogy, and engineering properties--consolidation, density, grain-size distribution, and percent clay) to estimate the effect of the properties on infiltration and retardation of contaminants and release of gaseous contaminants, and to provide information on the engineering aspects of site corrective action.

- soil chemistry (leachability, adsorptability, cation exchange capacity, pH, and contaminant chemistry) to identify the nature and extent of contaminants and to predict contaminant movement through soils.

- vadose zone characteristics (permeability, porosity, moisture content, and contaminant chemistry) to identify the nature and extent of contaminants, to estimate flux and velocity in the vadose zone, and to evaluate contaminant movement through the vadose zone.

The phases of the boring program are summarized below. A detailed description of this phased boring program is described in Section 4.4 of the Field Sampling Plan. These phases are identified in this Work Plan in arabic numerals to distinguish them from Phase I of the RCRA facility investigation, of which they are a part. All borehole soil sampling will be conducted at 1.5-m (5 ft) intervals, at "hot spots" as determined by real-time screening, and at major changes in lithology.

At facilities that are not sampled as part of the Task 1g source sampling or Task 3c test pit sampling, and for which the complete range of contaminants is unknown, a three-phased soil boring program will be carried out as follows:

Phase 1 - The nature of contamination will be determined by means one shallow boring, located where maximum contamination can be expected or at a random location if contamination is expected to be evenly distributed, to a depth of 3 m (10 ft) below the base of the facility. Samples will be analyzed for the entire CERCLA target compound list (TCL) of organic compounds and the target analyte list (TAL) of inorganics using analytical Level IV equivalent procedures, and the full suite of radionuclides likely to be present in the operable unit. Radionuclide analysis will be analytical Level V. One physical sample from each geologic unit encountered will be archived for future analysis. The borehole will be temporarily capped until the list of contaminant parameters can be refined based on laboratory results. If significant contamination is identified, the boring program will proceed to Phase 2.

Phase 2 - If contamination is identified in Phase 1, the borehole will be reentered and deepened to 3 m (10 ft) above the expected maximum groundwater level to determine the vertical extent of contamination. At larger facilities, additional deep borings may be required to further define the extent of contamination within the facility boundaries. The proposed target depth of each boring will be based upon the high-river stages in the Columbia River, using records complied since the Priest Rapids Dam was built, and a groundwater level data base that includes existing wells and that is updated if 100-HR-3 well data are available.

Phase 2 samples will be analyzed only for those contaminants detected in Phase 1 boring program. Organics and inorganics will be analyzed by standard EPA Level III methods, unless the analysis must be conducted in a hot cell due to radioactivity. Hot cell analyses will be Level V. In addition, 20 percent duplicate samples will be analyzed using Level IV equivalent procedures for quality assurance. Physical samples will be collected from each geologic unit encountered; either these samples or the samples collected in Phase 1 will be selected for actual physical analysis.

Phase 3 - Additional deep borings will be drilled and sampled in Phase 3 to determine the lateral extent of contamination. Unless the likely route of seepage is known, at least two randomly located borings will be spaced at a distance from the facility boundaries determined by professional judgement, incorporating any available results of horizontal dispersion studies at the Hanford Site. Sample parameters and analytical levels will be the same as those in Phase 2, and sample depth will be determined by the vertical extent of contamination identified in Phase 2. If significant contamination is detected in these borings, additional horizontal sampling will be required.

At facilities that have been sampled as part of Task 1g source sampling and/or Task 3c test pit sampling, and for which specific contaminants have been identified, a two-phased soil boring program will be carried out as follows:

Phase 1 - The vertical extent of contamination within the facility boundaries will be evaluated by one or more borings, depending upon the size of the facility, to a depth of 3-m (10 ft) above the expected maximum groundwater level. Sample parameters will be those identified in Task 1g or 3c. Organics and inorganics will be analyzed by standard EPA Level III methods, unless the analysis must be conducted in a hot cell due to radioactivity. Radionuclide analyses will be Level V. In addition, 20 percent duplicate samples will be analyzed using Level IV equivalent procedures for quality assurance. Physical samples will be collected from each geologic unit encountered.

Phase 2 - Additional deep borings will be drilled and sampled in Phase 2 to determine the lateral extent of contamination. Unless the likely route of seepage is known, at least two randomly located borings will be spaced at a distance from the facility boundaries determined by professional judgment, incorporating any available results of horizontal dispersion studies at the Hanford Site. Sample parameters and analytical levels will be the same as those in Phase 1, and sample depth will be determined by the vertical extent of contamination identified in Phase 1. If significant contamination is detected in these borings, additional horizontal sampling will be required.

Additional Level II field or laboratory screening techniques, such as X-ray fluorescence, may also be used during the Phase II and III boring program if a reliable correlation can be established between this screening and Phase I CLP-equivalent sampling results. If a reliable correlation is established, this screening can be used to determine the depths of Phase II and III borings and the need for additional Phase III borings.

Borehole drilling procedures are described in EII 6.7, "Groundwater Well and Borehole Drilling," and subsurface soil sampling methods are described in procedure EII 5.2, "Soil and Sediment Sampling" (WHC 1989c). The sampling method used will depend on the nature of the geologic units at 100-DR-1 and on the ability to obtain acceptable samples for analysis. If the nature of the soils is unacceptable for the collection of contaminated samples and undisturbed samples for physical and organic volatile analysis, the sampling program will require modification.

All boreholes will be geologically logged and sampled for laboratory analysis at specified intervals, as well as at any changes in lithology. Borehole geologic logs will record the applicable information specified in EII 9.1, "Geologic Logging" (WHC 1989c). Drill cuttings and core samples will be continuously screened with hand-held instruments for radiation and volatile organic compounds. Density measurements will be obtained during drive sampling by recording blow counts on the borehole log. Procedures may have to be developed for Level II screening techniques.

Each borehole will be geophysically logged prior to pulling the casing, using down-hole probes for gamma-gamma, neutron, epithermal neutron, and high-resolution spectral gamma radiation. Borehole geophysical logging permits stratigraphic correlation of the lateral continuity of fine-grained and coarse-grained facies and the lateral persistence of physical properties such as density and porosity. High-resolution spectral gamma logging permits generation of profiles of gamma-emitting radionuclides. Borehole geophysical logging will be performed in borings where casing does not interfere with logging techniques in accordance with EII 5.6, "Control of Geophysical Logging" (WHC 1989c). Additional details on geophysical logging equipment and procedures will be specified in an EII to be developed in accordance with EII 1.2, "Preparation and Revision of Environmental Investigation Instructions" (WHC 1989c), or in participant contractor or subcontractor procedures approved and controlled as specified in Section 4.0 of the QAPP.

A discussion of the facilities, number of borings to be sampled, and other pertinent data follows. Groundwater well borings are described in the 100-HR-3 Work Plan (in preparation). A detailed discussion of the borehole soil sampling subtask, including figures showing borehole locations and a table that describes a phased boring program at each facility, is contained in Chapter 4.0 of the Field Sampling Plan.

Facilities have been identified in several categories according to designated use. Facilities that were used for liquid waste disposal by means of percolating waste into the soil column for radionuclide absorption is the first category. This category primarily includes cribs, French drains, trenches, and some of the basins. The following facilities are included in this category:

- The 116-D-1A fuel storage basin trench No. 1
- The 116-D-1B fuel storage basin trench No. 2
- The 116-D-2 pluto crib
- The 116-D-6 cushion corridor French drain
- The 116-DR-1 liquid waste disposal trench No. 1
- The 116-DR-2 liquid waste disposal trench No 2
- The 116-D-3 crib No. 1
- The 116-D-4 crib No. 2
- The 116-D-9 reactor confinement seal pit drainage pit.

The soil sampling methodology in Phase 1 for all of the aforementioned facilities will include drilling shallow vertical borehole(s) within the facility boundaries to identify the complete range of contaminants, with followup Phase 2 and 3 deep borings as necessary.

Facilities that were used for sanitary sewage transfer, treatment, and disposal include the following facilities:

- The 1607-D2 septic tank
- The 1607-D4 septic tank
- The 1607-D5 septic tank
- Septic tank at N93050 and W52850
- Pipelines associated with above sanitary waste facilities
- Tile field associated with above septic tanks.

The septic tanks and pipelines will be sampled only if the Task 3c test pit sampling indicates the presence of contaminants and necessitates further sampling to determine the extent of contamination. They will be sampled by deep borings in Phase 1, with followup Phase 2 borings as necessary. Because sludges that are currently in the septic tanks may not represent all of the wastes that entered the field, the tile field will be evaluated by a three-phased boring program, with one shallow boring in Phase 1 at the beginning of the distribution system, followed by additional deep borings in Phases 2 and 3, as necessary.

Facilities that were used in transporting the liquid waste include the following:

- Process effluent pipelines
- Discharge pipelines to river (land portions only)
- The 116-D-5 and 116-DR-5 outfall structures.

Process effluent pipelines extend from the 100-D and 100-DR reactors to the 116-D-7 and 116-DR-9 process effluent retention basins, respectively. Soil sampling related to the process effluent pipelines will be limited to inside the 100-DR-1 operable unit boundary. Discharge pipelines extend from the process effluent retention basins to the flowline of the Columbia River. Sampling related to the discharge pipelines will be limited to the portion that is on land. Sampling of the river portions of the discharge pipelines is within the scope of the 100-HR-3 RFI/CMS investigation. Both of these pipelines are known to have significant leaks. Information from the analysis performed under Task 1 will be used to determine locations for soil sampling. This task will provide additional information regarding vertical extent of contamination. The sampling methodology proposed for the pipelines is to drill deep vertical boreholes at the positions defined when Task 1 is completed. Because the complete range of contamination of the outfall structures is unknown, one shallow vertical boring will be drilled in Phase 1 at the center of each structure, with followup Phase 2 and 3 deep borings as necessary.

Facilities that were used to retain process effluents until a certain degree of thermal and radioactive decay had occurred include the following:

- The 116-D-7 process effluent retention basin
- The 116-DR-9 process effluent retention basin.

The surficial sediments in the basins have been sampled for radionuclides using shallow boreholes (Dorian and Richards 1978). The investigation performed under this task will supply data regarding the vertical and horizontal extent of contamination. The basins have been filled with soil and most likely contain large quantities of rubble. The concrete walls, which divided the basin into individual compartments, were demolished in place as part of the decommissioning process. This may impact the method of drilling and sampling in the retention basins. A three-phased boring program will be carried out to investigate these facilities. Information from the Task 1 source investigation and Task 3a surface radiation survey will be used to determine the locations of additional boreholes in the soils adjacent to the process effluent retention basins.

The five sludge disposal trenches adjacent to the retention basins are reported by Dorian and Richards (1978) to contain levels of contamination similar to that in adjacent soils. For this reason, only one of the trenches will be initially evaluated by one shallow vertical boring to determine the nature of contamination. If the results of this sampling show the same levels of contamination as adjacent areas, no further sampling will be done specifically for the sludge disposal trenches. If the sampling results vary from adjacent areas, the remainder of the trenches will be sampled in Phase 2 by one deep borehole in the center of each trench, with followup borings as necessary.

Results of investigations performed in Task 1 or Task 3c will determine the need for borings in the vicinity of a number of facilities. If contamination is detected, additional sampling through Phase 1 deep borings will be required to determine the vertical extent of contamination. The facilities in this category include the following:

- Fuel oil tank west of the 184-DA building
- The 166-D fuel oil tank and pipeline
- Sodium dichromate tanks
- The 120-D-1 (100-D) ponds
- Support facilities, including
  - The 1713-D instrument and electrical development laboratory
  - The 1714-D solvent storage building
  - The 1715-D oil and paint storage
  - The 1716-D gas station
  - The 1722-D equipment development lab
  - The 1724-DA underwater test facility
  - The 1734-D cylinder storage
  - Paint shop (west of 182-D reservoir)
- The 103-D fuel element storage building
- Salt dissolving pit
- Electrical facilities
- The 126-D-2 solid waste landfill.

The 130-D-1 gasoline storage tank was removed in July 1989 as part of an ongoing program at the Hanford Site to remove underground storage tanks in accordance with CERCLA/RCRA guidelines. Sampling results from soil samples collected from within the excavated hole indicate that petroleum hydrocarbon contamination is present (Lerch 1989). The Phase 1 boring program at this location will consist of one deep vertical borehole at the location where visible oil contamination was noted under the tank, followed by Phase 2 borings as necessary.

Additional facilities at which Phase 1 shallow borings will be required to identify the types of contaminants include the following:

- Waste acid reservoir
- Sites of demolished contaminated ancillary facilities, including
  - -The 108-D equipment decontamination building
  - -The 132-D-3 effluent pumping station
  - -The 115-D gas recirculation building
  - -The 117-D exhaust air recirculation building
- Burial grounds 4A, 4B, and 18.

If contaminants are identified, drilling will continue to depth, with a follow-up boring program as necessary to determine the horizontal extent of contamination.

Facilities that have not been identified for soil sampling are those that have been determined to pose no potential apparent threat of contamination, either because of the specific use of the facility or because of an analysis previously performed.

5.3.3.4.3 Task 3d-3--Soil Sample Storage and Cuttings Disposal. Soil cuttings containing unknown wastes will be stored and disposed of in accordance with EII 4.2, "Interim Control of Unknown Waste" (WHC 1989c). Soil cuttings containing hazardous wastes will be stored and disposed of in accordance with EII 4.1, "Nonradioactive Hazardous Waste Disposal" (WHC, 1989c). Storage of archive samples will be in accordance with Procedure EII 5.7A, "Hanford Geotechnical Library Sample Control." Low-level and mixed radioactive waste soil cuttings will be stored and disposed of according to procedures to be developed.

5.3.3.4.4 Task 3d-4--Soil Sample Analysis. Phase 1 samples at facilities where the complete range of contaminants is unknown will be analyzed for the entire CERCLA target compound list (TCL) of organic compounds, the target analyte list (TAL) of inorganics, and the full suite of radionuclides likely to be present in the operable unit. Radionuclide analysis will be analytical Level V, and CERCLA TCL and TAL analysis will be conducted using Level IV equivalent procedures. Phase 2 and 3 samples at these facilities will be analyzed only for those contaminants detected in the Phase 1 boring program. During Phases 2 and 3, organics and inorganics will be analyzed by standard EPA Level III methods, unless the analysis must be conducted in a hot cell due to radioactivity. Hot cell analyses for organics or inorganics for these samples and radionuclide analyses will be Level V. In addition, 20 percent duplicate Phase 2 and 3 samples will be analyzed using Level IV equivalent procedures for quality assurance.

Phase 1 samples at facilities where contaminants have been identified by Task 1g or Task 3c sampling and analysis will be analyzed for the parameters identified in those tasks. Organics and inorganics will be analyzed by standard EPA Level III methods, unless the analysis must be conducted in a hot cell due to radioactivity. Hot cell analyses for organics or inorganics for these samples and radionuclide analyses will be Level V. Sample parameters and analytical levels in Phase 2 will be the same as those in Phase 1. In addition, 20 percent duplicate Phase 2 samples will be analyzed using Level IV equivalent procedures for quality assurance.

Soil physical parameters will be analyzed as part of the soil sample analysis task. Soil physical parameter analysis will include soil types (classification), grain-size distribution, consolidation, density, cation exchange capacity, permeability, porosity, pH, and moisture content. Depending on the needs for risk assessment, additional testing of archive samples may be needed for leachability, adsorptability, and soil phase mineralogy.

5.3.3.4.5 Task 3d-5--Borehole Abandonment. Upon completion of all activities associated with the Task 3d borings, each borehole will be properly abandoned in accordance with state regulation WAC 173-160. All steel casing will be removed and transferred to an appropriate controlled decontamination facility.

5.3.4 Task 4--Air Investigation

Because air is not anticipated to be a significant contaminant transport medium for the 100-DR-1 operable unit, the air investigation currently consists of a single subtask: Task 4a--Meteorological Data Compilation. Meteorological data compilation is defined as a subtask, even though no other subtasks are currently envisioned, to provide flexibility in the air investigation task structure. If the need for additional air investigation work becomes apparent during the course of the project, additional subtasks can be added as required. Air monitoring data obtained as part of site health and safety activities will also be evaluated.

The objective of the meteorological data compilation subtask is to provide a summary of climatic conditions at 100-DR-1.

5.3.4.1 Task 4a--Meterological Data Compilation. This subtask consists of the compilation of existing climatic data and the collection of real-time data from the Hanford Meteorological Station, which is located in the 200 Areas, and from the nearby 100-N wind tower and the Pasco airport. Both past data and meteorological monitoring data generated during project implementation will be used. To be more cost effective, the compilation of these data will be coordinated with the meteorological data compilation subtask being conducted for the 100-HR-1 operable unit.

Information describing extremes, frequency of extremes, annual averages, and seasonal (preferably monthly) averages of meteorological data will be obtained. Average values will be calculated using data over the past 30 years when such data are available. If a particular station has not been in operation for 30 years, all available data will be used. Long-term averages will allow for an accurate description of typical climatic conditions and variations. Frequencies and magnitudes of extreme weather events will be derived from all available information.

5.3.5 Task 5--Terrestrial Biologic Investigation

The objective of the 100-DR-1 terrestrial biologic investigation is to provide a description of the potentially impacted terrestrial ecosystem at 100-DR-1. Such a description will assist in the subsequent selection of important 100-DR-1 ecological variables that could be monitored for possible contaminant-release-related impacts, if the need for such monitoring becomes apparent, either during the later phases of the RFI/CMS or during corrective measures implementation. Because of the relative uniformity of the 100 Areas terrestrial habitat, this investigation will be coordinated with preceding (i.e., 100-HR-1) and subsequent terrestrial biologic investigations to maximize cost effectiveness.

The description of the terrestrial ecosystem developed under this task will be used, in conjunction with general and site-specific ecological knowledge, to help identify any valued terrestrial biological populations and to determine whether any such populations are, or have a substantial potential to be, significantly impacted by contaminant releases from the operable unit. Any significant, potential biological impacts noted may indicate a need to incorporate mitigative measures into the corrective measure alternatives developed for the operable unit. Alternatively, such noted impacts may indicate the need for implementation of interim measures to immediately eliminate an exposure pathway. The terrestrial ecosystem description may indicate an opportunity to provide for a feasible means of ecological monitoring, focusing on indicator species or ecological indicators, during corrective measures implementation to assess the effectiveness of the corrective action. In the unlikely event of the no action alternative being granted serious consideration for this operable unit, the terrestrial ecological description may show a need to expand the terrestrial biological investigation, particularly along the lines of a biocontamination study.

Two subtasks have been established to supplement and verify the initial description of the 100-DR-1 terrestrial biotic system as presented in Section 2.2.6:

- Task 5a--Terrestrial Biologic Data Compilation
- Task 5b--Onsite Terrestrial Biologic Survey.

The specific objectives of both tasks are the same; they differ only in the manner in which the information is obtained. The objectives are as follows.

- Determine species composition
- Determine feeding relationships within the terrestrial ecosystem
- Determine potential terrestrial indicator species and ecological indicators.

The determination of species composition will be limited to major species present in and near 100-DR-1. Major species are defined here as those that fall into at least one of the following categories:

- Species that are structurally or functionally important in the terrestrial ecosystem
- Species granted protective management status
- Species providing an environmental service to man.

Structurally or functionally important species are those that are dominant in the community in terms of productivity, relative abundance, or biomass. Key species, those whose removal from the ecosystem would result in a drastic change in the characteristics of that system, are also considered to be important.

Species that have been granted protected management status under federal or state law are important. The Washington State Departments of Wildlife and Natural Resources are responsible for administering endangered and threatened species laws for animals and plants, respectively. Working with these two agencies will ensure compliance with both state and federal laws because Washington State designations, with respect to endangered or threatened status of particular species, are at least as strict as the corresponding federal designations.

Species that provide a service to man are those that are of commercial interest, of recreational interest, or that perform miscellaneous environmental services (e.g., pest control).

Once the major species associated with 100-DR-1 have been identified, the feeding relationships among them will be defined. A knowledge of feeding relationships is important in understanding potential biocontamination transport pathways.

Once an understanding of feeding relationships is achieved, potential terrestrial indicator species and ecological indicators for the operable unit will be identified. Indicator species are those species or groups of species that could be used to evaluate prevailing environmental conditions at 100-DR-1. Indicator species tend to be those that are highly susceptible to contaminant release impacts. It could be more cost-effective to monitor such species rather than monitoring the actual release within transport media, especially during any long-term environmental monitoring that is performed during and following implementation of the operable unit corrective measure.

If the species that are determined to be highly susceptible to contaminant release impacts are difficult to monitor directly (e.g., humans, protected management status species, highly mobile species), it may be possible to find an appropriate indicator species that is a significant component of the food chain of the susceptible species. Indicator species are those selected to monitor movements, accumulations and modification of contaminants in the ecosystem. They can also be selected to monitor the biological effects of contamination.

Ecological indicators could also be used to evaluate the environmental conditions prevailing at 100-DR-1. Ecological indicators are those parameters that are not species-specific, but that measure an integrated biological community process or characteristic.

5.3.5.1 Task 5a--Terrestrial Biologic Data Compilation. This subtask involves the compilation of any Hanford Site terrestrial biologic data that are specific to 100-DR-1 (or the 100-D/DR Area or the 100 Areas, if appropriate), as well as the compilation of general terrestrial ecological information relevant to attaining the task objectives. Task 5a will be conducted by terrestrial biologists having experience at the Hanford Site.

This subtask will focus on the use of existing ecological literature and data collected for 100-HR-1 to identify major species present, feeding relationships among these species, and any potential terrestrial indicator species or ecological indicators that might be of use in future biological monitoring at 100-DR-1.

Both the Department of Wildlife and the Department of Natural Resources maintain computer data bases that contain information on the known occurrences of endangered and threatened species throughout the state. These data bases will be accessed to search for such occurrences at and near the Hanford Site.

The resulting printouts will then be reviewed to determine the known occurrence of any protected management status species at or near the 100-DR-1 operable unit, thereby helping to verify the information presented in Sections 2.2.6.1, 2.2.6.2, and 2.2.6.3.

5.3.5.2 Task 5b--Onsite Terrestrial Biologic Survey. This subtask will supplement the literature review under Task 5a through an onsite, qualitative survey of the operable unit and its surroundings. This subtask can be regarded as an operable unit-specific verification of the body of knowledge on the 100-DR-1 terrestrial ecosystem. The biologist in charge of this task will make the decision as to if and when a field survey is required to support Task 5a.

The survey will be conducted over the entire operable unit surface, including the riparian zone and will be performed by the same biologists conducting Task 5a. Major species present will be confirmed, to the extent practicable, under this subtask.

5.3.6 Task 6--Data Evaluation

Data generated during the RFI Phase I will be evaluated, coordinated with CMS activities, and presented in an ongoing manner to allow decisions to be made regarding any necessary rescoping during the course of the project. The results of these evaluations will be incorporated into the quarterly progress reports to make them available to project management personnel and to keep project staff informed of progress being made.

Data evaluation will be undertaken in subtasks that correspond to the various subcomponent investigations:

- Task 6a--Source Data Evaluation
- Task 6b--Geologic Data Evaluation
- Task 6c--Soil Data Evaluation
- Task 6d--Air Data Evaluation
- Task 6e--Terrestrial Biologic Data Evaluation.

The interpretations developed under this task will be used in Task 8--Risk Assessment, to evaluate the overall risk to human health and the environment posed by 100-DR-1. Appendix A contains information on available computer models that may be used to interpret and evaluate data.

5.3.6.1 Task 6a--Source Data Evaluation. Information compiled under Task 1a on gathering additional existing information on the 100-DR-1 facilities will be evaluated under this subtask. Electromagnetic induction/magnetometer survey results (Task 1c) will be plotted to determine tank, waste acid reservoir, 126-D-2 landfill, burial grounds, and pipeline locations and possible leaks. The ground-penetrating radar survey results (Task 1d) will be plotted to determine the locations of the 116-DR-5 outfall structure, the septic tanks and tile fields, and the boundaries and depth of the 126-D-2 solid waste landfill. The soil gas survey results (Task 1e) will be compiled to identify areas possibly contaminated by petroleum products.

The source data evaluation will include the periodic updating of the topographic base map developed under Task 1b to incorporate sampling locations established under other investigation tasks. The updated maps produced under this subtask will be made available for plotting data generated during the project.

5.3.6.2 Task 6b--Geologic Data Evaluation. The surface geologic map prepared under Task 2b and the new operable unit-specific geologic data collected during Task 3d and the 100-HR-3 groundwater investigation will be evaluated under this subtask. Data from well and borehole logs and physical analytical results will be graphically formatted and used to refine existing geologic and hydrostratigraphic cross sections and to develop fence diagrams and any other graphic or tabular aids for interpreting data. The geologic concept of the 100-D/DR Area, as presented in Section 2.2.2, will be refined, as necessary, based on the results of the geologic evaluation.

5.3.6.3 Task 6c--Soil Data Evaluation. Surface radiation survey results (Task 3a) will be evaluated to determine locations for additional sampling in Task 3d. Physical soil characteristics obtained from Task 3d will be evaluated to provide physical and numerical descriptions of each of the geological units present in the operable unit. These data will be used to estimate the effect of the properties on infiltration and retardation of contaminants, to estimate flux and velocity in the vadose zone, to evaluate contaminant movement through soils and the vadose zone, and to provide information on engineering aspects of site corrective action. This information will be used in appropriate vadose zone flow and transport models. Contaminant data will be statistically compared to background values to determine what soil contaminants are present at elevated levels. Values above the 0.95/0.95 upper tolerance limit of the background distribution, or as determined by other statistical methods, as appropriate, will be regarded as elevated. Contaminant data will also be plotted to reveal areal and depth concentration distributions.

5.3.6.4 Task 6d--Air Data Evaluation. Data compiled from existing meteorological stations will be formatted and analyzed to present numerical descriptions of long-term average climatic conditions, including annual and seasonal variations, and frequencies and magnitudes of extreme weather events. The understanding of the meteorological setting of 100-DR-1, as presented in Section 2.2.5, will then be revised as needed.

5.3.6.5 Task 6e--Terrestrial Biologic Data Evaluation. Major terrestrial species present in and near 100-DR-1, as determined through Tasks 5a and 5b, will be tabulated. Feeding relationships among these species will be presented graphically in the form of a generalized food web. Potential indicator species and ecological indicators will also be presented tabularly. The understanding of the biological setting of the operable unit, as presented in Section 2.2.6, will be updated, as appropriate.

5.3.7 Task 7--Verification of Contaminant- and Location-Specific ARARs

The formulation of operable unit-specific ARARs is an ongoing process throughout the RFI/CMS. As 100-DR-1 becomes better characterized during the course of the RFI Phase I, the pertinence of the potential contaminant- and location-specific ARARs identified in Section 3.2, and possibly other potential ARARs, becomes more apparent. Once the nature and levels of contamination attributable to 100-DR-1 are sufficiently well defined to the degree that the project staff believes the potential ARARs to be properly identified, Ecology and EPA will be asked to verify the potential contaminant- and location-specific ARARs. Project staff will work with the regulatory agencies and, taking operable unit-specific conditions into account, will decide which promulgated environmental standards, requirements, criteria, and limitations are actually applicable or relevant and appropriate to 100-DR-1.

5.3.8 Task 8--Baseline Risk Assessment

The baseline risk assessment will provide an evaluation of the potential threats to human health and the environment in the absence of an action-oriented corrective measure. In addition to providing the basis for determining whether or not an action-oriented corrective measure is necessary, this assessment provides the justification, along with the ARAR verification process under Task 7, for determining cleanup levels. The risk assessment will be developed in accordance with EPA (1986a), and will be divided into four subtasks:

- Task 8a--Contaminant Identification
- Task 8b--Exposure Assessment
- Task 8c--Toxicity Assessment
- Task 8d--Risk Characterization.

5.3.8.1 Task 8a--Contaminant Identification. The objective of this subtask is to screen the nature and extent of contamination data to identify target contaminants for the risk assessment. Target contaminants are selected on the basis of intrinsic toxicological properties, including radiological properties, waste volumes, and environmental occurrence.

Indicator contaminants will also be selected as a part of this process. Indicator contaminants are selected, for each of the various contaminant types present, by focusing on those contaminants that are most toxic, most abundant, most mobile, most persistent, have the greatest propensity for bioaccumulation, and are best documented in terms of toxicological and environmental properties.

5.3.8.2 Task 8b--Exposure Assessment. The objective of the exposure assessment is to determine the type and magnitude of potential contaminant exposures to human and environmental receptor populations. This assessment will be performed in accordance with EPA (1988b) and will proceed in five steps. Computer codes to perform these analysis are included in Appendix A.

The first step of the exposure assessment process is contaminant release analysis. Each significant operable unit release point will be identified for every target or indicator contaminant, and the mass loading to each environmental medium of concern will be determined or estimated.

The second step is the analysis of contaminant transport and fate--a description of the extent and magnitude of environmental contamination, including the estimation of future conditions. A variety of computer models and codes may be used in conducting the exposure assessment. These are described in more detail in Appendix A.

Step three is an exposed population analysis. Human and environmental populations having the potential to be exposed to operable unit contaminants are evaluated through identification, enumeration, and characterization. In addition to delineating which populations could come into contact with operable unit contaminants, this analysis estimates how and with what frequency and duration such contacts occur.

Next is an integrated exposure analysis. In this step, the individual contaminant-specific exposure estimates for each exposure route (e.g., ingestion, inhalation, direct contact) are developed. All exposures to each of the target or indicator contaminants are identified for each population.

The final exposure assessment step is an uncertainty analysis. The exposure assessment process involves several necessary estimates. These estimates are reviewed to identify uncertainties and to evaluate their separate and cumulative impacts on the results of the assessment.

5.3.8.3 Task 8c--Toxicity Assessment. To assess the risks associated with the release of contaminants, a comparison is performed between the acceptable levels of contamination and the actual levels identified in the exposure assessment. Contaminant-specific ARARs, when available, will be used to determine acceptable levels. When ARARs are not available, acceptable levels will be based on either regulatory advisories or guidance values (to-be-considered values) or on environmental concentrations that will yield exposures no greater than either of the following:

- The reference dose RFD for noncarcinogens
- The risk specific dose RSD, in the range of 10^{-7} to 10^{-4} excess lifetime cancer risk, for carcinogens.

Priority will be given to the acceptable environmental concentrations thus determined in establishing contaminant-specific cleanup goals for the final operable unit corrective measure.

5.3.8.4 Task 8d--Risk Characterization. The final subtask of the baseline risk assessment involves the characterization of risks whenever the potential for adverse human health or environmental impacts are predicted for a receptor population. A summary of the risks posed by 100-DR-1 will be generated. Such factors as the weight-of-evidence associated with toxicity information, estimated uncertainties associated with the previous subtasks, and assumptions contained within the estimates used will be incorporated into the summary.

5.3.9 Task 9--RFI Phase I Report: Preliminary Operable Unit Characterization Summary

An interim report will be prepared at the end of the RFI Phase I. This report will consist of a preliminary summary of the results of the 100-DR-1 characterization activities. Information pertinent to the 100-DR-1 conceptual model will be refined as necessary, sources of contaminant releases will be definitively identified, the nature and extent of contamination within the operable unit soils, air, and terrestrial biota will be described, a definitive list of contaminant- and location-specific ARARs will be provided, and the risks associated with the contaminant releases will be presented.

This report will be prepared primarily for interim internal review, although EPA and Ecology have the option to comment on it. It will also provide a means for communicating 100-DR-1 findings to the project CMS coordinator for use in the ongoing evaluation of potential operable unit corrective measures.

5.4 CMS PHASE I--CORRECTIVE MEASURE ALTERNATIVES DEVELOPMENT

The CMS Phase I will develop potential corrective measures, encompassing a range of appropriate waste management options, that protect human health and the environment. A range of options is developed to provide project decision-makers with a choice of several approaches to solving the 100-DR-1 operable unit problems.

Section 3.4 presented a preliminary identification of corrective action objectives, general response actions, corrective measure technologies, and a range of corrective measure alternatives for the 100-DR-1 operable unit. The alternatives identified in Section 3.4 are broad in scope. The first phase of the CMS process will further develop these alternatives in a series of iterative and interactive steps. These steps are listed in draft RI/FS guidance (EPA 1988a) and are summarized in the following sections.

5.4.1 Task 1--Development of Corrective Action Objectives

Corrective action objectives will be developed that state environmental medium-specific or waste management unit-specific goals for protecting human health and the environment. Contaminants of concern, exposure routes, receptors, and acceptable contaminant levels or ranges of levels for each exposure route will be specified for each medium. Acceptable contaminant levels will be based on identified potential ARARs or to-be-considered values or risk assessment calculations.

5.4.2 Task 2--Development of General Response Actions

General response actions, broad classifications of actions or combinations of actions, that will satisfy the corrective action objectives will be developed for each medium. Examples of general response action categories are no action, institutional controls, disposal, extraction, excavation, containment, and treatment.

During this stage of the corrective measure alternatives development process, an initial determination of areas or volumes of environmental media to which general response actions might be applied will be made. Media areas or volumes of interest will be determined relative to the acceptable contaminant levels identified in each corrective action objective developed under Task 1.

5.4.3 Task 3--Identification of Corrective Measure Technologies

Once medium-specific general response action categories have been identified and initial determinations as to the areas or volumes of contaminated media have been made, corrective measure technology types applicable to each category will be identified. Identified potential corrective measure technology types will then be screened on the basis of technical implementability. The screening will likely result in the elimination of entire technology types from further consideration when operable unit-specific considerations, such as setting and contaminant types and concentrations present, are taken into account. The rationale for screening each corrective measure technology will be documented.

Once the potential corrective measure technologies have been screened on the basis of technical implementability, technology process options applicable to each will be identified. A technology process option is a specific process within a particular corrective measure technology type; it is the most basic technological unit used in the evaluation of potential corrective measures during the CMS. The following example, using a hypothetical groundwater medium, illustrates how the degree of technological specificity narrows in going from general response action to corrective measure technology to process option categories:

- General response action for groundwater--containment

- Potential corrective measure technologies within the groundwater containment category:
  -Capping
  -Vertical barriers
  -Horizontal barriers

- Potential process options within the groundwater capping technology type:
  -Clay cap
  -Synthetic membrane
  -Multilayer cap.

Corrective measure technology types and appropriate potential process options within each type will be identified by using various source documents, including CERCLA-related and standard engineering guidance. A good initial list of such documents is contained in EPA (1988a, Appendix C).

5.4.4 Task 4--Evaluation of Process Options

This task of the alternatives development process will evaluate those process options identified under each corrective measure technology type deemed, under Task 3, to be technically implementable. The goal of this evaluation is to select one process option, if possible, to represent each corrective measure technology type throughout the remainder of the CMS evaluations. This simplifies the subsequent development and evaluation of alternatives without limiting flexibility during corrective measures selection, design, or implementation.

During this task, the list of media- and technology-specific process options developed during Task 3 will be evaluated in three steps, with respect to effectiveness, implementability, and cost, respectively. The evaluation will be confined to a comparison of process options within the same corrective measure technology type. In other words, capping options would not be compared to vertical barrier options, for example, at this stage of the CMS. Therefore, further elimination of corrective measure technology types does not occur under this task.

The primary focus of the Task 4 evaluation will be on effectiveness and implementability. A representative process option will be selected for those groups of process options determined to be similar in terms of the evaluation criteria. If two or more processes are sufficiently different in their performance or effect that one would not adequately represent the other, they will all be retained for further consideration.

Some innovative technologies may be applicable at the 100-DR-1 operable unit. However, it is likely that detailed data on their effectiveness and cost will not be available. Therefore, the evaluation of these technologies will be somewhat more liberal than normal. Innovative technologies will be retained based primarily on their implementability. Effectiveness and cost will not be the basis for elimination of innovative technologies from consideration unless there is clear evidence that one of these factors is limiting.

5.4.4.1 Task 4a--Effectiveness Evaluation. The effectiveness evaluation will focus on the following:

- The potential effectiveness of the process options in handling the estimated areas or volumes of the contaminated medium and attaining the corrective action objectives for that medium
- The effectiveness of the process options in protecting human health and the environment during corrective measure construction and implementation

- How proven and reliable the process option is with respect to the contaminants and conditions at 100-DR-1.

Information needed to perform this evaluation includes contaminant types and concentrations, areas or volumes of contaminated media, and, if appropriate, rates of collection of fluid media. Sensitivity analyses will be carried out to evaluate the effectiveness of performance. It may be necessary to conduct preliminary analyses and limited conceptual designs or await the collection of additional 100-DR-1 characterization data before being able to adequately evaluate effectiveness. However, such analyses and designs, if needed, are generally conducted later in the CMS and are not anticipated to be required at this stage of the 100-DR-1 CMS.

5.4.4.2 Task 4b--Implementability Evaluation. Both technical and institutional implementability are considered as part of this evaluation. Technical implementability will be used to screen process options, in the same manner as was described for corrective measure technology type screening under Task 3, to eliminate from further consideration those options that are clearly ineffective or unworkable at the operable unit.

Institutional factors include such issues as the ability to obtain necessary permits for any offsite actions, the ability to meet the substantive requirements of relevant permits for onsite actions, the availability and capacity of treatment, storage, and disposal services, as appropriate, and the availability of any essential equipment and skilled labor.

5.4.4.3 Task 4c--Cost Evaluation. This will be the least important of the criteria used to evaluate process options at this point in the CMS. Relative capital and operations and maintenance costs, as opposed to detailed estimates, will be developed to the extent possible, and will be largely based on engineering judgement. Processes will be evaluated as to whether costs are high, low, or medium relative to other process options within the same corrective measure technology type.

5.4.5 Task 5--Assembly of Corrective Measure Alternatives

Preliminary corrective measure alternatives will be developed by assembling medium-specific process options (or corrective measure technologies or general response actions, as appropriate), for each contaminated environmental medium determined to be of concern, in such a manner that the alternatives will address the entire operable unit or particular waste management units.

Alternatives will be assembled so as to present a range of waste management options for further evaluation. This ensures that project decision-makers have a range of corrective measure alternatives from which to select the final corrective measure. To provide such a range, the following types of alternatives, at a minimum, will be developed, if practicable:

- An alternative emphasizing no further action
- An alternative emphasizing institutional controls

- An alternative emphasizing waste removal and onsite disposal
- An alternative emphasizing waste removal and offsite disposal
- An alternative emphasizing waste containment
- An alternative emphasizing waste treatment resulting in the permanent and significant reduction in the volume, mobility, or toxicity of waste.

Because of a statutory preference (CERCLA 121(b)(1)) for permanent and significant waste treatment, the various treatment alternatives, emphasizing different treatment technologies and degrees of treatment, will be developed, as appropriate. Various containment alternatives will also be developed. Waste removal and offsite disposal alternatives that do not employ treatment, where practicable treatment technologies are available, are statutorily considered the least preferred alternatives.

5.4.6 Task 6--Identification of Action-Specific ARARs

Potential action-specific ARARs are preliminarily identified, as appropriate, throughout the CMS Phase I. These include legally applicable, or relevant and appropriate, promulgated federal and state environmental standards, requirements, criteria, and limitations pertinent to actions, technologies, and processes being considered during corrective measure alternatives development. Action-specific ARARs are considered, as necessary, during the implementability screening steps under Tasks 3 and 4.

Once corrective measure alternatives have been assembled under Task 5, potential action-specific ARARs pertaining to 100-DR-1 conditions and the general response actions, corrective measure technologies, and process options incorporated into each alternative, will be identified and documented. These requirements will provide feasibility-level design goals for the next phase of the CMS.

As identification of action-specific ARARs is an ongoing process in itself, a verification task involving active participation on the part of the environmental regulatory agencies is included under the CMS Phase II.

5.4.7 Task 7--Reevaluation of Data Needs

In the process of performing the CMS Phase I, additional data needs may be determined. The CMS coordinator will communicate these needs to the RFI coordinator so that the RFI Phase I can be modified, if necessary. Additional data needs requiring any treatability testing will be obtained during the RFI Phase II, as described in Section 5.6. The interim CMS Phase I report will serve as a means of documenting the data needs identified during this phase of the CMS.

5.4.8 Task 8--Interim CMS Phase I Report: Preliminary Corrective Measure Alternatives Development Summary

An interim CMS Phase I report will be prepared upon completion of the tasks described above. The following types of information will be included:

- Summary of background information supplemented with available project scoping information and any initial RFI data, including the nature and extent of contamination, and contaminant fate and transport
- Determination, with rationale, of which of the 100-DR-1 environmental media are of concern
- Identification of the preliminary corrective action objectives for each environmental medium of concern
- Identification of the general response actions for each environmental medium of concern
- Identification of potential corrective measure technology types for each medium-specific general response action category
- Documentation of the corrective measure technology types technical implementability screening process
- Identification of potential technological process options for each corrective measure technology type retained
- Documentation of the process options evaluation process and the selection of representative process options for each corrective measure technology type
- Documentation of the assembly of process options, corrective measure technologies, and general response action into a range of corrective measure alternatives
- Identification of action-specific ARARs potentially pertinent to each alternative
- Identification of any new data needs for the RFI Phase I or Phase II.

This report is viewed as an interim, informal deliverable, developed for the purpose of internal review. The CMS Phase II activities will be in progress during this review cycle. Following the review cycle, this interim report will not be finalized as a separate document--any significant comments will be incorporated into a formal CMS Phase I/II report to be generated under the CMS Phase II.

5.5 CMS PHASE II--CORRECTIVE MEASURE ALTERNATIVES SCREENING

The screening of corrective measure alternatives follows corrective measure alternatives development and precedes corrective measure alternatives analysis. The objective of alternatives screening is to reduce the list of potential corrective measures that will be further evaluated in detail, based on the criteria of effectiveness, implementability, and cost. This screening ensures that the most promising potential corrective measures are being considered and narrows the scope of the CMS Phase III to manageable proportions. To the extent practicable, a range of appropriate waste management options, as discussed in Section 5.4.5, will be preserved so as to allow project decision-makers significant choices during their selection of an operable unit corrective measure.

Three major steps are performed during the screening of corrective measure alternatives. First, the corrective action objectives developed during Phase I are refined based on additional RFI Phase I information, potential multiple pathway exposures, and significant interactions among environmental media. Second, alternatives developed in Phase I are further refined, based on the quantities or areas of environmental media affected, the sizes and capacities of corrective measure technologies or process options, and other pertinent data available from the RFI Phase I. Third, the refined alternatives are evaluated on a general basis to determine their effectiveness, implementability, and cost. Those alternatives best able to meet the corrective action objectives are then retained for detailed analysis in Phase III of the CMS.

The following is a brief summary of the CMS Phase II process. Further details can be found in the draft EPA RI/FS guidance (1988a).

5.5.1 Task 1--Refinement of Corrective Action Objectives

Alternatives are developed in Phase I of the CMS to meet corrective action objectives for each environmental medium of interest. However, exposures may occur through more than one pathway and involve several environmental media. The assembled corrective measure alternatives are thus evaluated to ensure that they protect human health and the environment from all potential pathways of concern at the operable unit.

If it is found that an alternative is not fully protective, it may be necessary to refine the corrective action objectives by reducing the specified acceptable contaminant levels for one or more media, thereby reducing the exposures to an acceptable overall level. On the other hand, it may be determined that a specific alternative is unable to meet an acceptable contaminant level and would, therefore, not be retained. Also, it may be determined that certain media do not pose a significant risk, and certain alternatives could then possibly be eliminated from further evaluation.

Media interactions will be evaluated to determine if ongoing releases significantly affect contaminant levels in other media (e.g., soil to groundwater). Information available from the RFI Phase I will be used to consider media interactions in refining corrective action objectives so that alternatives are fully protective of human health and the environment.

5.5.2 Task 2--Definition of Corrective Measure Alternatives

Before the screening begins, alternatives must be further defined to identify details of process options, process sizing requirements, corrective measure time frames, and refined corrective action objectives.

The information available from the RFI Phase I will be used to refine the areas or volumes of contaminated media so that the sizes of the corrective measure technologies and process options associated with each alternative can be determined. This will allow for quantitative differentiation among alternatives with respect to effectiveness, implementability, and cost under Task 3. If media interactions are determined to be significant under Task 1, the effects of source control actions on corrective measure time frames will be evaluated.

Specific types of information will be developed under this task for the corrective measure technologies and process options used in each alternative, as appropriate:

- Size and configuration of onsite extraction and treatment systems
- Identification of contaminants that impose the greatest treatment requirements
- Size and configuration of containment structures
- Time frame in which treatment, containment, or removal goals can be achieved
- Treatment rates or flow rates associated with treatment processes
- Special requirements for construction of treatment or containment structures, for staging construction materials, or for excavation
- Distances for disposal technologies
- Required permits and imposed limitations.

All information and assumptions used in generating this information will be thoroughly documented.

5.5.3 Task 3--Screening Evaluation

In the screening evaluation, information assembled in the further definition of alternatives is used to evaluate the alternatives with regard to the short- and long-term aspects of effectiveness, implementability, and cost. During this screening, comparisons will be made between similar alternatives, with the most promising carried forward for further analysis during the CMS Phase III, at which time distinctions across the entire range of alternatives will be made.

Alternatives with the most favorable composite evaluation of all factors will be retained. Alternatives selected, to the extent practicable, will preserve the range of appropriate waste management options, as discussed in Section 5.4.5. No more than approximately ten alternatives, which address the entire operable unit, are expected to be retained. Additional alternatives may be needed if waste management unit-specific alternatives are developed in preference to operable unit-specific alternatives. Unselected alternatives may be reconsidered at a later step in the detailed analysis if later information shows an additional advantage not previously apparent. However, it is expected that alternatives eliminated during this phase will not be reconsidered for selection.

5.5.3.1 Task 3a--Effectiveness Evaluation. Each alternative will be evaluated with respect to the level of protection to human health and the environment that it will provide through reductions of waste in terms of toxicity, mobility, or volume. The short-term component, occurring during the construction and operation period, and the long-term component, occurring after completion of the corrective measure alternative, will both be evaluated. Sensitivity analyses will be carried out to evaluate the effectiveness of performance.

Residual contaminant levels that can be expected to remain after a reduction of waste toxicity, mobility, or volume will be compared to contaminant-specific ARARs, to pertinent to-be-considered values, or to levels established through risk assessment calculations.

5.5.3.2 Task 3b--Implementability Evaluation. Implementability is the measure of both the technical and institutional feasibility of constructing, operating, and maintaining a corrective measure alternative with respect to the operable unit. Technical feasibility refers to the ability to construct, operate, meet action-specific ARARs, and maintain and monitor the corrective measure technologies or process options under consideration. Institutional feasibility refers to the ability to obtain approvals from appropriate agencies and the ability to procure required services, equipment, and personnel.

Alternatives deemed to be technically unfeasible will be dropped from further consideration. Institutionally unfeasible alternatives will also be dropped from further consideration, unless it is the lack of agency approval that is the negative factor involved. In the latter situation, the corrective measure alternative will be retained, if possible, with the incorporation of appropriate coordination steps needed to lessen its negative aspects.

5.5.3.3 Task 3c--Cost Evaluation. Comparative cost estimates, using relative accuracy within an alternative category, will be made. Cost estimates will be based on cost curves, generic unit costs, vendor information, conventional cost-estimating guides, and prior similar estimates, as appropriate. Both capital and operating and maintenance costs will be considered where appropriate. Present worth analyses will be used to evaluate expenditures that occur over different time periods, so that costs for different corrective measure alternatives can be compared on the basis of a single figure for each.

5.5.3.4 Task 3d--Evaluation of Innovative Alternatives. Innovative technologies are those that are fully developed but lack sufficient cost or performance data for routine use at hazardous substance release sites. Therefore, it is unlikely that alternatives that incorporate innovative technologies will be evaluated to the degree of detail, with respect to effectiveness, implementability, and cost, to which available technologies are subjected. However, innovative technologies will be carried through the screening phase if there is reason to believe that they offer significant advantages. The need for treatability studies on any retained innovative technologies will be determined at this time, in conjunction with Task 5.

5.5.4 Task 4--Verification of Action-Specific ARARs

At the conclusion of screening, sufficient information will exist on the technologies and configurations of greatest interest to perform a more definitive identification of action-specific ARARs. The ARARs previously identified will be refined by project staff with input from Ecology and EPA. Regulatory agency participation will be important in providing project focus and direction and in expediting the regulatory review of the CMS Phase I/II report to be generated under Task 6.

5.5.5 Task 5--Reevaluation of Data Needs

Once the field of alternatives has been narrowed, the need for any treatability testing will be apparent. Such testing will occur during the RFI Phase II. Additional site characterization data needs may also be identified during the alternatives screening phase. However, it is expected that the nature and extent of contamination will be well defined by the end of the RFI Phase I. Therefore, any additional field investigations deemed to be needed during the RFI Phase II will focus on better defining the effect of operable unit conditions on the performance of the corrective measure technologies and process options of greatest interest. Sensitivity analyses will be carried out to evaluate the effectiveness of performance. Data quality objectives will be refined or developed, as necessary, for any additional investigations.

5.5.6 Task 6--CMS Phase I/II Report: Corrective Measure Alternatives Development and Screening Summary

The results of the initial screening of alternatives will be combined with the interim CMS Phase I report, and any significant comments on that report, to develop a document summarizing both the development and screening of alternatives for the 100-DR-1 operable unit. In addition to the types of information mentioned in Section 5.4.8, the report will document the procedures for evaluating, defining, and screening the alternatives. Therefore, the following types of information pertinent to the screening phase will also be included:

- Refined corrective action objectives associated with each alternative, including any modifications made to ensure that multiple-pathway exposures and media interactions are addressed

- Definition of each alternative including extent of correction, area or volume of contaminated media, sizes of major technologies, process parameters, cleanup time frames, transportation distances, and special considerations

- Notation of those process options that have not been screened out but are being represented by the processes comprising the alternative
- Screening evaluation summaries of each alternative
- A comparison of screening evaluations among alternatives.

A reevaluation of data needs for the RFI Phase II will be included in this report. Details of the CMS Phase I/II report will, in turn, be summarized in the final CMS report, which is to be prepared during the third phase of the CMS.

5.6 RFI PHASE II--TREATABILITY INVESTIGATION

As operable unit information is collected during the RFI Phase I, and alternatives are being developed and screened during the first and second phases of the CMS, additional data needs necessary to adequately evaluate alternatives during corrective measure alternatives analysis may be identified. Activities may include the collection of additional necessary 100-DR-1 characterization data or the performance of treatability studies to better evaluate the performance of certain corrective measure technologies.

Some of the technologies selected for detailed analysis at the 100-DR-1 operable unit may be well developed, proven, and documented such that unit-specific information collected during the RFI Phase I is adequate for evaluation without conducting treatability testing. However, some technologies may not be sufficiently demonstrated to predict treatment performance or to estimate the size and cost of treatment units. Some treatment processes, particularly innovative technologies, are not sufficiently understood for performance to be predicted, even with a complete characterization of the wastes.

When treatment performance is difficult to predict, actual testing of the process, on either a bench scale or pilot scale, may provide the most cost-effective means of obtaining the necessary performance data. At the Hanford Site, some treatability investigations may be performed on a site-wide basis, rather than on a unit-specific basis. Any such site-wide treatability investigation results relevant to 100-DR-1 that are completed in time to be applied to the operable unit will be incorporated into the project through the normal CMS technology implementability evaluation processes.

The primary purpose of the treatability investigation is to provide sufficient technology performance information and to reduce cost and performance uncertainties to acceptable levels, such that treatment alternatives can be fully developed and evaluated during the CMS Phase III. Secondarily, the treatability investigation may generate information useful in conducting the detailed design of a treatment corrective measure, if the particular technology investigated is a component of the alternative selected to be the corrective measure for 100-DR-1. The allocation of time for a potential treatability investigation also provides a mechanism through which to conduct further operable unit characterization activities in the event that the need for such activities is identified at or toward the end of the RFI Phase I or CMS Phase II.

The need for any treatment investigation or additional characterization of 100-DR-1 will be apparent once the CMS Phase II is completed. If and when the need arises to implement a treatability investigation, this portion of the Work Plan will be expanded by amendment to provide such details of the RFI Phase II activities. If the need for further 100-DR-1 characterization is identified after, or toward the end of, the RFI Phase I, the RFI Phase II will also focus on obtaining any additional operable unit characterization information needed to support the CMS Phase III. The accompanying volumes of the RFI/CMS project plans, and pertinent portions of this work plan, will also be amended, as appropriate, to provide guidance for the required work prior to implementation. The RFI Phase I, CMS Phase I (interim), and CMS Phases I/II reports will provide formal, interim evaluations of further data needs, in terms of both treatability investigation and operable unit characterization, for the RFI Phase II.

5.6.1 Task 1--Treatability Investigation Work Plan Development

Treatability testing to support the CMS Phase III can be performed by using either bench-scale or pilot-scale studies. An appropriate work plan for such studies will be developed. If necessary, a literature survey supplementing those conducted during the initial phases of the CMS will be undertaken to identify specific data needs for the treatability investigation.

The survey will have the following objectives:

- Determine whether the performances of treatment technologies under consideration have been sufficiently documented on similar wastes, taking into consideration the scale of such documentation (e.g., bench, pilot, or full scale).

- Determine the number of times the treatment technologies have been successfully used.

- Gather information on relative costs, applicability, removal efficiencies, operations and maintenance requirements, and implementability of the candidate treatment technologies.

- Determine specific testing requirements and appropriate scale for any required treatability tests.

Any treatability studies will include the following steps:

- Preparation, review, and approval of a treatability investigation work plan for the bench-scale or pilot-scale studies.

- Performance of the bench-scale or pilot-scale testing.

- Evaluation of data from bench-scale or pilot-scale testing.

- Incorporation of the results of the testing into the final RFI report.

Bench-scale (laboratory) testing may be used to provide information to determine the feasibility of waste treatment or destruction technologies, although care must be taken in extrapolating laboratory data to full-scale performance. Bench-scale tests can be used to evaluate a wide variety of operating conditions and to determine broad operating conditions to allow optimization during additional bench- or pilot-scale tests. Bench-scale testing is usually a fast and low-cost process, relative to pilot-scale testing.

Potential objectives of bench-scale testing are to determine the following:

- The effectiveness of the treatment technology on the 100-DR-1 wastes
- The differences in performance between competing manufacturers
- The differences in performance between alternative chemicals used in the treatment process
- The sizing requirements for any pilot-scale studies
- The potential technologies to be pilot tested
- Sizing of those treatment units that would affect the cost of the technology sufficiently to affect the corrective measure alternatives analysis process (CMS Phase III)
- Compatibility of process materials with the operable unit wastes.

Before bench-scale treatability tests are initiated, the following information will be collected or developed:

- Test procedures
- A waste sampling plan
- Waste characterization information (will be available from RFI Phase I data)
- Treatment goals (will be available, or can be derived, from corrective action objectives defined and refined during the initial phases of the CMS)
- Data requirements for estimating the technology cost within -30 to +50 percent accuracy
- Required test services, equipment, chemicals, and analytical services.

For a technology that is well developed and tested, bench-scale studies are usually sufficient to evaluate performance on new wastes. For innovative technologies, however, pilot-scale tests may be required because information necessary to conduct full-scale tests is either limited or nonexistent.

A pilot-scale test, as compared to a bench-scale test, is intended to more accurately simulate the operations of a full-scale process. However, pilot-scale tests require significant time and can be quite costly. Therefore, the need for pilot-scale testing must be determined by comparing the potential for improved performance or savings in time or money during corrective measures implementation against the additional time and expense needed for the test. Pilot-scale testing is often appropriate for innovative technologies, and such testing will be considered if it offers the potential for more permanent waste treatment or destruction, or the potential for significant savings in time or money required for a corrective measure to achieve corrective action objectives.

Prior to the initiation of any pilot-scale testing, the following information, in addition to the items mentioned above with regard to bench-scale testing, will be collected or developed:

- Unit-specific information impacting test requirements (waste characteristics, facility characteristics, and availability of services and equipment)
- Waste requirements for testing (volumes, need for any pretreatment, handling, transport, and disposal)
- Specific data requirements for technologies to be tested.

Recommended formats for bench-scale and pilot-scale treatability investigation work plans, along with further details on the process, can be found in EPA's draft RI/FS guidance (EPA 1988a).

5.6.2 Task 2--Treatability Investigation Implementation

This task is reserved for the actual implementation of any treatability investigation or additional operable unit characterization activities deemed necessary. This task will also include any related data evaluation activities that are needed. However, every effort will be made to attempt to gather all 100-DR-1 characterization data under the RFI Phase I. The results of this task will be integrated into the preliminary site characterization summary (RFI Phase I report) to create the final RFI report.

5.6.3 Task 3--RFI Report

The treatability investigation results will describe the testing that was performed, the results of the tests, and an interpretation of how the results would affect the evaluation of the corrective measure alternatives considered for the operable unit. The report will contain a discussion of the effectiveness of the treatment technology for the wastes onsite and will contain an evaluation of how test results affect treatment costs developed during the detailed analysis of alternatives. These results will be combined with the 100-DR-1 characterization results, including the results of any further activities carried out under the RFI Phase II, and will be published as the final report documenting all RFI activities for the 100-DR-1 project.

5.7 CMS PHASE III--CORRECTIVE MEASURE ALTERNATIVES ANALYSIS

The detailed analysis of corrective measure alternatives follows the development and screening of alternatives and precedes the actual selection of the corrective measure to be implemented at 100-DR-1. The results of the detailed analysis provide the basis for identifying a preferred alternative and preparing the proposed 100-DR-1 corrective action plan. The detailed analysis of alternatives consists of the following components:

- Further definition of each alternative, if appropriate, with respect to the volumes or areas of contaminated environmental media to be addressed, the technologies to be used, and any performance requirements associated with those technologies

- An assessment and a summary of each alternative against nine evaluation criteria

- A comparative analysis among each of the alternatives that will facilitate the selection of an operable unit corrective measure.

The results of this phase of the CMS, along with a summary of the first two CMS phases and the RFI, are then documented in a final CMS report.

The brief summary of the CMS Phase III process presented below was derived from EPA's draft RI/FS guidance (EPA 1988a).

5.7.1 Task 1--Definition of Corrective Measure Alternatives

The corrective measure alternatives that remain after screening may need to be defined more completely before the detailed analysis is begun. During the detailed analysis, each alternative will be reviewed to determine if additional definition is required to apply the evaluation criteria consistently and to develop order-of-magnitude cost estimates (-30 to +50 percent). Information developed to further define alternatives at this stage may include preliminary design calculations, process flow diagrams, sizing of key process components, preliminary layouts, and a discussion of limitations, assumptions, and uncertainties concerning each alternative. Information collected from treatability investigations, if conducted, will also be used to further define applicable alternatives.

5.7.2 Task 2--Detailed Analysis of Corrective Measure Alternatives

Nine evaluation criteria will serve as the basis for conducting thedetailed analysis and for subsequent selection of a cost-effective and protective corrective measure:

- Short-term effectiveness
- Long-term effectiveness and permanence
- Reduction of toxicity, mobility, or volume
- Implementability
- Cost
- Compliance with ARARs
- Overall protection of human health and the environment
- Environmental agency acceptance
- Community acceptance.

These criteria encompass technical, cost, and institutional considerations, compliance with specific promulgated requirements, environmental and health protection, and community relations concerns.

5.7.2.1 Task 2a--Short-Term Effectiveness Analysis. This evaluation criterion addresses the effects of the alternative during the construction and implementation that precedes corrective action objectives being attained. The following factors relating to effects on human health and the environment will be addressed for each alternative:

- Protection of the community during construction and implementation
- Protection of workers during construction and implementation
- Environmental impacts during construction and implementation
- Time until corrective action objectives are achieved.

The evaluation of these factors will include a discussion of any increased risks posed by the corrective measure alternative being evaluated and an evaluation of the effectiveness and reliability of protective measures that could be taken for any worker protection or environmental impact mitigation that may be needed.

5.7.2.2 Task 2b--Long-Term Effectiveness Analysis

This criterion is a performance assessment/risk analysis that will address the results of a potential corrective measure in terms of any risk that would remain at 100-DR-1 after corrective action objectives have been met. The following components will be addressed to evaluate the extent and effectiveness of controls that may be required to manage residual or untreated wastes:

- Magnitude of remaining risk
- Adequacy of controls
- Reliability of controls.

The evaluation of these components will include an assessment of residual risk, the adequacy of containment systems and institutional controls, and the potential need to replace components of the corrective measure alternative.

5.7.2.3 Task 2c--Analysis of Reduction in Waste Toxicity, Mobility, and Volume. This evaluation criterion addresses the statutory preference for selecting corrective measures that employ treatment technologies that permanently and significantly reduce toxicity, mobility, or volume of a hazardous substance as their principal element (CERCLA 121(b)(1)). The following specific factors will be addressed:

- The treatment processes, the corrective measures they will employ, and the materials they will treat
- The amount of hazardous materials that will be destroyed or treated
- The degree of expected reduction in toxicity, mobility, or volume as a percentage
- The degree to which treatment will be irreversible
- The type and quantity of treatment residuals that will remain.

Alternatives that treat a site through destruction of toxic contaminants, reduction of the total mass of toxic contaminants, irreversible reduction in contaminant mobility, or reduction of total volumes of contaminated media will be deemed to satisfy the preference for permanent treatment.

5.7.2.4 Task 2d--Implementability Analysis. The implementability criterion addresses the technical and institutional feasibility of implementing an alternative and the availability of various services and materials required during its implementation. In evaluating this criterion, the following factors will be analyzed:

- Technical feasibility including construction and operation, reliability of technology, ease of undertaking additional corrective actions, and monitoring considerations
- Institutional feasibility
- Availability of services and materials.

5.7.2.5 Task 2e--Cost Analysis. Cost considerations will be an important evaluation criteria at the Hanford Site because funding is distributed by the U.S. Congress. Costing procedures outlined in the Remedial Action Costing Procedures Manual (EPA 1985) will be used in this analysis. Both capital costs and annual operation and maintenance costs will be considered. Costs will be developed within an accuracy of -30 to +50 percent. In addition, a present worth analysis will be conducted so that all alternatives can be compared on the basis of a single figure in a common base year. A discount rate of 5 percent will be used along with a period of performance of 30 years.

5.7.2.6 Task 2f--Analysis of Compliance with ARARs. This evaluation criterion is used to determine how each alternative complies with ARARs. The detailed analysis will summarize which federal and state environmental standards, requirements, criteria, or limitations are applicable, or relevant and appropriate, to an alternative. How the alternative meets these contaminant-, location-, and action-specific requirements will be described.

5.7.2.7 Task 2g--Analysis of Overall Protection of Human Health and the Environment. This evaluation criterion provides a final check to assess whether each alternative meets the statutory requirement that it be protective of human health and the environment (CERCLA 121(d)(1)). The overall assessment of protection is based on a composite of factors discussed under long-term effectiveness and permanence, short-term effectiveness, and compliance with ARARs. The analysis will address how each specific alternative achieves protection over time and how operable unit risks are reduced. A discussion will be included of how each source of contamination is to be eliminated, reduced, or controlled for each alternative.

5.7.2.8 Task 2h--Analysis of Environmental Agency Acceptance. Because Ecology and EPA will have an opportunity to review and comment on the CMS report, this analysis will be limited to formal comments made by the agencies during previous phases of the RFI/CMS. Agency comments on the corrective measure alternatives analysis phase will be specifically addressed in a responsiveness summary before modification of the Hanford Site RCRA permit that documents the selection of the corrective measure. Therefore, the analysis of this criterion will focus on those features of alternatives that Ecology or EPA have reservations about or oppose. A brief discussion of what processes were used to incorporate environmental agency inputs to the project will be included.

5.7.2.9 Task 2i--Analysis of Community Acceptance. The potentially impacted community, special interest groups, the general public, and other interested governmental agencies will have an opportunity to review and comment on the CMS report as well. Before the RCRA permit modification is developed, community concerns will also be addressed in the responsiveness summary. Thus, this analysis will also be confined to community concerns formally transmitted to project management personnel earlier in the RFI/CMS. A discussion of the processes used to solicit and address such concerns will be included.

5.7.3 Task 3--Comparison of Corrective Measure Alternatives

Once the alternatives have been individually assessed against the nine criteria, a comparative analysis will be conducted to evaluate the relative performance of each alternative in relation to each specific evaluation criterion. They key tradeoffs or concerns among alternatives will generally be based on the evaluations of short-term effectiveness; long-term effectiveness and permanence; reduction of toxicity, mobility, and volume; implementability; and cost. Overall protection and compliance with ARARs will generally serve as a threshold determination in that they either will or will not be met.

The comparative analysis will include a narrative discussion describing the strengths and weaknesses of the alternatives relative to one another with respect to each criterion. The potential advantages in cost or performance of innovative technologies and the degree of uncertainty in their expected performance will also be discussed. The differences between all the alternatives will be summarized in matrix form to facilitate direct comparisons.

5.7.4 Task 4--CMS Report

The analysis of individual alternatives against the nine criteria will be presented as a narrative discussion accompanied by a summary matrix. The alternatives discussion will include data on technology components, quantity of hazardous materials handled, time required for implementation, process sizing, implementation requirements, and assumptions. The key ARARs for each alternative will also be incorporated into those discussions. The discussion will focus on how, and to what extent, the various factors within each of the nine criteria are addressed. A summary matrix will highlight the assessment of each alternative with respect to each of the nine criteria.

Based on the results of the comparison of alternatives, the CMS report will indicate which corrective measure alternative is preferred. The preferred alternative will be developed into a proposed corrective action plan under Task 5.

5.7.5 Task 5--Proposed Corrective Action Plan

In accordance with CERCLA 117(a), a brief analysis of the preferred corrective measure alternative, or proposed corrective action plan, will be published for public review and comment. The proposed plan and CMS report will be made available for public review at the same time, after regulatory approval. The proposed plan will consist of a very brief summary, written for the public, in terms of content and distribution, of the nature and extent of contamination at 100-DR-1, the overall corrective action process, the preferred alternative and its advantages and disadvantages, and the other alternatives that are fully developed and analyzed in the CMS Phase III.

Significant comments on the proposed plan will be addressed in a responsiveness summary to be prepared during the selection-of-corrective measures process that immediately follows the RFI/CMS. The proposed plan will be finalized based on significant comments and published as a final corrective action plan. The corrective measure selection process will then be formally documented by modification of the Hanford Site RCRA permit developed between DOE, Ecology, and EPA.

5.8 INTEGRATION OF 120-D-1 PONDS CLOSURE PLAN WITH RFI/CMS ACTIVITIES

Closure plan development for the 120-D-1 Ponds is linked to the RFI/CMS work for the rest of the 100-DR-1 operable Unit to ensure that work for both is done efficiently and timely.

This page left intentionally blank.

6.0 SCHEDULE

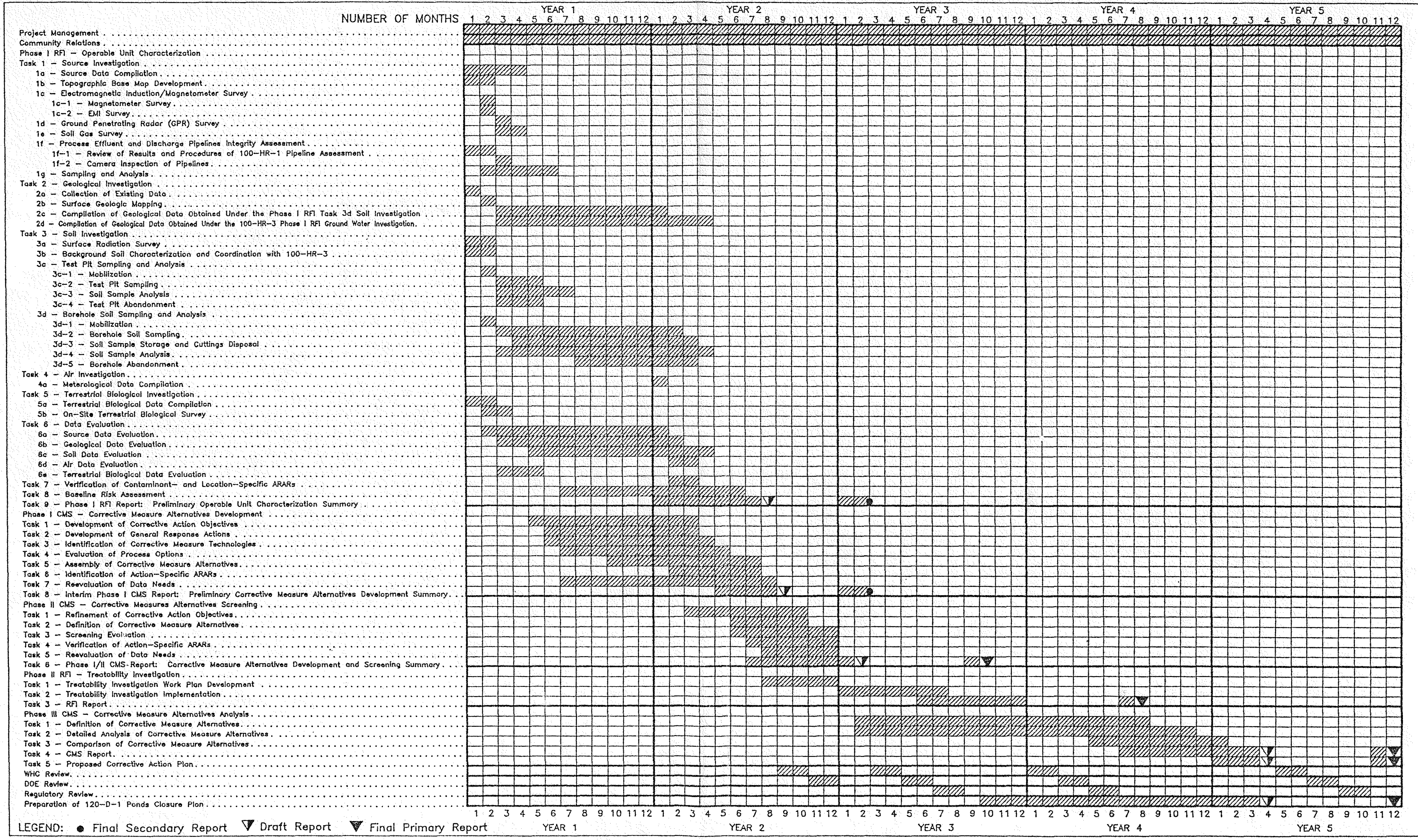
The anticipated schedule for completing the RFI/CMS is presented in Figure 17. The following assumptions were used in developing this schedule.

- Two drill rigs will be used during Tasks 3d--Borehole Soil Sampling and Analysis.
- Drilling contractors will be prequalified, thereby eliminating the need to undertake a competitive bid process immediately before drilling.
- Up to 20 test pits may be excavated.
- Approximately 30 deep borings and 20 shallow borings may be drilled in Phase 1, and up to 90 additional deep borings may be drilled in Phases 2 and 3, depending on previous sampling results.
- Contract laboratory program analysis of samples will take six to eight weeks.
- It will take project management three months to develop procedures for activities for which there are none currently approved.
- Westinghouse Hanford and DOE reviews of draft documents will each take six weeks.
- Regulatory review of the RFI Phase II and CMS Phase II reports will take seven months.

There is a high degree of uncertainty associated with the anticipated schedule for the RFI Phase II. Specific tasks are not now identified, because the actual scope of this phase will depend on the results of the RFI Phase I and the CMS Phase I and Phase II.

This page left intentionally blank

DO NOT MICROFILM
THIS PAGE



8831736\WP\32915

Figure 18. Anticipated Schedule for the 100-DR-1 RCRA Facility Investigation/Corrective Measures Study.

7.0 PROJECT MANAGEMENT

Details on the management structure, organization, and responsibilities for the RFI/CMS project are provided in the Project Management Plan (Attachment 3).

This page left intentionally blank.

8.0 REFERENCES

Allen, J.N., 1980, "The Ecology and Behavior of the Long-Billed Curlew, Numenius americanus parvus, in Southeastern Washington," Wildlife Monograph 73:67.

ANSI/ASME, 1986, Quality Assurance Program Requirements for Nuclear Facilities ANSI/ASME NQA-1, American National Standards Institute/American Society of Mechanical Engineers, New York, New York.

Baker, V.R., editor, 1981, "Catastrophic Flooding, The Origin of the Channeled Scabland," Benchmark Papers in Geology, Vol. 55, Dowden, Hutchinson & Ross., Inc., Stroudsburg, Pennsylvania.

CEQ, 1978, Regulations for Implementing the Procedural Provisions of the National Environmental Policy Act, Title 40, Code of Federal Regulations, Parts 1500-1508, Council on Environmental Quality Washington, D.C.; also in Federal Register, Vol. 43, p. 55978.

Cushing, E.C. Jr., ed. 1975, Radioecology and Energy Resources, the Ecological Society of America, Special Publication No. 1, Dowden, Hutchington, and Ross, Inc., Stroudsburg, Pennsylvania.

DOE, 1987, Final Environmental Impact Statement - Disposal of Hanford Defense High-Level, Transuranic, and Tank Wastes, DOE/EIS-0113, Volumes 1 through 5, U.S. Department of Energy, Washington, D.C.

DOE, 1988, Consultation Draft, Site Characterization Plan, Reference Repository Location, Hanford Site, Washington, DOE/RW-0164, Office of Civilian Radioactive Waste Management, U.S. Department of Energy, Washington, D.C.

DOE, 1989, Draft Environmental Impact Statement, Decommissioning of Eight Surplus Production Reactors at the Hanford Site, Richland, Washington, DOE/EIS-0119D, U.S. Department of Energy, Washington, D.C..

DOE-RL, 1983, Quality Assurance, DOE Order 5700.1A, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE-RL, 1988, Final Status Post-Closure Permit Application: 183-H Solar Evaporation Basins, DOE/RL 88-09, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE-RL, 1989a. Hanford Site Waste Information Data System, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE-RL, 1989b, Hanford Site Waste Management Units Report, DOE/RL 88-30, U.S. Department of Energy, Richland, Washington.

Dorian, J.J. and V.R. Richards, 1978, Radiological Characterization of the Retired 100 Areas, UNI-946, United Nuclear Industries, Inc., Richland, Washington.

Eberhardt, L.E., 1987, Ecology of Great Basin Canada Goose Broods in Southeastern Washington, Ph.D. dissertation, Oregon State University, Corvallis, Oregon.

Ecology, EPA, and DOE, 1989, Hanford Federal Facility Agreement and Consent Order, Washington State Department of Ecology, U.S. Environmental Protection Agency, and U.S. Department of Energy, Olympia, Washington.

EPA, 1983, Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans, QAMS/005/80, U.S. Environmental Protection Agency, Washington, DC.

EPA, 1985, Remedial Action Costing Procedures Manual, EPA/600/8-87/049, OSWER Dir. 9355.0-10, Environmental Protection Agency, Washington, D.C.

EPA, 1986, Quality Criteria for Water 1986, EPA/440/5-86/001, Office of Water Regulations and Standards, U.S. Environmental Protection Agency, Washington, D.C.

EPA, 1987, Data Quality Objectives for Remedial Response Activities: Volume 1, Development Process, EPA/540/6-87/1003, OSWER Dir. 9355.0-7B, U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response, Washington, D.C.

EPA, 1988a, Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA (Interim Final), EPA/540/G-89/004, OSWER Dir. 9335.3-01, U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response, Washington, D.C.

EPA, 1988b, Superfund Exposure Assessment Manual, OSWER Directive No. 9285.5-1, U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response, Washington, D.C.

EPA, 1988c, NPL Candidate: U.S. DOE Hanford 100 Area, U.S. Environmental Protection Agency, Region 10, Seattle, Washington.

EPA, 1989, Integrated Risk Information System Database, Dialcom, U.S. Environmental Protection Agency, Silver Springs, Maryland.

Fitzner, R.E. and W.H. Rickard, 1983, "Canada Goose Nesting Performance along the Hanford Reach of the Columbia River, 1971-1981," Northwest Science 57,4:267-272.

Fitzner, R.E., W.H. Rickard, L.L. Cadwell, and L.E. Rogers, 1981, Raptors of the Hanford Site and Nearby Areas of Southcentral Washington, PNL-3212, Pacific Northwest Laboratory, Richland, Washington.

Gee, G.W., 1987, Recharge at the Hanford Site: Status Report, PNL-6403, Pacific Northwest Laboratory, Richland, Washington.

Gee, G.W. and P.R. Heller, 1985, Unsaturated Water Flow at the Hanford Site: A Review of Literature and Annotated Bibliography, PNL-5428, Pacific Northwest Laboratory, Richland, Washington.

Gee, G.W. and P.R. Heller, 1985, Unsaturated Water Flow at the Hanford Site: A Review of Literature and Annotated Bibliography, PNL-5428, Pacific Northwest Laboratory, Richland, Washington.

Gilmore, T.J., 1989, Ground-Water Quality Assessment Program for the 1324-N/NA Facilities, WHC-SD-EN-AP-005, Prepared by Pacific Northwest Laboratory for Westinghouse Hanford Company, Richland, Washington.

Hitchcock, C.L. and A. Cronquist, 1978, Flora of the Pacific Northwest, University of Washington Press, Seattle, Washington.

Jacques, I.D., 1986, UNC Environmental Surveillance Report for the 100 Areas - FY 1985, UNI-3760, UNC Nuclear Industries, Richland, Washington.

Jacques, I.D., 1987, UNC Environmental Surveillance Report for the 100 Areas - FY 1986, UNI-4065, UNC Nuclear Industries, Richland, Washington.

McCormack, W.D. and J.M.V. Carlile, 1984, Investigation of Ground-Water Seepage from the Hanford Shoreline of the Columbia River, PNL-5289, Pacific Northwest Laboratory, Richland, Washington.

Miller, R.L. and J.M. Steffes (Eds.), 1987, Radionuclide Inventory and Source Terms for the Surplus Production Reactors at Hanford, UNI-3714, Rev. 1, UNC Nuclear Industries, Richland, Washington.

Mullineaux, D.R., R.E. Wilcox, W.F. Ebaugh, R. Fryxell, and M. Rubin, 1977, "Age of the Last Major Scabland Flood of Eastern Washington, as Inferred from Associated Ash Beds of Mount St. Helens Set S," Geological Society of America Abstracts with Programs, Vol. 5, No. 7, p. 1105.

Myers, C.W./S.M. Price, and J.A. Caggiano, M.P. Cochran, W.H. Czimer, N.J. Davidson, R.C. Edwards, K.R. Fecht, G.E. Holmes, M.G. Jones, J.R. Kunk, R.D. Landon, R.K. Ledgerwood, J.T. Lillie, P.E. Long, T.H. Mitchell, E.H. Price, S.P. Reidel, and A.M. Tallman, 1979, Geologic Studies of the Columbia Plateau: A Status Report, RHO-BWI-ST-4, Rockwell Hanford Operations, Richland, Washington.

NRC, 1987, Standards for Protection Against Radiation, Title 10, Code of Federal Regulations, Part 20, U.S. Nuclear Regulatory Commission, Washington, D.C.

Owen, F.E., 1967, Radiological Guide to Deactivation of D-DR Production Facilities, DUN-2447, Douglas United Nuclear, Inc., Richland, Washington.

PNL, 1988a, Geohydrologic Characterization of the Area Surrounding the 183-H Solar Evaporation Basins, PNL-6728, Pacific Northwest Laboratory, Richland, Washington.

PNL, 1988b, Environmental Monitoring at Hanford for 1987, PNL-6464, Pacific Northwest Laboratory, Richland, Washington.

PNL, 1988c, Hanford Site Groundwater Monitoring for April through June 1987. PNL-6315-1, Pacific Northwest Laboratory, Richland, Washington.

Price, K.R. (Ed.), 1986, Environmental Monitoring at Hanford for 1985, PNL-5817, Pacific Northwest Laboratory, Richland, Washington.

Rice, D.G., 1980, Cultural Resources Assessment of the Hanford Reach of the Columbia River, State of Washington, U.S. Army Corps of Engineers, Seattle District, Seattle, Washington.

Schatz, A.L., J.J. Ammerman, and J.A. Serkowski, 1987, Hanford Site Water Table Map, June 1987, WHC-EP-0054, Westinghouse Hanford Company, Richland, Washington.

Stenner, R.D., K.H. Cramer, K.A. Higley, S.J. Jette, D.A. Lamar, T.J. McLaughlin, D.R. Sherwood, and N.E. Van Houten, 1988, Hazard Ranking System Evaluation of CERCLA Inactive Waste Sites at Hanford, PNL-6456, 3 Vols., Pacific Northwest Laboratory, Richland, Washington.

USGS, 1986, Coyote Rapids 7.5-Minute Topographic Quadrangle, Provisional Edition, U.S. Geological Survey, Denver, Colorado.

USWB/USDOA, 1962, Evapotranspiration Maps for the State of Washington, U.S. Weather Bureau/U.S. Department of Agriculture, Seattle and Spokane, Washington.

Washington State Department of Natural Resources, 1987, Endangered, Threatened, and Sensitive Vascular Plants of Washington, Washington Natural Heritage Program, Olympia, Washington.

Washington State Department of Wildlife, 1987, Threatened and Endangered Wildlife in Washington, Olympia, Washington.

WHC, 1989a, Preliminary Operable Units Designation Project, WHC-EP-0216, Westinghouse Hanford Company, Richland, Washington.

WHC, 1989b, Westinghouse Hanford Company Quality Assurance Manual, WHC-CM-4-2, Westinghouse Hanford Company, Richland, Washington.

WHC, 1989c, Environmental Investigations and Site Characterization Manual, WHC-CM-7-7, Westinghouse Hanford Company, Richland, Washington.

APPENDIX A

EVALUATION OF AVAILABLE CODES FOR RCRA FACILITY INVESTIGATION/CORRECTIVE MEASURE STUDY

This page is intentionally left blank.

APPENDIX A

EVALUATION OF AVAILABLE CODES FOR RCRA FACILITY INVESTIGATION/CORRECTIVE MEASURE STUDY

1.1 PURPOSE

Computer models and codes provide a framework to incorporate the processes that are active at a waste disposal site, thereby permitting assessment and evaluation of various waste management options for a given site. The time frames, ranging from decades to thousands of years, associated with the evaluation of waste isolation potential for a given site also necessitate the use of models and codes.

Because of the importance of the computer models relative to the performance assessment and risk assessment of a waste disposal site, a procedure for independent evaluation of reliability and these models and codes is required. Codes must be evaluated to determine the limitations of theories and reliability of supporting empirical relations and laboratory tests used for evaluation of long-term waste isolation potential.

The purpose of this section is to provide an evaluation of a variety of codes that are possible candidates for use in RCRA facility investigation/ corrective measure study (RFI/CMS) of a given site. The groundwater, air, biotic, direct contact and surface-water pathways are considered for transport of contaminants. Such an evaluation can be used for the following:

- To facilitate a comparison of codes
- To provide a screening mechanism (i.e., to determine which codes are applicable to a specific requirement at a given site)
- As an indication of potential deficiencies of the codes
- To evaluate the necessity of additional codes that do not currently exist, but might be required in the future for RFI/CMS of a site
- To provide a basis for gathering additional field data for site characterization and RFI/CMS

1.2 SCOPE OF WORK

The codes evaluated in this report were selected as part of a two-step process. The first step in evaluating the codes was to assemble the list of relevant codes that can potentially be used in an RFI/CMS of a waste disposal site. The second step was to prepare a table describing the important features of selected codes. As part of the second step, a detailed evaluation of the selected codes was performed and a comparison table was developed.

The criteria used in assembling the list of codes may be summarized as follows:

- Codes developed and used by the U.S. Department of Energy (DOE), Nuclear Regulatory Commission (NRC), and U.S. Environmental Protection Agency (EPA) should be selected
- These codes should be:
  - Unclassified
  - off-the-shelf
  - Documented sufficiently to make preparation of an evaluation feasible.
- If codes are available in several versions, the most recent should be used
- The total number of codes reviewed must be consistent with schedule and manhours available.

Furthermore, the comparative evaluation process should address the following:

- Stage of development of the code
- Verification of benchmark status
- Validation status
- Availability of users' manual
- Acceptance by regulatory agencies (i.e., code usage by DOE, NRC, and EPA)
- Acceptance by scientific community (i.e., availability of peer-reviewed journal articles incorporating code description and verification and benchmark results)
- Operational readiness status of the code at the Hanford Site
- Cost of using the code
- Strengths of the code
- Limitations
- Input data required
- Availability of pre- and post-processors for a code

- Ability (or inability) to model Hanford Site conditions; in particular, ability to model the dry, heterogenous vadose zone soils at the Hanford Site

- Hardware requirements for a code

- Expertise required to use a code

- Marginal Advantage of one code over another.

The evaluations are based on available publications and documentation of the codes, supplemented in some cases by the experience of members of the Environmental Technology Group. The evaluations are not comprehensive; rather, the goal was to indicate how the codes might be used in RFI/CMS analysis and point out the deficiencies in the codes. These evaluations, therefore, represent a first step in the screening process for using a code for a given site.

Table A-1 provides a comparison table for integrated transport codes. Table A-2 describes several groundwater pathway codes. Table A-3 describes transport codes for the air, biotic, and direct contact pathways.

Table A-1. Integrated Models for All Pathways. (Sheet 1 of 2)

Computer code name	Stage of development	Verification/ benchmarking status	Validation status	Users' manual available?	Acceptance by regulatory agencies	Acceptance by scientific community	Operational readiness	Cost of utilization	Strengths	Limitations	Input data required	Pre/post processors available?	Ability to model Hanford Site conditions	Hardware requirements	Expertise required	Marginal advantage of one model/ another
RAPS/ MEPAS (model to simulate contaminant transport from a waste disposal site and to evaluate human exposure)	Fully developed	Verified and benchmarked (Whelan et al. 1987)	Not validated	Yes (Whelan et al. 1986)	U.S. Department of Energy (DOE), U.S. Environmental Protection Agency (EPA)	Unknown	Available on site Pacific Northwest Laboratory (PNL)	Low	Minimum knowledge of risk assessment and a minimum amount of input data; considers groundwater, overland, surface water, and atmospheric pathways	Can be used to rank or prioritize sites; but cannot be used in a predictive mode to simulate actual risks at a particular site from the release of contaminants	Dispersion coefficients, hydraulic conductivities, degradation rates, modes of exposure, and dose response information	No	Unknown	Micro/mini-computer	Familiarity with users' manual	Can be applied to rank or prioritize sites; includes simplified models for risk assessments to important receptors
PATHRAE (simulates transport from groundwater, surface water, atmospheric, and occupational pathways)	Fully developed	Unknown	Not validated	Yes (Rogers and Hung 1987)	DOE/U.S. Nuclear Regulatory Commission (NRC)	Unknown	Available on site (PNL)	Low	Minimum user knowledge of risk assessment and a minimum amount of input data; considers complex processes migration, degradation, transformation, transfer between media (air, water, etc.) and biological uptake	Can be used to rank or prioritize sites, but cannot be used in a predictive mode to simulate actual risks at a particular site from the release of contaminants	Dispersion coefficients, hydraulic conductivities, degradation rates, modes of exposure, and dose response information	No	Unknown	Micro/mini-computer	Familiarity with users' manual	Can be applied to rank or prioritize sites; includes simplified models for risk assessments to important receptors

PST89-5845-C1

Table A-1. Integrated Models for All Pathways. (Sheet 2 of 2)

Computer code name	Stage of development	Verification/ benchmarking status	Validation status	Users' manual available?	Acceptance by regulatory agencies	Acceptance by scientific community	Operational readiness	Cost of utilization	Strengths	Limitations	Input data required	Pre/post processors available?	Ability to model Hanford Site conditions	Hardware requirements	Expertise required	Marginal advantage of one model/ another
GEMS (EPA library of codes to model each potential transport pathway)	Fully developed	Unknown	Unknown	Yes (GSC 1982)	EPA	Unknown	Not currently available on site	Medium to high	Unknown	Unknown	Dispersion coefficients, hydraulic, conductivities, degradation rates, modes of exposure, and dose response information	Yes	Unknown	Terminal and modem to access GEMS	Limited modeling experience and familiarity with users' manual	EPA model

PST89-3045-C1

Table A-2. Available Groundwater Pathway Computer Codes for Remedial Investigation/Feasibility Study. (Sheet 1 of 4)

Computer code name	Stage of development	Verification/ benchmarking status	Validation status	Users' manual available ?	Acceptance by regulatory agencies	Acceptance by scientific community	Operational readiness	Cost of utilization	Strengths	Limitations	Input data required	Pre/post processors available?	Ability to model Hanford Site conditions	Hardware requirements	Expertise required	Marginal advantage of one model/ another
CHAINT (2D transport code for saturated and unsaturated media; includes radionuclide decay and adsorption for contaminants)	Fully developed	Partially verified and benchmarked	Not validated	Yes	DOE	Unknown	Available on PRIME 750	Medium	Low cost for vadose zone flow simulation, two-dimensional transport	One-dimensional, vertical, steady-state unit gradient model for vadose zone, does not allow for source/sink terms	Soil moisture characteristics for various layers	Yes	Applied to 200 Areas solid waste disposal sites	Mini/ mainframe computers	Familiarity with users' manual, theory description	Low cost of simulation, Westinghouse Hanford Company personnel familiarity with codes, less data requirements
MAGNUM (2D code for simulated groundwater flow in saturated aquifers)	Fully developed	Verified and benchmarked	Not validated	Yes	DOE	Unknown	Available on PRIME 750	Medium	Two-dimensional flow simulations	Does not allow for source/sink terms within aquifers	Hydraulic characteristics for various zones with aquifers	Yes	Extensively applied to Hanford Site basalt aquifers (flow tops and dense interiors)	Mini/ mainframe computers	Familiarity with users' manual, theory description	Low cost of simulation, Westinghouse Hanford Company personnel familiarity with code. MAGNUM was especially developed for modeling flow in basalt environment
FEMWATER/ FEMWASTE	Fully developed	Verified and benchmarked (Yeh et al. 1987)	Not validated	Yes	DOE		Not available on site	High	Two-dimensional flow and transport includes sources/ sinks	Long execution times, inability to model heterogeneous vadose zone soils	Moisture characteristic curves for various vadose zone layers	No	Unknown	Mini/ mainframe computers	High degree of familiarity with theory and users' manuals	Integrated saturated/ unsaturated zone modeling flow including sources/ sinks for unconfined aquifer

PST89-3045-C2

Table A-2. Available Groundwater Pathway Computer Codes for Remedial Investigation/Feasibility Study. (Sheet 2 of 4)

Computer code name	Stage of development	Verification/ benchmarking status	Validation status	Users' manual available?	Acceptance by regulatory agencies	Acceptance by scientific community	Operational readiness	Cost of utilization	Strengths	Limitations	Input data required	Pre/post processors available?	Ability to model Hanford Site conditions	Hardware requirements	Expertise required	Marginal advantage of one model/ another
VAM2D/ SATURN (2D flow and transport code for saturated/ unsaturated media; includes decay and adsorption)	Fully developed	Verified and benchmarked (Huyakorn et al. 1984)	Not validated	Yes	U.S. Department of Energy (DOE) U.S. Nuclear Regulatory Commission (NRC)	Huyakorn et al. 1984, 1985, 1987		Medium	Includes a simplified option for modeling vadose zone; includes option sources/ sinks for aquifers	Long execution times, for the full saturated/ unsaturated flow and transport modeling	Hydraulic characteristics for various vadose zone layers and unconfined aquifers	No	Capable of modeling heterogeneous layered media (such as those existing at Hanford Site)	Mini/ mainframe computers	High degree of familiarity with theory and users' manuals	Simplified option for vadose zone modeling; option for including sources/ sinks for unconfined aquifer; integrated modeling of saturated/ unsaturated media
TRACR3D (3D code for modeling flow and transport of multiphase organics in vadose zone)	Fully developed	Currently being verified and benchmarked at Pacific Northwest Laboratory (PNL) for the Hanford Site grout program	Not validated	Yes, (Travis 1984)	DOE, NRC	Unknown	Available at PNL	High	Multidimensional modeling of flow and transport of organics	Does not include flow and transport in unconfined aquifer; limited ability to model heterogeneous vadose zone properties	Relative permeability versus saturation relationships for various multiphase organics	No	Has difficulty in simulating flow through heterogeneous layered media (such as those existing at Hanford Site)	Mini/ mainframe computers	High degree of familiarity with theory and users' manuals	Ability to model multidimensional, multiphase flow and transport in vadose zone
PORFLO (3D code for simulating flow, heat transport and mass transport saturated porous media)	Fully developed	(Eyler and Budden 1984)	Not validated	Yes, (Kline et al. 1983)	DOE	Unknown	Available onsite	Medium	Three-dimensional simulations possible; allows for sources/ sinks in unconfined aquifers	Vadose zone simulation capabilities not available but are currently being incorporated	Hydraulic properties of various heterogeneities in the saturated aquifer	Yes	Extensively applied to model flow and transport through Hanford Site basalts	Mini/ mainframe computers	High degree of familiarity with theory and users' manuals	Ability to model three-dimensional flow and transport in saturated media, Westinghouse Hanford Company familiarity with code
MODFLO (3D code for simulating flow in saturated porous media)	Fully developed	(McDonald and Harbaugh 1984)	Not validated	Yes	U.S. Geological Survey	Unknown	Not available onsite	Medium	Modular structure of various submodels	Vadose zone simulation capabilities not available	Hydraulic properties of saturated confined and unconfined aquifers	No	Unknown	Mini/ mainframe computers	Familiarity with users' manual	Ability to model three-dimensional flow in saturated media

PST89-5045-C2

Table A-2. Available Groundwater Pathway Computer Codes for Remedial Investigation/Feasibility Study. (Sheet 3 of 4)

Computer code name	Stage of develop-ment	Verification/ benchmark-ing status	Validation status	Users' manual available ?	Acceptance by regulatory agencies	Acceptance by scientific community	Operational readiness	Cost of utilization	Strengths	Limitations	Input data required	Pre/post processors available?	Ability to model Hanford Site conditions	Hardware require-ments	Expertise required	Marginal advantage of one model/ another
VAM3D (3D flow and transport code for modeling flow and transport through saturated/ unsaturated media; includes decay and adsorption)	Fully developed	Verified and bench-marked (Huyakorn et al. 1985)	Not validated	Yes	DOE	Unknown	Not avail-able on site	Verify high	Includes a simplified option for modeling vadose zone; includes option for incorpor-ating source/ sink terms in aquifers	Very long execution times for modeling the full, 3D, saturated/ unsaturated media	Hydraulic properties for various vadose zone layers and unconfined aquifers	No	Capable of modeling hetero-geneous layered media (such as those existing at Hanford Site)	Mainframe computer	Very high degree of familiarity with theory and users manuals	Ability to the fill, 3D flow and transport in an inte-grated saturated/ unsaturated media, with sources/ sinks in unconfined aquifers
UNSAT2	Fully developed	Verified and bench-marked	Not validated	Yes	DOE/NRC	(Neuman 1973)	Available at PNL	Medium	Two-dimen-sional vadose zone and uncon-fined aquifer simulations with sources/ sinks present in unconfined aquifer	Vadose zone flow simula-tion capabil-ities limited to simpler, smaller flow domains; does not include con-taminant transport modeling option	Hydraulic properties for various vadose zone layers and unconfined aquifers	No	Has diffi-culty in simulating flow through hetero-geneous, layered media (such as those existing at Hanford Site)	Mini/ mainframe computer	High degree of familiarity with theory and users manuals	Ability to model 2D in integrated saturated/ unsaturated media, with sources/ sinks in unconfined aquifers
UNSAT-H (1D model for simu-lating flow through vadose zone)	Fully developed	Verified and bench-marked	Not validated	Yes	DOE	Unknown	Available at PNL	Low	Developed specifically for Hanford Site condi-tions; includes a water balance subroutine	One-dimen-sional model, limited applicability to multi-dimensional, heterogen-eous layered media	Soil proper-ties, plant data for ET calculations	Unknown	Capable of simulating flow in heterogen-eous layered media	Mini/ mainframe computer	Familiarity with users manual	Has been applied to Hanford Site conditions

PST89-5845-C2

Table A-2. Available Groundwater Pathway Computer Codes for Remedial Investigation/Feasibility Study. (Sheet 4 of 4)

Computer code name	Stage of development	Verification/ benchmarking status	Validation status	Users' manual available?	Acceptance by regulatory agencies	Acceptance by scientific community	Operational readiness	Cost of utilization	Strengths	Limitations	Input data required	Pre/post processors available?	Ability to model Hanford Site conditions	Hardware requirements	Expertise required	Marginal advantage of one model/ another
RITZ (simulates movement fate of hazardous chemicals during land treatment of oily wastes)	Fully developed	Unknown	Not validated	Yes, (Nofziger and Williams 1988)	U.S. Environmental Protection Agency (EPA)	Unknown	Available onsite	Low	Simple model with few data requirements; can be applied in case of organics	Assumptions are highly simplistic and may not be valid in nature; cannot be used to simulate actual risks at a site	Input data on soil, pollutant, oil, environmental, and operational parameters for land treatment sites	Yes	Unknown	Microcomputer	Familiarity with users' manual	Can be applied to obtain preliminary data on transport and fate of organics in the vadose zone
SESOIL (unsaturated zone transport model)	Fully developed	Unknown	Not validated	Yes, (Bonazountas and Wagner 1981)	EPA	Unknown	Available through GEMS	Low - Medium	Models organic and inorganic species; accounts for adsorption, volatilization, degradation, and biodegradation	Only handles up to three soil layers	Hydrologic and meteorologic data, contaminant information	Yes	Unknown	Terminal and modem access to GEMS	Familiarity with users' manual	Versatile, easy to use, EPA acceptance
HELP (1-D unsaturated flow and transport model)	Fully developed	Unknown	Not validated		EPA	Unknown	Available onsite	Low	Simple model for rough calculations, models organic and inorganic species	Simple 1-D approach may not be adequate at some sites	Hydrologic and meteorologic data, contaminant information	No	Yes	IBM-PC or equivalent	Familiarity with users' manual	Easy to use, EPA acceptance

PST89-5045-C2

Table A-3. Models for Air, Biotic, Direct Contact, and Surface Water Pathways. (Sheet 1 of 3)

Computer code name	Stage of development	Verification/ benchmarking status	Validation status	Users' manual available?	Acceptance by regulatory agencies	Acceptance by scientific community	Operational readiness	Cost of utilization	Strengths	Limitations	Input data required	Pre/post processors available?	Ability to model Hanford Site conditions	Hardware requirements	Expertise required	Marginal advantage of one model/ another
AIR PATHWAY																
TOXBOX (basic box model)	Fully developed	Unknown	Unknown	(GSC 1982)	U.S. Environmental Protection Agency (EPA)	Unknown	Not currently accessible at Hanford Site	Low-Medium	Can represent vertical dispersion; areal source; available through GEMS	Simplified box model	Unknown	Yes	No site-specific limitations	Terminal and modem to access GEMS	Limited modeling experience	Ease of use and EPA acceptance
INDUSTRIAL SOURCE COMPLEX (Gaussian dispersion model)	Fully developed	Unknown	Unknown	(GSC 1982)	EPA	Unknown	Not currently accessible at Hanford Site	Low-Medium	Long- and short term simulations; settling and dry deposition of particles; multiple point sources; limited terrain adjustments	Unknown	Meteorological and source data	Yes	No site-specific limitations	Terminal and modem to access GEMS; mini/ mainframe computer	Limited modeling experience	Rigorous approach and EPA acceptance
SEE ALSO PATHRAE AND RAPS/ MEPAS																

PST89-5045-C3

Table A-3. Models for Air, Biotic, Direct Contact, and Surface Water Pathways. (Sheet 2 of 3)

Computer code name	Stage of development	Verification/ benchmarking status	Validation status	Users' manual available?	Acceptance by regulatory agencies	Acceptance by scientific community	Operational readiness	Cost of utilization	Strengths	Limitations	Input data required	Pre/post processors available?	Ability to model Hanford Site conditions	Hardware requirements	Expertise required	Marginal advantage of one model/another
BIOTIC PATHWAY BIOPORT/ MAXI 1 (Radiation dose due to plants and animals	Fully developed	Planned for FY 1989	Planned for FY 1989	(McKenzie et al. 1985)	NRC	Unknown	Available at Hanford Site	Low	Radiation dose calculated for ingestion, inhalation, and direct exposure; intrusion and active physical transport are considered	Does not consider hazardous chemicals	Agricultural and water-usage practices; wildlife information	No	No site-specific limitations	Mini/ mainframe computer	Limited modeling experience	Developed at Hanford Site
SEE ALSO PATHRAE AND RAPS/ MEPAS																
DIRECT-CONTACT PATHWAY ONSITE/ MAXI 1 (Radiation dose due to direct intrusion)	Fully developed	Unknown	Unknown	(Kennedy et al. 1986, 1987)	NRC	Unknown	Available at Hanford Site	Low	Radiation dose calculated for direct exposure and ingestion (food and water)	Does not consider hazardous chemicals	Agricultural and water-usage practices; lifestyle characteristics of intruder/ resident	No	No site-specific limitations	Micro/mini/ mainframe computer	Limited modeling experience	Developed at Hanford Site
SEE ALSO PATHRAE AND RAPS/ MEPAS																

PST89-3065-C3

Table A-3. Models for Air, Biotic, Direct Contact, and Surface Water Pathways. (Sheet 3 of 3)

Computer code name	Stage of development	Verification/ benchmarking status	Validation status	Users' manual available?	Acceptance by regulatory agencies	Acceptance by scientific community	Operational readiness	Cost of utilization	Strengths	Limitations	Input data required	Pre/post processors available?	Ability to model Hanford Site conditions	Hardware requirements	Expertise required	Marginal advantage of one model/ another
SURFACE WATER PATHWAY EXPOSURE ANALYSIS MODELING SYSTEM (3-D compartmental model for freshwater, nontidal systems)	Fully developed	Unknown	Unknown	(Burns et al. 1982) (GSD 1982)	EPA	Unknown	Not currently accessible at Hanford	Medium-High		Unknown	Unknown	Yes	No site-specific requirements	Mini/ mainframe computer	Understanding of transport process and modeling experience	Rigorous approach and EPA acceptance
WATER QUALITY ASSESSMENT METHODOLOGY (1-D Model for lakes, rivers, and streams)	Fully developed	Unknown	Unknown	(Mills et al. 1982)	EPA	Unknown	Not currently accessible at Hanford	Low	Easy to use with desk calculator	Very simple approach	Limited data requirements	No	No site-specific requirements	Calculator	Limited modeling experience	Ease of use and EPA acceptance
SEE ALSO RAPS/ MEPAS AND PATHRAE																

PST89-3045-C3

1.3 REFERENCES

Bonazountas, M. and J. Wagner, 1981, SESOIL, A Seasonal Soil Compartment Model, A.d. Little Company, Incorporated, for the U.S. Environmental Protection Agency, Cambridge, Massachusetts.

Burns, L.A., D.M. Cline, and R.R. Lassiter, 1982, Exposure Analysis Modeling System (EXAMS) User's Manual and System Documentation, EPA 600 3-82-023, U.S. Environmental Protection Agency, Athens, Georgia.

Eyler, L.L. and M.J. Budden, 1984, Verification and Benchmarking of PORFLO: An Equivalent Porous Continuum Code for Repository Scale Analysis, PNL-5044, Pacific Northwest Laboratory, Richland, Washington.

GSC, 1982, Graphic Exposure Modeling System (GEMS): User's Guide, General Software Corporation for the U.S. Environmental Protection Agency, Washington, D.C.

Huyakorn, P.S., S.D. Thomas, and B. M. Thompson, 1984, "Techniques for Making Finite Element Competitive in Modeling Flow in Variable-Saturated Porous Media," Water Resources Research, Vol. 20, No. 8, pp. 1099-1115.

Huyakorn, P.S., J.W. Mercer, and D.S. Ward, 1985, "Finite Element Matrix and Mass Balance Computational Schemes for Transport in Variable-Saturated Porous Media," Water Resources Research, Vol. 21, NO.3, pp. 346-358.

Huyakorn, P.S., B.G. Jones, J.C. Parker, T.D. Wadsworth, and H.D. White, Jr. 1987, Finite Element Simulation of Moisture Movement and Solute Transport in a Large Caisson, in Modeling Study of Solute Transport in the Unsaturated Zone, NUREG/CR-4615, Vol. 2, U.S. Nuclear Regulatory Commission, Washington, D.C., pp. 117-170.

Kennedy, W.E., Jr., R.A. Peloquin, B.A. Napier, and S.M. Neuder, 1986, Intruder Dose Pathway Analysis for the Onsite Disposal of Radioactive Wastes: The ONSITE/MAXII Computer Program, NUREG/CR-3620, Supplement 1, U.S. Nuclear Regulatory Commission, Washington, D.C.

Kennedy, W.E., Jr., R.A. Peloquin, B.A. Napier, and S.M. Neuder, 1987, Intruder Dose Pathway Analysis for the Onsite Disposal of Radioactive Wastes: The ONSITE/MAXII Computer Program, NUREG/CR-3620, Supplement 2, U.S. Nuclear Regulatory Commission, Washington, D.C.

Kline, N.W., A.K. Runchal, and R.G. Baca, 1983, PORFLO Computer Code: Users Guide, RHO-BW-CR-138 P, Rockwell Hanford Operations, Richland, Washington.

McDonald, M.G. and A.W. Harbaugh, 1984, A Modular Three-Dimensional Finite-Difference Ground Water Flow Model, Open-File Report OFR 83-875, U.S. Geological Survey, Washington, D. C.

McKenzie, D.H., L.L. Cadwell, K.A. Gano, W.E. Kennedy, Jr., B.A. Napier, R.A. Peloquin, and M.A. Simmons, 1985, Relevance of Biotic Pathways to the Long-Term Regulation of Nuclear Waste Disposal. Estimation of Radiation Dose to Man Resulting from Biotic Transport: the Bioport/MAXII Software Package, NUREG/CR-2675, Vol 5, PNL-4241, U.S. Nuclear Regulatory Commission, Washington, D.C.

Mills, W.B., J.D. Dean, and D.B. Porcella, 1982, Water Quality Assessment: A Screening Procedure for Toxic and Conventional Pollutants, Parts 1, 2, and 3, EPA 600 6-82-004, U.S Environmental Protection Agency, Athens, Georgia.

Neuman, S.P., 1973, "Saturated-Unsaturated Seepage by Finite Elements," Journal of the Hydraulics Division, American Society of Civil Engineers, Vol. 99, HY12, pp. 2233-2250.

Nofziger, D.L. and J.R. Williams, 1988, Interactive Simulation of the Fate of Hazardous Chemicals During Land Treatment of Oily Wastes: RITZ User's Guide, EPA/600/8-88/001, U.S. Environmental Protection Agency, Ada, Oklahoma.

Rogers, V. and C. Hung, 1987, PATHRAE-EPA: A Low-Level Radioactive Waste Environmental Transport and Risk Assessment Code, EPA 520/1-87-028, U.S. Environmental Protection Agency, Washington, D.C.

Travis, B., 1984, TRACR#D: A Model of Flow and Transport in Porous Fractured Media, LA-9667-MS, Los Alamos National Laboratory, Los Alamos, New Mexico.

Whelan, G., B.L. Steelman, D.L. Strenge, and J.G. Droppo, 1986, Overview of the Remedial Action Priority System (RAPS), PNL-SA-13324, Pacific Northwest Laboratory, Richland, Washington.

Whelan, G., D.L. Strenge, J.G. Droppo, B.L. Steelman, and J.W. Buck, 1987, The Remedial Action Priority System (RAPS): Mathematical Formulations, DOE/RL 87-09, U.S. Department of Energy-Richland Operations Office, Richland Washington.

Yeh, G. T., 1987, FEMWATER: A Finite Element Model of Water Flow through Saturated-Unsaturated Porous Media, First Revision, ORNL-5567/R1, Oak Ridge National Laboratory, Oak Ridge, Tennessee.

SAMPLING AND ANALYSIS PLAN

This page intentionally left blank.

CONTENTS

This page intentionally left blank.

1.0 INTRODUCTION

1.1 BACKGROUND

The U.S. Environmental Protection Agency (EPA) has proposed the 100 Area at the Hanford Site for inclusion on the National Priorities List (NPL) under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). The 100-D/DR Area has been divided into three source operable units, including the 100-DR-1 operable unit, for the purpose of focusing and managing the needed environmental investigations, studies, and actions. Groundwater, surface water, and aquatic biota are being addressed in the 100-HR-3 operable unit. The 100-DR-1 operable unit is located immediately adjacent to the Columbia River in the northern portion of the 100-D/DR Area, and covers an area of approximately 140 acres. Operable unit 100-DR-1 is known as the process liquid operable unit because it contains all the major past liquid waste disposal facilities for the 100 D/DR Area (WHC 1989a). Details of this operable unit are presented in the 100-DR-1 Work Plan.

1.2 PURPOSE AND OBJECTIVE

The purpose of this Sampling and Analysis Plan (SAP) is to guide Westinghouse Hanford Company (Westinghouse Hanford) and U.S. Department of Energy (DOE) in all environmental investigation activities conducted at the 100-DR-1 operable unit. This SAP was developed in accordance with the requirements of CERCLA.

1.3 CONTENT

This SAP consists of two parts:

- Part 1a--Field Sampling Plan (FSP)
- Part 1b--Quality Assurance Project Plan (QAPP).

The FSP and QAPP each conform with EPA guidance with respect to content and format (EPA 1988). All procedures (including participant contractor or subcontractor procedures) required for this project shall be approved as being in compliance with Westinghouse Hanford procedures. Where Westinghouse Hanford Environmental Investigations and Instructions (EII) are referenced, they shall be the latest approved version from WHC-CM-7-7, "Environmental Investigations and Site Characterization Manual" (WHC 1989b). The QAPP details all of the quality assurance/quality control (QA/QC) procedures to be followed to ensure that usable and defendable data are collected during the course of the investigations. The FSP contains task-by-task descriptions of investigation activities including sampling locations and frequencies, sample designations, sampling equipment and procedures, and sample handling and analysis.

This page intentionally left blank.

2.0 REFERENCES

EPA, 1988, Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA (Interim Final), EPA/540/G-89/004, OSWER Dir. 9335.3-01, U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response, Washington, D.C.

WHC, 1989a, Preliminary Operable Units Designation Project, WHC-EP-0216, Westinghouse Hanford Company, Richland, Washington.

WHC, 1989b, Environmental Investigations and Site Characterization Manual, WHC-CM-7-7, Westinghouse Hanford Company, Richland, Washington.

This page intentionally left blank.

FIELD SAMPLING PLAN

This page left intentionally blank.

CONTENTS

CONTENTS (Cont)

CONTENTS (Cont)

LIST OF FIGURES

LIST OF TABLES

This page intentionally left blank.

PART 1a-FIELD SAMPLING PLAN FOR RCRA FACILITY INVESTIGATIONS AT THE 100-DR-1 OPERABLE UNIT

1.0 INTRODUCTION

This plan, Part 1a of Attachment 1 to the 100-DR-1 RCRA facility investigation/ corrective measures study (RFI/CMS) Work Plan, is written for those assigned responsibility for obtaining field samples for the operable unit RFI/CMS. The Field Sampling Plan (FSP), while perhaps the best plan for the field person to first study before going into the field, is designed to be used in conjunction with the 100-DR-1 Work Plan, other attachments to that plan, and referenced procedures.

The Work Plan contains important summaries on the background and setting of 100-DR-1 in the first three chapters. The Work Plan also contains a list of acronyms and abbreviations that are also used in this plan. The field person should also be aware of the project schedule contained within Section 6.0 of the Work Plan (or the most recent update of that schedule).

The Quality Assurance Project Plan (QAPP) is an essential document to be familiar with because it references, among other things, the equipment and procedures that must be used during this project to obtain good representative field samples and measurements. Knowledge of the Health and Safety Plan (HSP) (Attachment 2) is critical because it specifies procedures to ensure the occupational health and safety of project field personnel. And, because field personnel must maintain field notebooks containing important project data, familiarity with applicable data management procedures specified and referenced in the Data Management Plan (DMP) (Attachment 4) is also necessary.

Because the operable unit characterization phase of the RFI is currently the only phase containing field sampling requirements, the FSP is outlined in the format corresponding to the Phase I RFI tasks, subtasks, and activities. For completeness, those Phase I RFI components that do not involve any field sampling or measurements are also briefly addressed in this plan. If additional field sampling or measurement requirements are determined to be needed in the operable unit characterization or other phases of the project, this plan will be amended in accordance with Section 3.0 of the Project Management Plan to incorporate such requirements.

The sampling approach taken in this Work Plan is to phase activities, starting with a source evaluation and geophysical surveys, followed by a test pit program and a phased boring program based on preceding sampling efforts. Sampling and analysis options will be evaluated during the program to ensure that the data collected are sufficient and of adequate quality for their intended uses. The data quality objectives process will be revised, as needed, based on the results of each data collection/analysis activity.

Several facilities within the 100-DR-1 operable unit are assigned to the ongoing Defense Decontamination and Decommissioning program, and some facilities have already been decommissioned as part of this program. Facilities assigned to that program that are sources of identified or potential contaminants are addressed in this Field Sampling Plan. The reactor building and its associated nuclear fuel storage basin will be decommissioned as part of the surplus production reactors decommissioning program at the Hanford Site. The reactor facilities are therefore addressed by the Environmental Impact Statement for that decommissioning program (DOE 1989) and are not within the scope of this plan.

2.0 PHASE I RFI TASK 1--SOURCE INVESTIGATION

This task is designed to provide necessary information regarding the locations, function or use, types of hazardous substances used or disposed, structure, and integrity of certain facilities within the operable unit.

2.1 TASK 1a--SOURCE DATA COMPILATION

This subtask does not involve any field sampling. Details of the activities that will be conducted are provided in Section 5.3.1.1 of the Work Plan.

2.2 TASK 1b--TOPOGRAPHIC BASE MAP AND GEODETIC SURVEY

2.2.1 Objectives

A site map of the 100-DR-1 operable unit will be established to be used during site characterization, evaluation of corrective measure alternatives, and engineering design. Geodetic surveys for elevation and north-south (N-S) and east-west (E-W) coordinates are necessary to provide vertical and horizontal control of RFI activities and data.

2.2.2 Survey Locations

The site topographic map will be at a scale that will allow the precision needed to show elevation contours at 0.6-m (2-ft) intervals. Site features such as the 100-DR-1 boundary, Columbia River, fence lines, gates, buildings, disposal facilities, and pipelines will be included. The site map will extend 100 m (330 ft) beyond the boundary of 100-DR-1. The National Geodetic Survey coordinate system will be used. Third-order precision and accuracy will be used for the development of the site map.

Horizontal control will also be provided for sampling points and grids established for completing the following tasks:

- Task 1c--Electromagnetic Induction/Magnetometer (EMI/MAG) Survey
- Task 1d--Ground Penetrating Radar (GPR) Survey
- Task 1e--Soil Gas Survey
- Task 3a--Surface Radiation Survey.

Horizontal control will be established on two points at each grid location required for these surveys. The horizontal plane survey accuracy will be ± 0.3 m (1 ft). Relative coordinates for the remainder of the grids will be obtained by using a tape and compass traverse or by Global Positioning

Satellite (GPS) instruments and electronic distance measuring instruments tied to these reference points. Grid point locations will be staked with coordinates marked. Adequate vertical control will be provided by the topographic base map.

Locations of soil borings conducted during Task 3 will be surveyed for both horizontal coordinates and vertical elevations. The horizontal plane survey accuracy will be ± 0.3 m (±1 ft). The vertical plane survey must be accurate to ± 0.03 m (±0.1 ft). The elevation will be obtained at the ground surface of the borehole locations.

2.2.3 Survey Equipment and Procedures

Surveys are to be completed by a surveyor who is licensed and registered in the State of Washington. Vertical control will be referenced to a United States Geological Survey (USGS) datum obtained from a permanent benchmark. Third-order plane surveys and horizontal angular measurements will be made with a 20-second or better transit. Angles will be doubled, with the mean of the doubled angle within 10 seconds at the first angle. Distance measurements will be made with a calibrated tape corrected for temperature and tension or with a calibrated electronic distance measuring instrument (EDMI). When using an EDMI, the manufacturer's parts per million (p/m) error continues to be applied as well as corrections for curvature and refraction. Global Positioning Satellite surveying techniques may also be used.

Additional details on the surveying equipment and procedures shall be specified in approved participant contractor procedures. Procedure approval and control are described in Section 4.0 of the QAPP.

2.2.4 Data Collection, Reduction, and Interpretation

All measurements will be recorded in a field notebook as required by EII 1.5, "Field Logbooks" (WHC 1989) and in accordance with the procedures specified in the DMP and QAPP.

The locations of all surveyed facilities and anomalies will be plotted on topographic base map(s). The base map(s) will include site features, elevation contours at 0.6-m (2-ft) intervals, locations of EMI/MAG, GPR, and soil gas, and surface radiation survey grids and anomalies, and the locations and elevations of soil borings and test pits.

Data and maps will be prepared to be compatible for input into the developing data base for the 100-D Area.

2.3 TASK 1c--ELECTROMAGNETIC INDUCTION/MAGNETOMETER (EMI/MAG) SURVEY

2.3.1 Electromagnetic Induction/Magnetometer Survey Objectives

The objective of the EMI/MAG survey is twofold:

- To screen large areas for potential contamination for subsequent sampling
- To precisely locate buried facilities.

Areas identified as having potential for being contaminated will be investigated further in the Task 3 soil investigation.

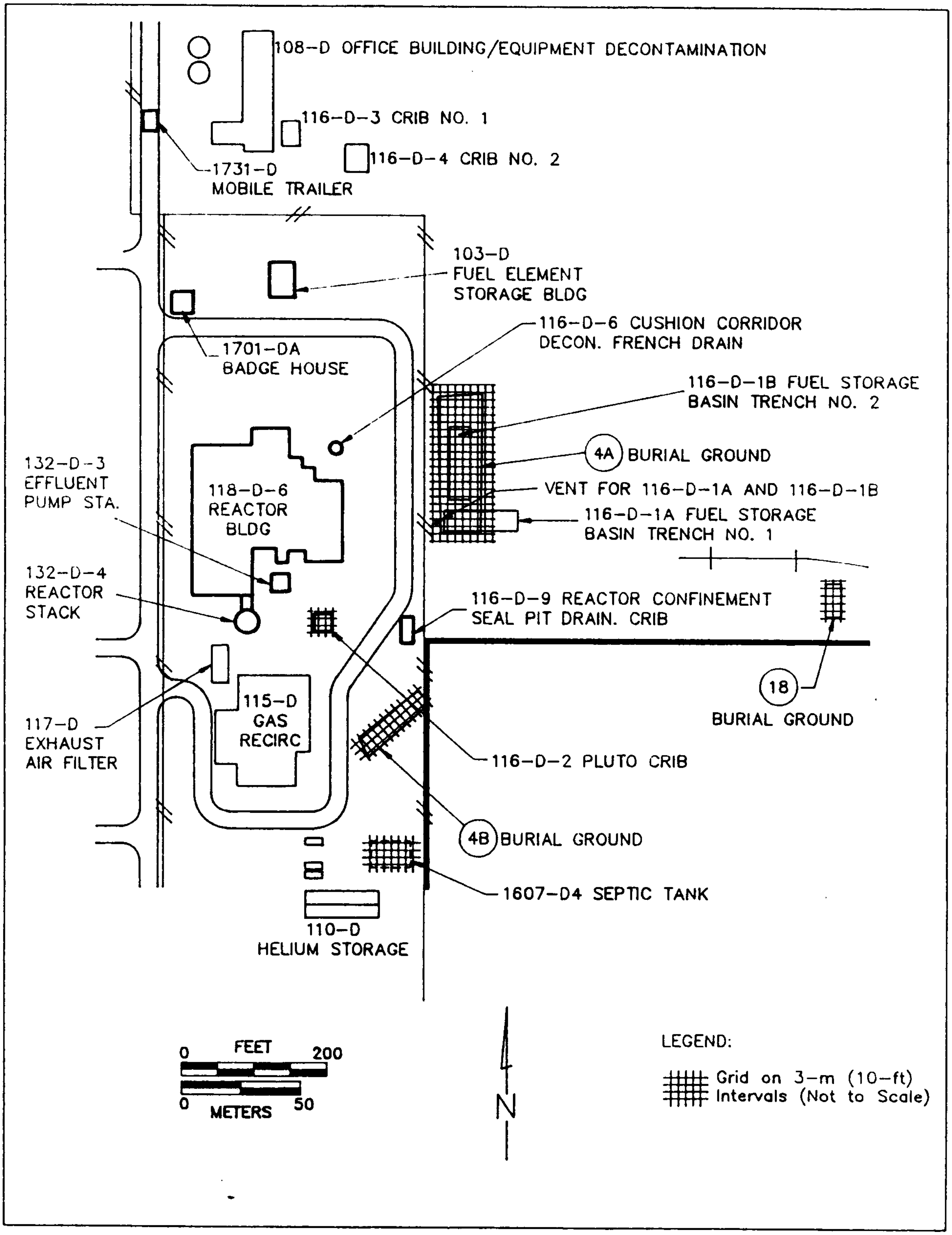
2.3.2 Electromagnetic Induction/Magnetometer Survey Locations and Frequencies

The implementation of the EMI/MAG survey will be a one-time occurrence. Initially a magnetometer survey will be conducted to define locations of the buried pipelines. Locations of the pipelines will be staked and the EMI survey will be conducted over the facilities as described below. A site reconnaissance will be conducted prior to the EMI survey to identify the background noise level at each facility.

For the smaller facilities, the survey will be conducted on a grid on 3-m (10-ft) intervals to determine the length and the width of the facility, as shown in Figures 1, 2, and 3. Horizontal control will be established under Task 1b. The survey will continue until readings approach background levels. The facilities that will be surveyed on this size grid include the following:

- Septic tanks 1607-D2, 1607-D4, 1607-D5, and septic tank located at N93050, W52850
- The 116-D-2 pluto crib
- Waste acid reservoir
- Underground fuel oil tank west of the 184-DA steam generating facility
- Burial grounds, 4A, 4B, and 18
- Salt dissolving pit.

For the larger facilities, the survey will be conducted on 7.6-m (25-ft) intervals to determine the length and the width of the facility. These facilities include the sanitary sewer tile field located north of the retention basins and the 126-D-2 solid waste landfill, which are shown on Figure 3.



8831736\FSP\32902

Figure 1. EMI/MAG Survey - 1607-D4 Septic Tank, 116-D-2 Pluto Crib, and Burial Grounds.

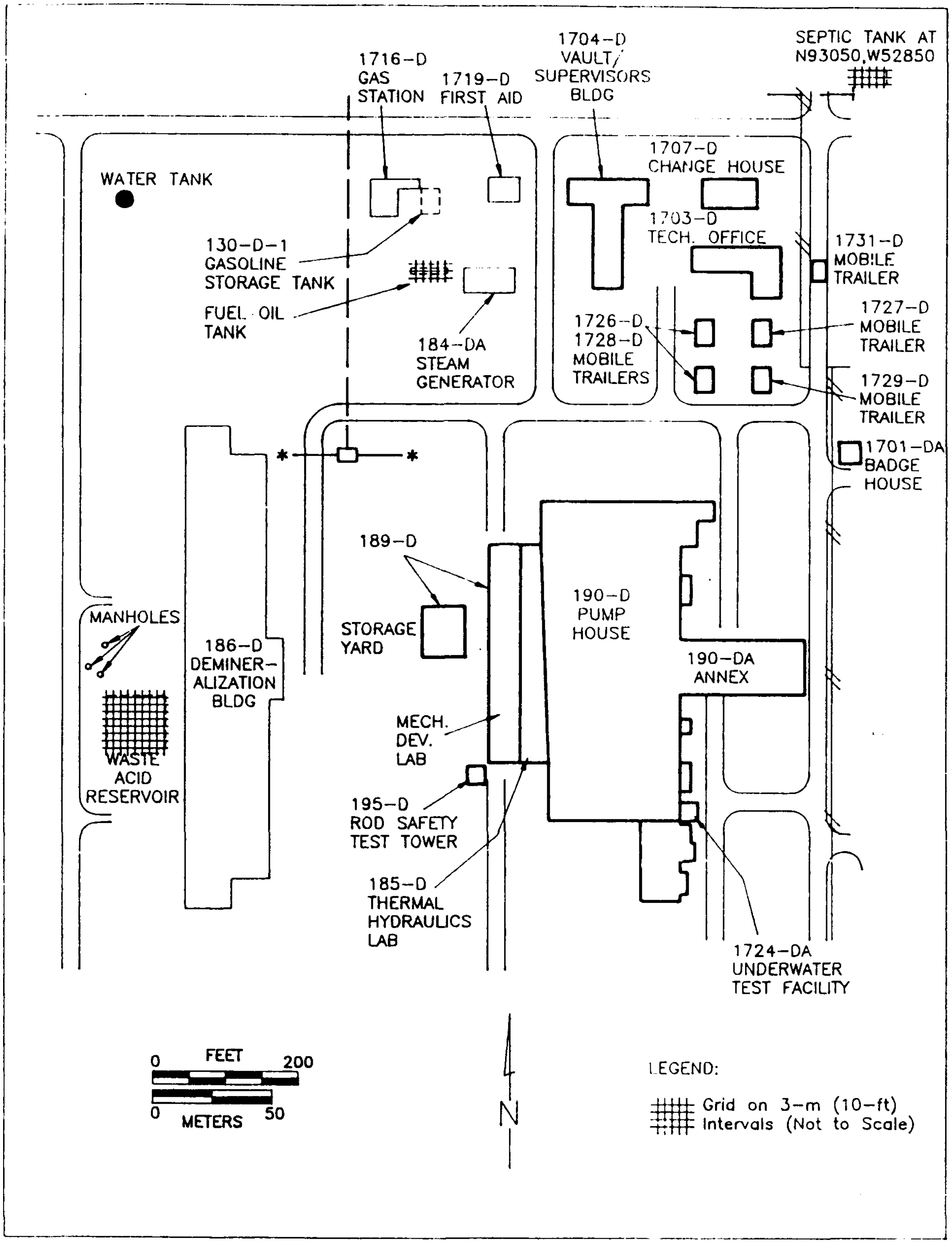


Figure 2. EMI/MAG Survey - Waste Acid Reservoir, Fuel Oil Tank, and Septic Tank at N93050, W52850.

This page intentionally left blank.

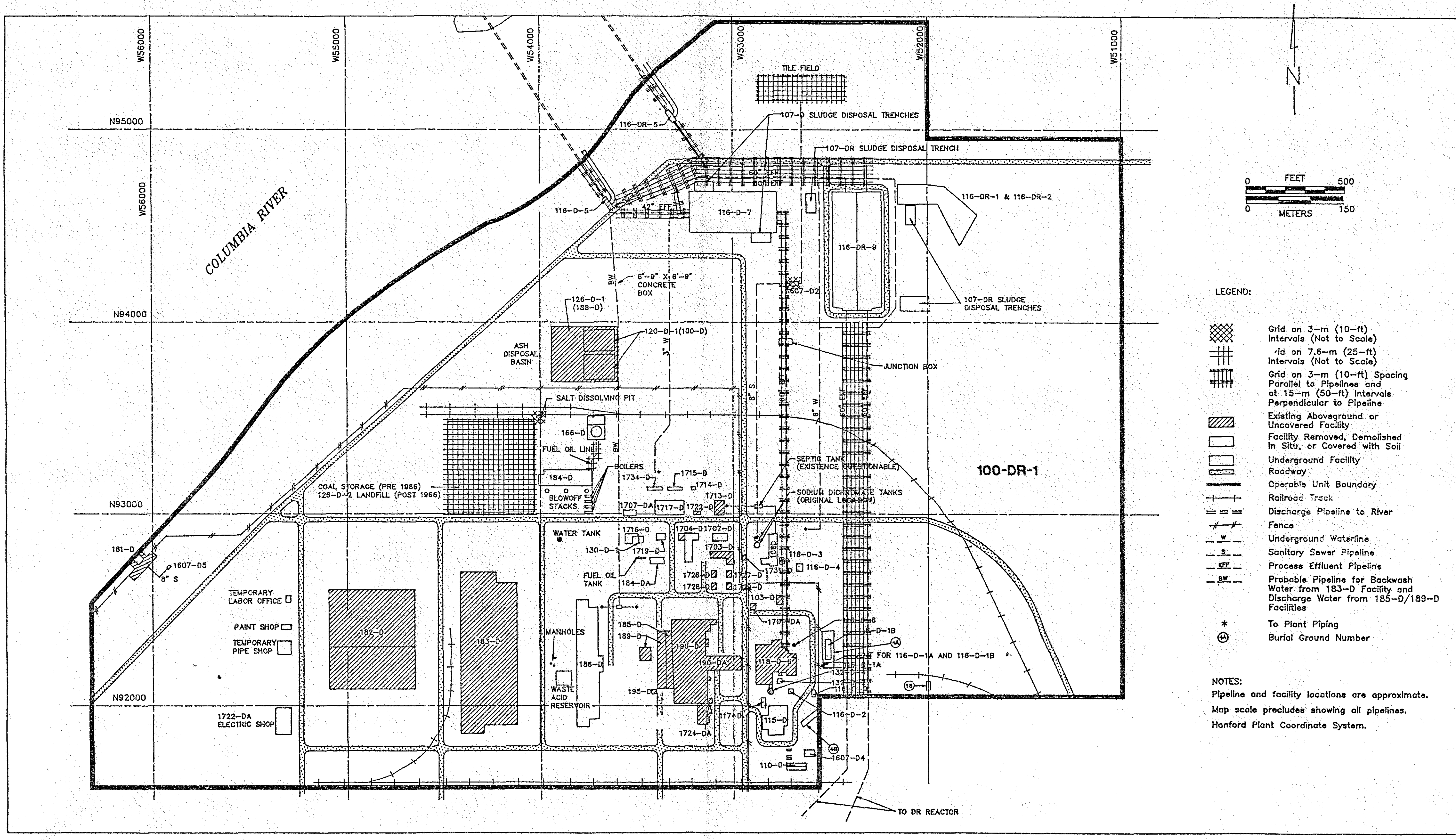


Figure 3. EMI/MAG Survey - Buried Process Effluent Pipe Lines, Septic Tanks 1607-D2 and 1607-D5, 126-D2 Solid Waste Landfill, Tile Field, and Dissolving Pit.

The grid spacing will be larger for long pipelines. A grid will be surveyed with two lines running parallel to the pipeline located 3 m (10 ft) from either side. Lines perpendicular to the pipeline will be on approximately 15-m (50-ft) intervals. Facilities that will be surveyed on this grid spacing are shown in Figure 3 and include the following:

- Buried fuel oil pipeline associated with the 166-D aboveground fuel oil tank
- Buried process effluent pipelines
- Buried discharge pipelines to the Columbia River (including alternate pipeline locations as shown on some drawings).

The EMI survey is anticipated to cover a total of approximately 12,500 linear meters (41,000 linear feet).

2.3.3 Electromagnetic Induction/Magnetometer Survey Anomaly Designation

Each anomaly detected during the EMI survey will be identified with a unique designation number. The designation will indicate which facility the anomaly is associated with, indicate the anomaly was identified during the EMI survey, and include the numerical sequence of the anomaly. For example the first anomaly detected at septic tank 1607-D2 will be designated "1607-D2-EMI#1." Where the objective of the EMI survey is to precisely locate buried facilities, the designation will include the facility name and waste information data system (WIDS) number if applicable. The facility boundaries will be staked and subsequently plotted on a base map using the relative coordinates from the grid established in the Task 1b geodetic survey. The name of the facility and coordinates will be marked on the stakes.

2.3.4 Electromagnetic Induction/Magnetometer Survey Equipment and Procedures

The magnetometer survey will be conducted using a fluxgate magnetometer. The EMI survey will be conducted using a Geonics* EM31 or equivalent. At each survey location, vertical dipole (parallel and perpendicular), horizontal dipole, and in-phase conductivity readings will be recorded on an automatic data logger. Azimuthal readings will be taken where anomalous readings are encountered to attempt to define geometry of the anomaly.

Additional details on magnetometer and electromagnetic survey equipment and procedures shall be specified in a Westinghouse Hanford EII to be developed in accordance with EII 1.2, "Preparation and Revision of Environmental Investigation Instructions" (WHC 1989). Alternatively, the

*Geonics is a trademark.

EMI/MAG survey may be conducted by approved participant contractor or subcontractor procedures as specified in Section 4.0 of the QAPP. These procedures will include details on equipment specifications, including sensitivities and interference, signal generator and antennae array, and data logging equipment.

2.3.5 Data Collection, Reduction, and Interpretation

Results of the EMI/MAG survey will be demarcated in the field by two types of stakes. One will indicate the presence of any anomalies and will be marked as indicated in Section 2.4.3. The other will indicate the boundaries of any buried structures. Data will be recorded in a field notebook in accordance with EII 1.5, "Field Logbooks" (WHC 1989) to supplement the staked locations. In addition, an automatic data logger will be used to log EMI survey data. All field data will be handled in accordance with QAPP and DMP procedures.

Data generated during the EMI/MAG survey will be displayed graphically with profiles showing the depth and lateral extent of any anomalies detected and the boundaries of buried structures. Contour maps defining site patterns in relation to survey lines will also be produced to depict the results of the EMI survey.

2.4 TASK 1d--GROUND PENETRATING RADAR (GPR) SURVEY

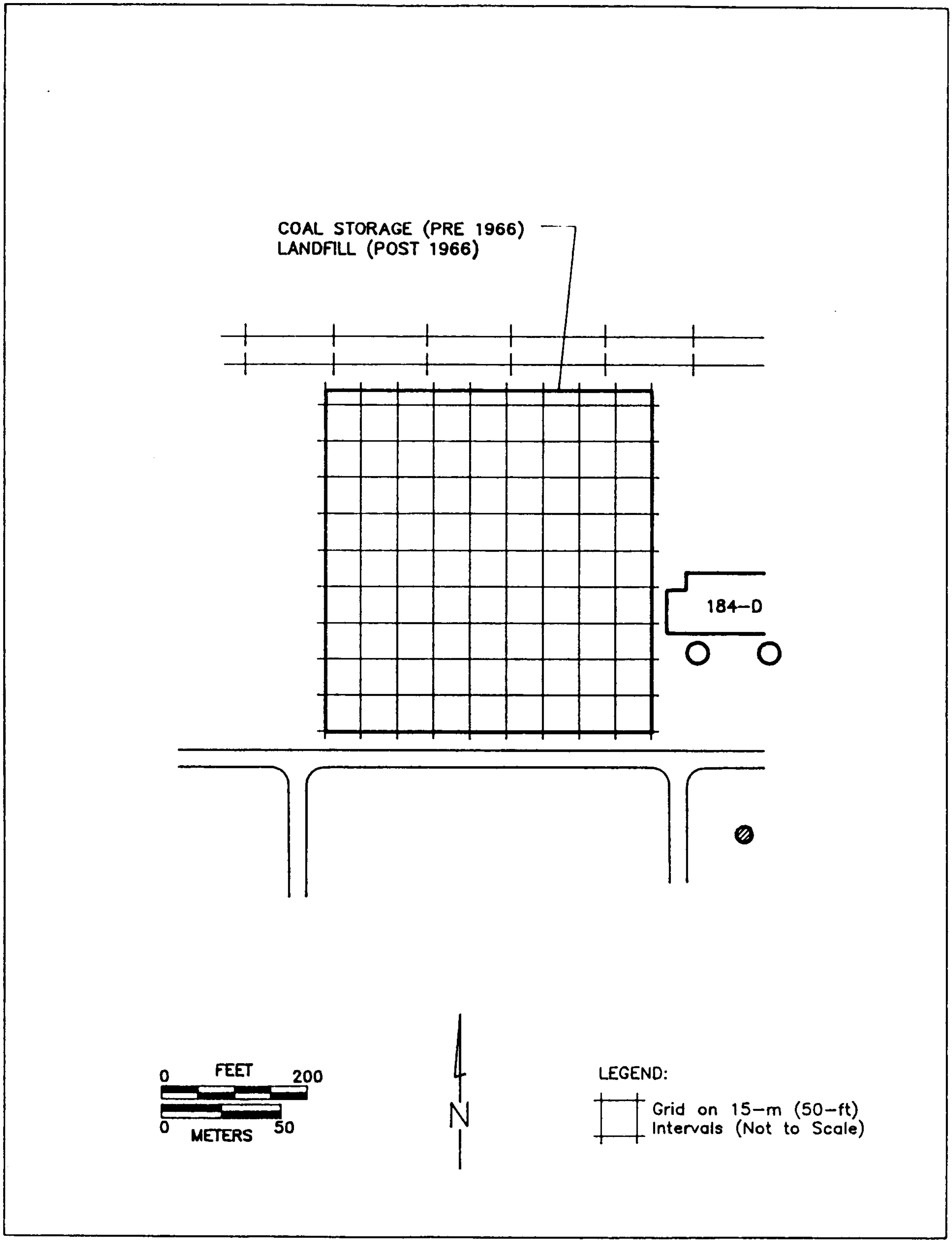
2.4.1 Ground Penetrating Radar Survey Objectives

This activity will determine the locations and boundaries of the solid waste landfill, cribs, other buried features that are presently uncertain, and other facilities that may not have been adequately identified during the EMI/MAG survey.

2.4.2 Ground-Penetrating Radar Survey Locations and Frequencies

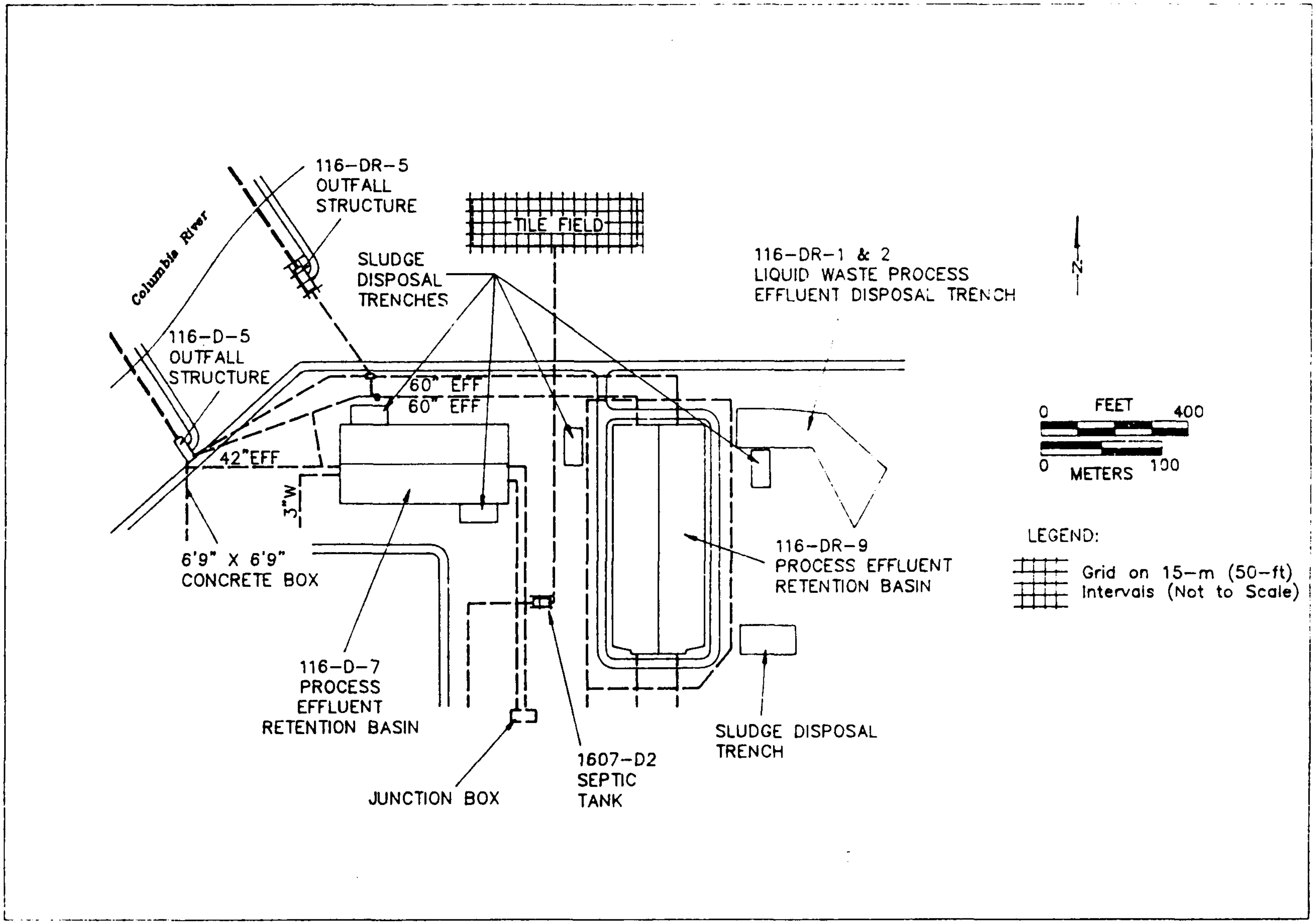
The GPR survey will be conducted at the locations shown in Figures 4, 5, and 6. Facilities include the solid waste landfill, the 116-D-2 pluto crib, the septic tanks and tile fields, the 116-DR-5 outfall structure, and the waste acid reservoir, if the locations are not adequately defined during the EMI/MAG survey described in Section 2.3. A 15-m (50-ft) grid will initially be surveyed to determine facility boundaries and depths. Horizontal control for the grid will be established under Task 1b. Closer grid spacing may be conducted at the 126-D-2 landfill if resolution of the GPR signals is adequate to determine specific types of buried objects (i.e., drums).

Approximately 3,260 linear meters (10,700 linear feet) of survey will be conducted initially. However, additional GPR surveys may be conducted as needed.



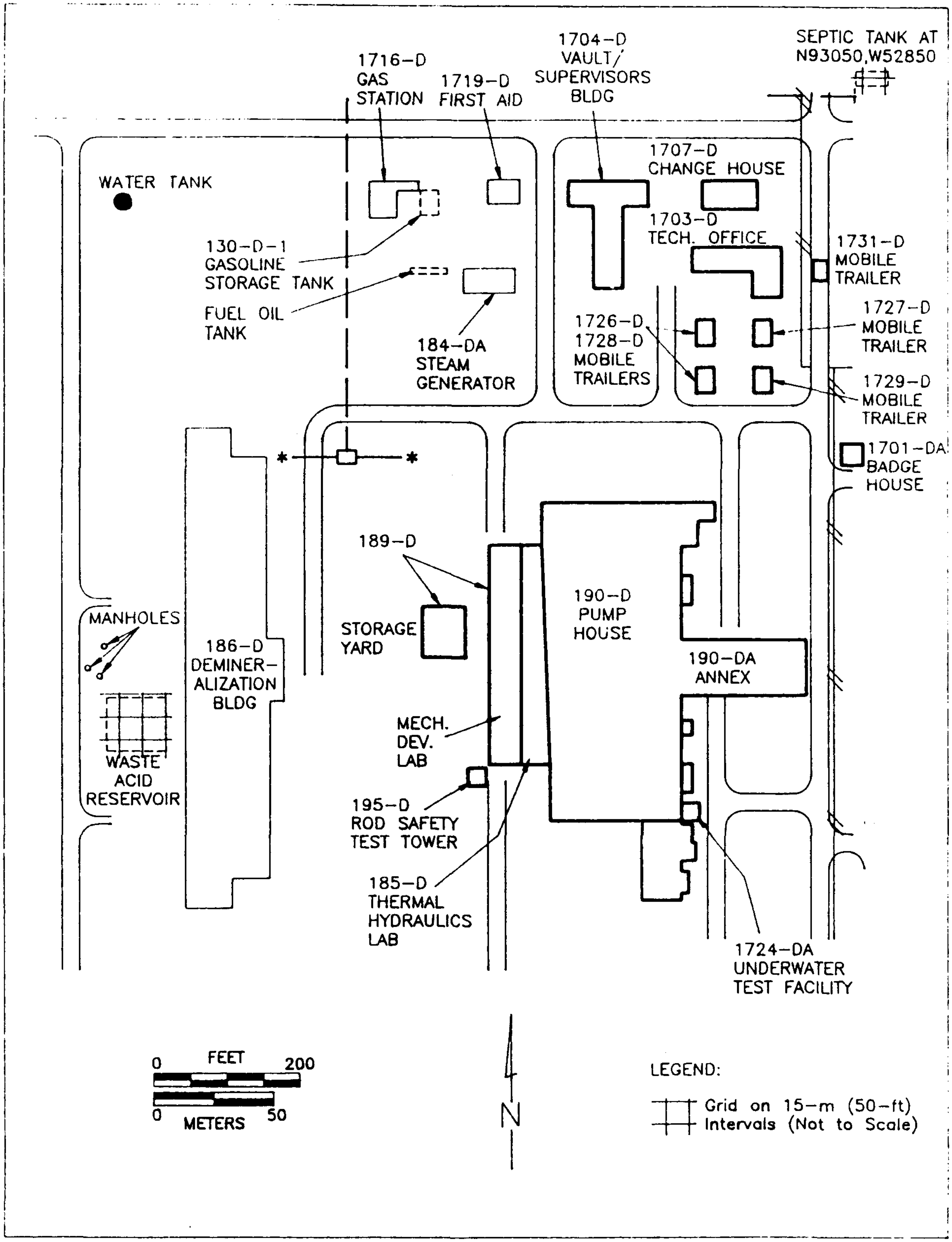
8831736\FSP\32900

Figure 4. GPR Survey Grid - 126-D-2 Solid Waste Landfill.



8831736\FSP\32899

Figure 5. GPR Survey Grid - Tile Field, 1607-D2 Septic Tank, and 116-DR-5 Outfall.



8831736\FSP\32924

Figure 6. GPR Survey - Waste Acid Reservoir and Septic Tank at N93050, W52850.

2.4.3 Ground-Penetrating Radar Survey Transect Designation

The grid coordinates established under Task 1b will be designated A, B, C, etc., along the length of each facility, and A′, B′, C′, etc., along the opposing length. The width coordinates will be designated 1, 2, 3, etc., and 1′, 2′, 3′, etc., respectively. Each transect sampled will therefore be designated by the endpoint coordinates, with the starting point of the sampling run coming first (e.g., A-A′, or 2-2′).

2.4.4 Ground Penetrating Radar Survey Equipment and Procedures

The GPR survey will be conducted along transects run between opposing stakes sited in Task 1b. Results will be plotted as to location by reference back to the established grid systems. Suitable antennae frequencies for the GPR may include 120 MHz (for deep profiling and reconnaissance) and 500 MHz (for high resolution of shallow buried objects).

Details on GPR survey equipment and procedures shall be specified in a Westinghouse Hanford EII to be developed in accordance with EII 1.2, "Preparation and Revision of Environmental Investigation Instructions" (WHC 1989). Alternatively, GPR may be conducted by participant contractor or subcontractor procedures approved and controlled as specified in Section 4.0 of the QAPP. These procedures will specify equipment sensitivities and interferences, radar antennae range, recording equipment, calibration requirements, and personnel certification/training requirements.

2.4.5 Data Collection, Reduction, and Interpretation

Continuous strip chart recording equipment will be used to generate profiles of the GPR survey. Digital signal processing equipment may also be used to enhance data interpretation. Records of all calibrations and procedures will be maintained in the field logbook in accordance with EII 1.5, "Field Logbooks" (WHC 1989). A geophysicist experienced in the interpretation of GPR data will analyze the profiles to determine locations and depths of anomalies and facility boundaries. This information will be incorporated into a map showing locations of features identified during the survey.

2.5 TASK 1e--SOIL GAS SURVEY

2.5.1 Soil Gas Survey Objectives

The objective of the soil gas survey is to identify areas where petroleum products or organic solvents may have been released. Areas where volatile organic compounds are detected in the soil gas survey will be further investigated during the Task 3 soil investigation.

2.5.2 Soil Gas Survey Locations and Frequencies

The areas covered by the soil gas survey are shown in Figures 7 through 11. Probes for the soil gas survey will be installed on a grid with about 7.6-m (25-ft) intervals at the following locations:

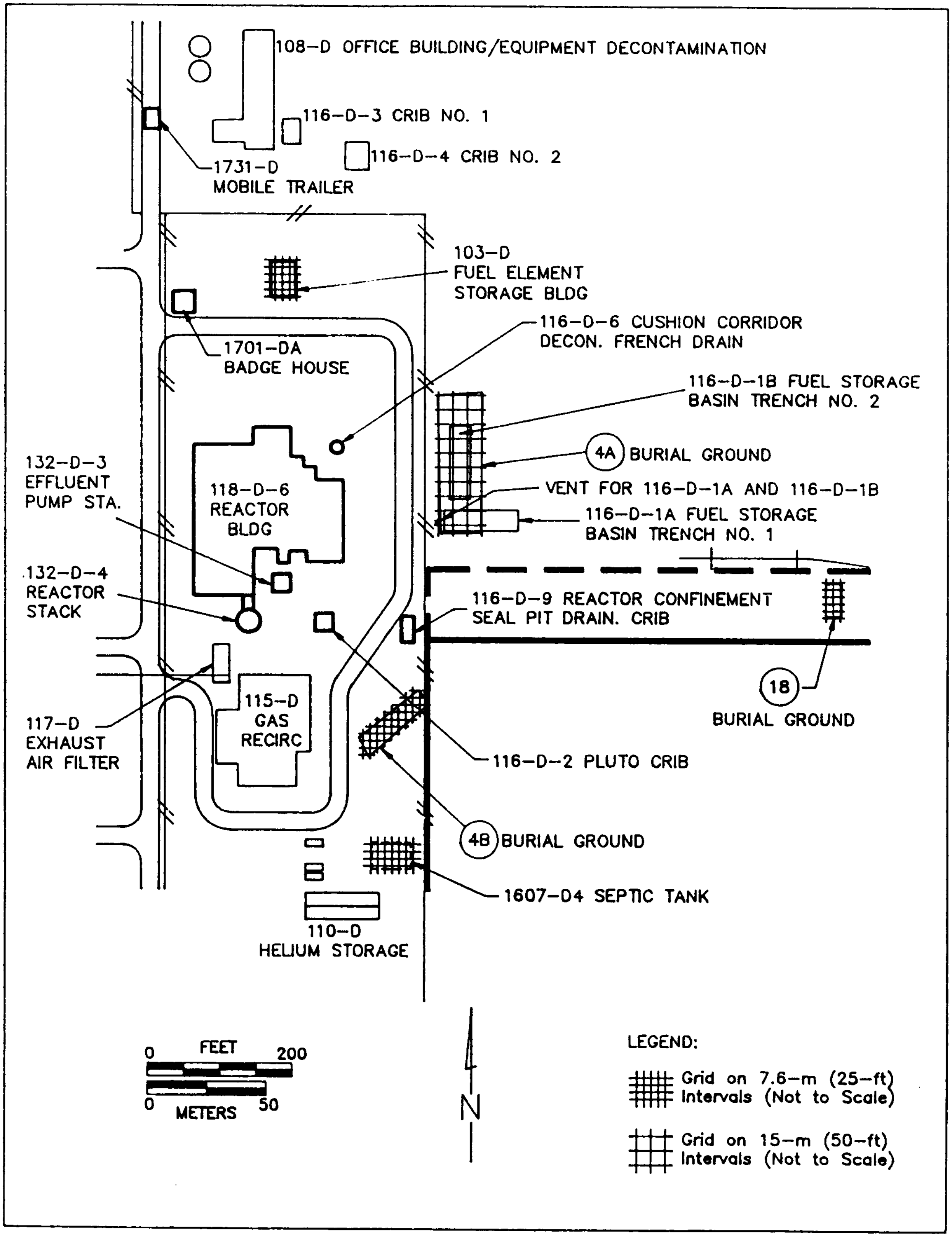
- The 103-D fuel element storage building
- Sewer lines (not shown on figures), septic tanks, and tile fields
- The 1713-D instrument and electrical development laboratory
- The 1714-D solvent storage building
- The 1715-D oil and paint storage
- The 1716-D gas station
- The 1722-D equipment development laboratory
- Underground fuel oil tank west of the 184-DA building
- The 166-D fuel oil tank
- Burial grounds 18 and 4B
- Paint shop (west of 182-D reservoir).

Probes will be installed around the perimeter of existing buildings on about 7.6 m (25 ft) centers. This grid spacing may be modified if it is determined that a closer spacing is required to define the extent of contamination.

Probes will be installed on a grid with about 15-m (50-ft) intervals at the 126-D-2 solid waste landfill located west of the 184-D building and the 4A burial ground, due to the large area to be covered.

The extent of contamination will be determined by installing additional probes until no detectable contamination is found in two adjacent probes bounding the area.

Probes will be installed to about 1- to 2-m (3- to 6-ft) depth at all locations. Final depth at any individual location will depend on subsurface obstructions.



8831736\FSP\32911

Figure 7. Soil Gas Survey - Burial Grounds 4A, 4B, and 18, 1607-D4 Septic Tank, 103-D Fuel Element Storage Building.

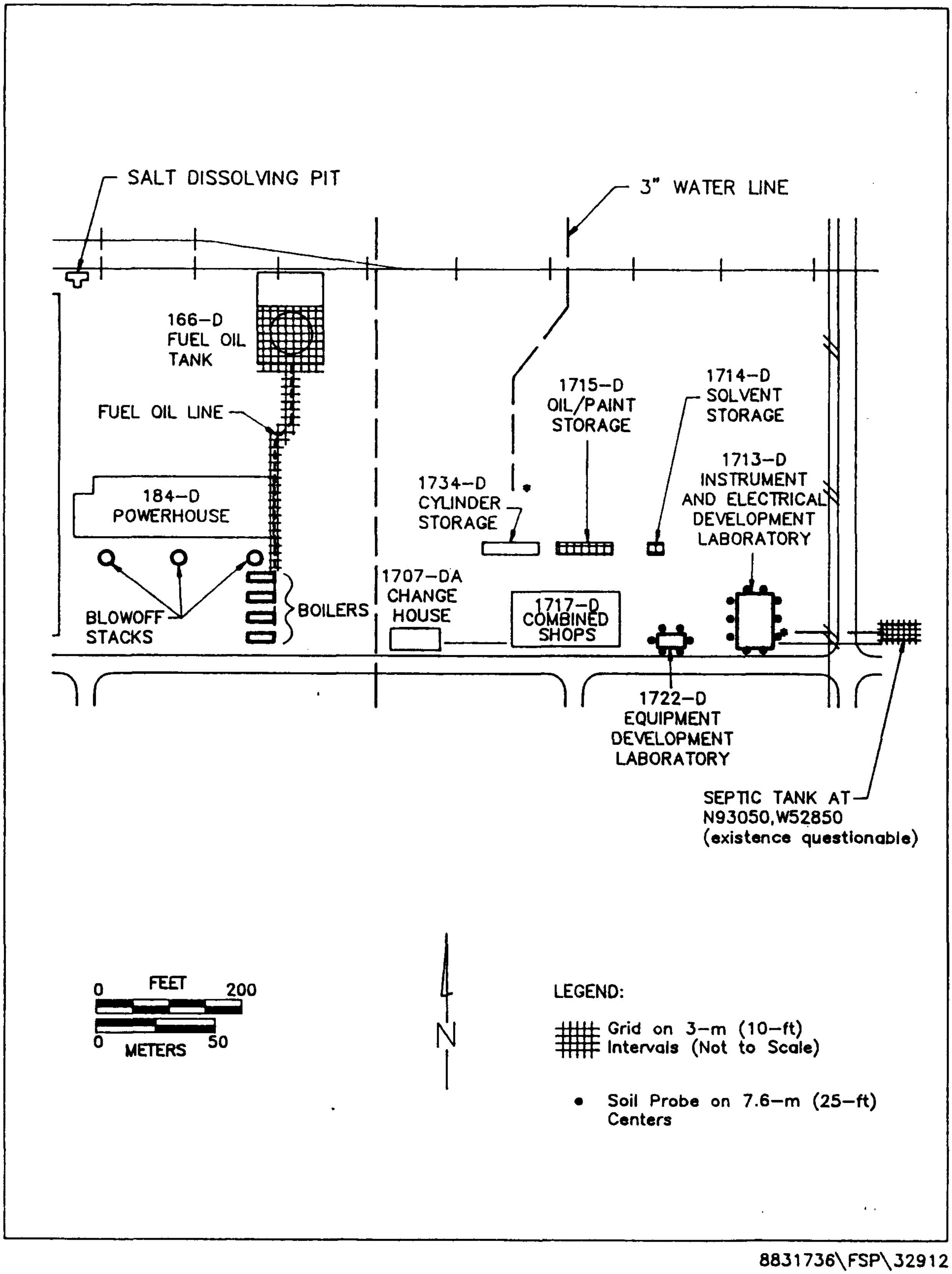
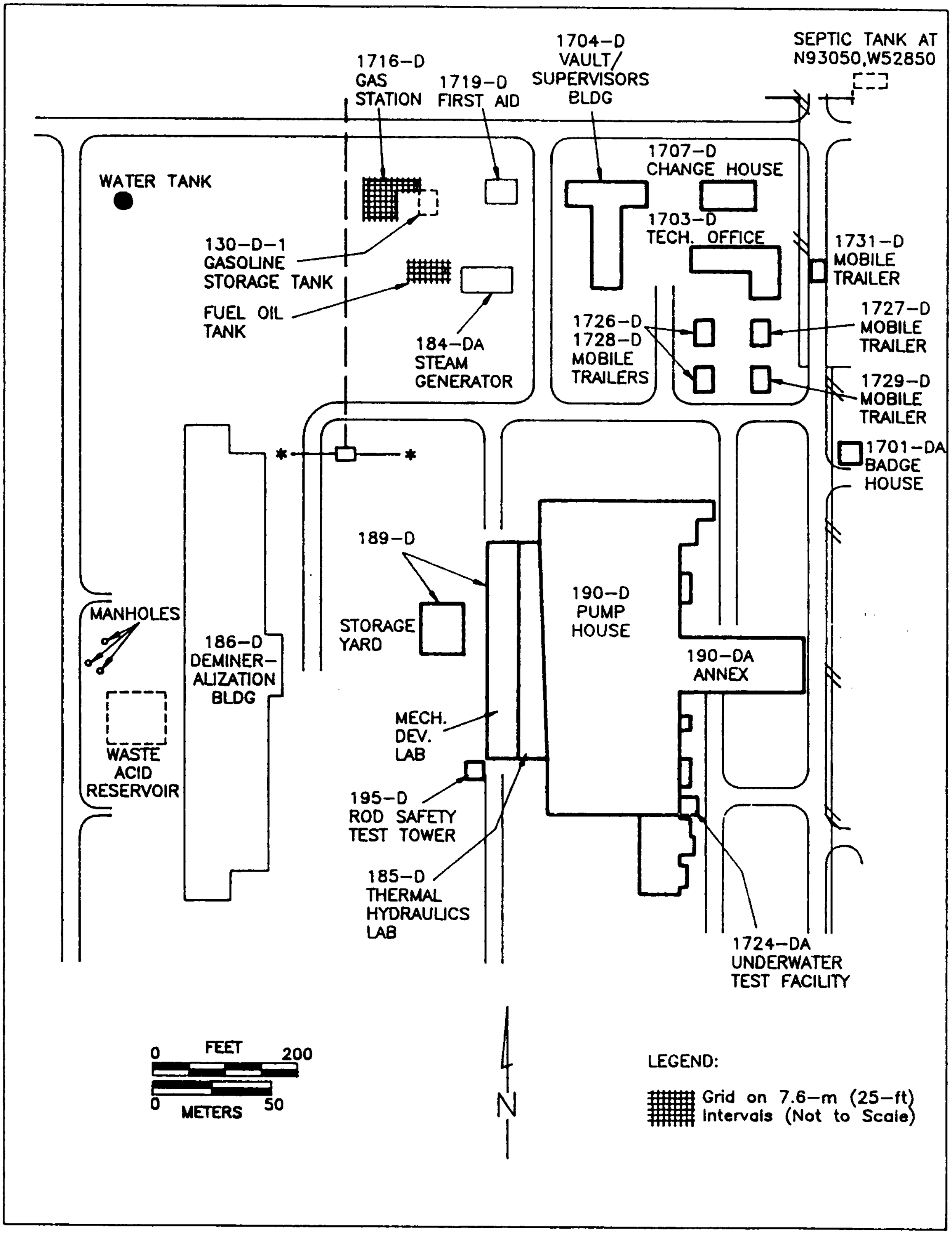
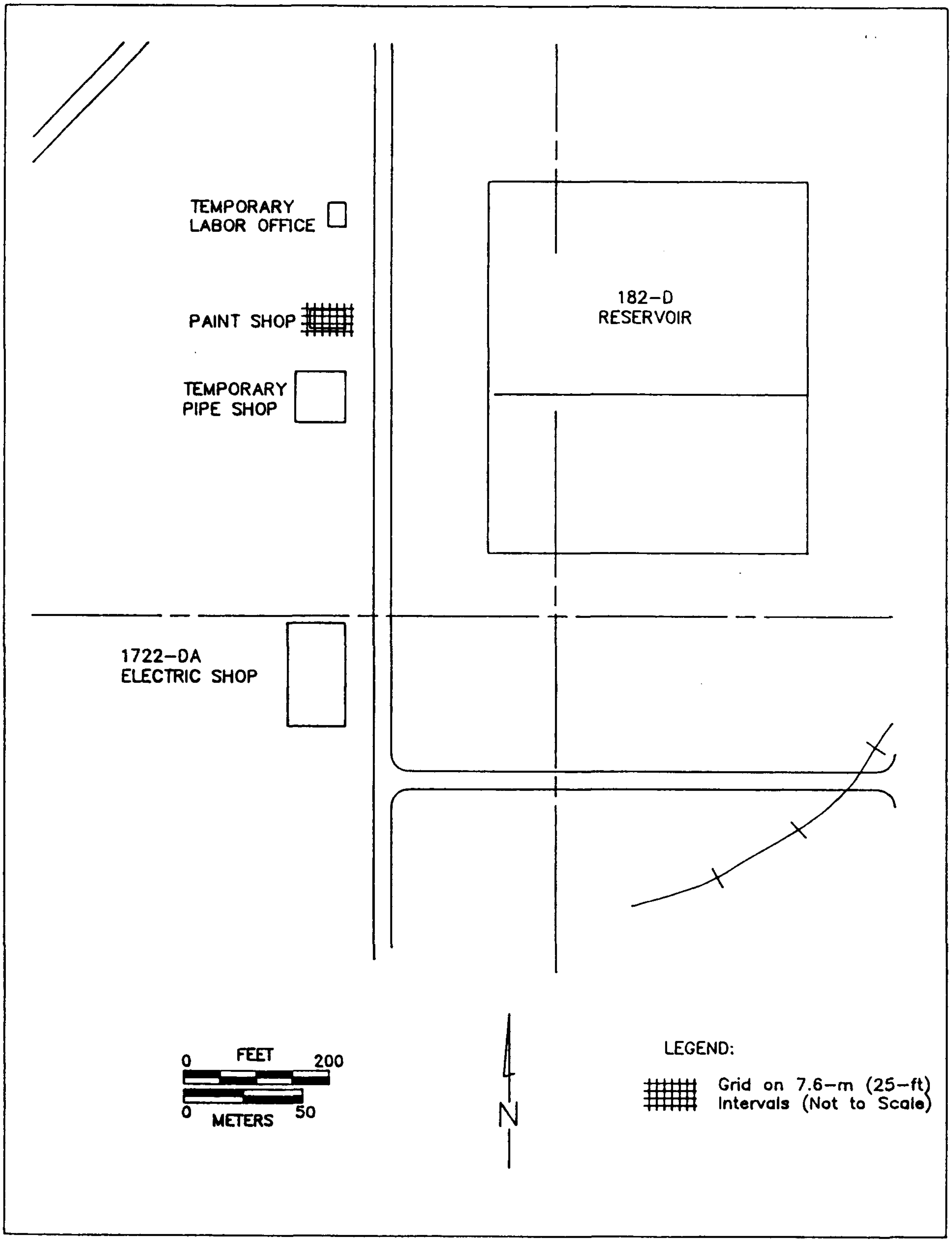


Figure 8. Soil Gas Survey - 166-D Fuel Oil Tank, 1713-D, 1714-D, 1715-D, and 1722-D Facilities, and Septic Tank at N93050, W51850.



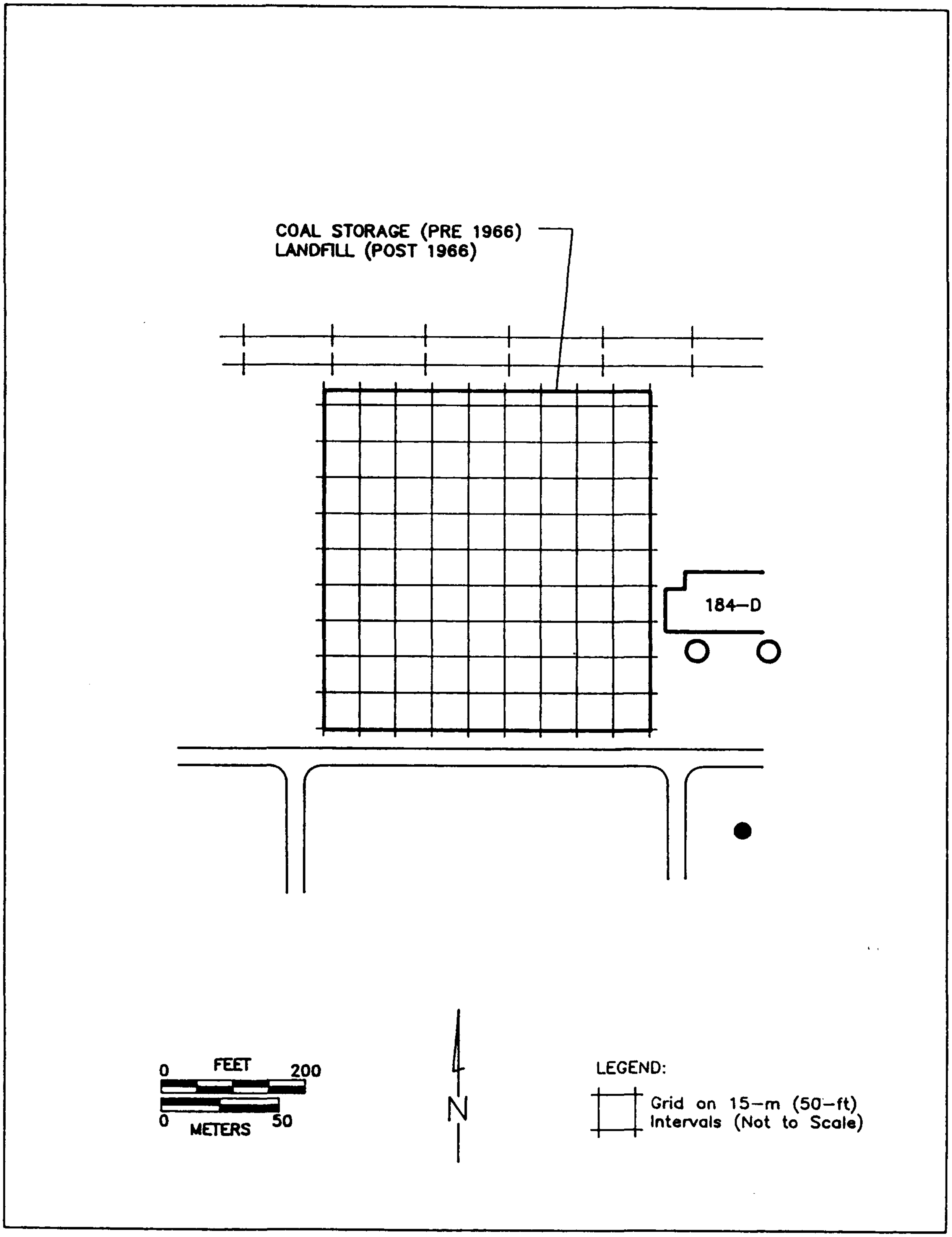
8831736\FSP\32913

Figure 9. Soil Gas Survey - Fuel Oil Tank and 1716-D Gas Station.



8831736\FSP\32914

Figure 10. Soil Gas Survey - Paint Shop West of 182-D Reservoir.



8831736\FSP\32901

Figure 11. Soil Gas Survey - 126-D-2 Solid Waste Landfill.

2.5.3 Sample Designation

Stakes will be used to mark the locations of the soil gas probes. Each probe location will be designated with a unique number associated with the facility being covered by the survey. This number will be followed by the letters "SG" to denote soil gas, and a number indicating the sequence. For example the first probe installed at the 1716-D gas station will be numbered, 1716-D-SG#1. The sample number will be marked in indelible ink on each stake for the probe locations. The sample number will also be used to indicate gas samples obtained for analysis.

2.5.4 Sampling Equipment and Procedures

Equipment required to conduct the soil gas survey includes (a) stainless steel probes, (b) gas-tight fittings for the probes, (c) vacuum pump for purging and sampling, and (d) sample containers (may include gas tight syringes, stainless steel cylinders, tedlar bags, glass sample bulbs). Complete details on equipment and procedures for soil gas probe installation, penetrating and sealing pavement, purge volumes, sample depths, soil gas extraction, sample collection, and sample analysis shall be specified in procedures to be developed. These procedures shall be approved and controlled as specified in Section 4.0 of the QAPP.

2.5.5 Sample Handling and Analysis

Soil gas samples will be obtained in clean gas-tight sample containers. Level II analysis for volatile organic (including methane for all landfill facilities) and halogenated compounds will be conducted onsite using a field portable gas chromatograph (GC) or samples will be shipped to a laboratory for analysis by EPA Method 8240 (Level III). The GC will be equipped with a photo-ionization detector (PID) and an electron-capture detector (ECD). The PID is suitable for detecting volatile organic compounds and the ECD is capable of detecting halogenated organic compounds at low concentrations.

Additional information on sample procedures is provided in Section 4.0 of the QAPP, sample custody in Section 5.0, and analytical procedures in Section 7.0. Procedures for soil gas surveys provided in a to be procedure to be developed, approved and controlled as specified in Section 4.0 of the QAPP, will also contain information on sample collection, handling, and analysis.

2.6 TASK 1f--PROCESS EFFLUENT AND DISCHARGE PIPELINE INTEGRITY ASSESSMENT

2.6.1 Task 1f-1--Review of Results and Procedures of 100-HR-1 Pipeline Assessment

It has been assumed in developing this plan that the 100-HR-1 pipeline integrity assessment will be implemented and completed before the implementation of the 100-DR-1 RFI. If the method assessment is not completed under 100-HR-1, the testing will be implemented during the 100-DR-1 RFI.

Prior to proceeding with Task 1f-2, the results of the 100-HR-1 pipeline integrity assessment will be evaluated to determine whether it was effective and whether any procedural modifications are required. If the results from 100-HR-1 assessment indicate that this method of assessing pipeline integrity is not feasible or provides limited useful information, Task 1f-2 will not be conducted. Instead, the Task 3 soil investigation will be modified to sample additional sites along the pipelines to determine the nature and extent of any contamination as a result of leakage.

If the results from the 100-HR-1 assessment indicate the method is practical, but procedural modifications are required, the procedure will be modified under this subtask. Items to be evaluated include the acceptability of the video camera, illumination equipment, bracing system, and methods for survey control of the camera location.

2.6.2 Task 1f-2--Remote Camera Inspection of Pipelines

2.6.2.1 Inspection Objectives. The purpose of the remote camera inspection of the process effluent and discharge pipelines is to locate places in the pipeline where leaks may have occurred in the past.

2.6.2.2 Locations for Pipeline Inspections. The entire length and interior circumference of all process effluent pipelines will be inspected for cracks or holes. The discharge pipelines will be inspected from the retention basins to the outfall structures at the Columbia River.

2.6.2.3 Designation of Pipeline Leak Locations. Stakes at ground surface marked with the name of the pipeline will be used to indicate the position of pipeline leaks. Locations at ground surface will be determined based on measuring and recording the linear distance of the camera in the pipeline where holes or cracks are detected.

2.6.2.4 Pipeline Inspection Equipment and Procedures. The details on remote camera equipment and procedures shall be developed by participant contractors or subcontractors subject to approval and control as specified in Section 4.0 of the QAPP. These procedures will include a description of dimensions and construction details of the camera, monitor and recording system, bracing and propulsion system, illumination system, method for determining location in the pipeline, methods for preventing contamination, and methods for decontaminating equipment.

As discussed in Section 2.6.1, results of the 100-HR-1 pipeline assessment will be evaluated to determine whether any modifications are required for equipment and procedures to complete this task.

2.6.2.5 Data Collection, Reduction, and Interpretation. The inspection by the remote camera will be recorded on videotape. The positions of cracks and holes in the pipeline will be noted in the field logbook. The location of all large pipeline breach sites will be identified for soil sampling. Groups of holes, cracks, etc., will be considered as one breach site. Soil sampling at these locations will be conducted as described in Task 3--Soil Sampling.

2.7 TASK 1g--SAMPLING AND ANALYSIS

2.7.1 Sampling Objectives

The purpose of this task will collect samples for chemical analysis from potential waste sources to determine if hazardous or radioactive substances are present. This task supplements the soil gas survey, which will identify areas where petroleum products or organic solvents may have been released. Sampling in Task 1g will be conducted for liquids, sludges, some building materials, and material deposited on some buildings (wipe samples). Boring and test pit sampling will be conducted during Task 3, if needed to determine the lateral and vertical extent of any contamination found.

2.7.2 Sampling Locations and Frequencies

Samples will be obtained from the following facilities for chemical analysis:

- Process effluent pipelines and discharge pipelines to river
- The 103-D fuel element storage building
- Septic tanks 1607-D-2, 1607-D-4, and 1607-D5, and septic tank at N93050/W52850
- The 120-D-1 (100-D) ponds
- The 1724-DA underwater test facility
- The 132-D-4 stack
- Various electrical facilities (i.e., transformers, capacitors, etc.).

2.7.2.1 Process Effluent and Discharge Pipelines. Sampling of the pipelines will only be conducted if sludges are identified during the remote camera inspection of the pipelines described in Section 2.6. A maximum of three composited sludge samples will be obtained from each pipeline where sludges are present. Locations for sampling will be selected where sludge is present in sufficient quality to sample effectively. The number of samples for each composite will depend on the volume of material available for sampling.

2.7.2.2 103-D Fuel Element Storage Building. An inspection of the building will be conducted to identify any physical or visible evidence of contamination. Wipe samples will be obtained from all areas of visible contamination. In addition, four random wipe samples will be obtained from the floor of the building where herbicides were stored. A soil sample will be obtained beneath the building (after excavating through the concrete floor) at each location where detectable concentrations of herbicides are found in the wipe samples. These samples will be obtained at the soil surface and at a 1-m (3-ft) depth. Locations for the soil samples will be selected at random, unless contamination detected in the wipe samples correlates with visible evidence. In this case, soil samples will be obtained from locations of visible contamination. Additional sampling will be conducted as described in Task 3 if contamination is detected at the 1-m (3-ft) sampling locations.

2.7.2.3 Septic Tanks 1607-D2, 1607-D4, 1607-D5, and Tank Located at N93050/W52850. One sample will be obtained from each of the septic tanks. Access to the septic tanks will be through clean-out ports. The entire column of sludge will be sampled with a corer to ensure that a representative sample of the contents of the tank is obtained.

2.7.2.4 120-D-1 (100-D) Ponds. Samples from the north 120-D-1 (100-D) pond will initially be obtained with a hand auger. The south pond will be sampled with a coring sampler if water is still in the pond. Samples will be obtained at four locations at the sediment surface and at a 1-m (3-ft) depth in each of the ponds. One sample location in each pond will be at the influent where insoluble or quickly precipitated compounds would be expected in highest concentrations. The other three sample locations in each pond will be selected randomly. A two-stage sampling program may be conducted as part of Task 1g to determine mean values of contaminant parameters with a certain degree of confidence and precision relative to soil background. Deep boring and sampling will be conducted as described in Task 3d, if contamination is detected in any of the samples collected at 1 m (3 ft).

2.7.2.5 1724-DA Underwater Test Facility. Although no radioactive or hazardous substances were reportedly used at this facility, it presently contains some sediments and liquid surfactant. Three composite sediment samples and one sample of the liquids will be obtained to verify that no contamination is present. Locations for sampling will be selected where sludge is present in sufficient quantity to sample effectively. The number of samples for each composite will depend on the volume of material available for sampling. Soil samples adjacent to the facility will be obtained as part of Task 3d sampling if contamination with radioactive or hazardous substances is found.

2.7.2.6 132-D-4 Reactor Exhaust Stack. A radiation survey for alpha, beta, and gamma radiation will be conducted in the interior of the stack, using a portable, laboratory-quality alpha detector and sodium iodide beta/gamma detector that reads in counts per minute. At least five randomly located wipe samples within the interior of the stack will be collected for laboratory analysis.

2.7.2.7 Electric Facilities. Surface soils around the areas where transformers and capacitors have been stored will be visually examined for evidence of leaks. Soil samples will be obtained at random locations where transformers existed and also where visibly stained soils are identified.

2.7.3 Sample Designation

The following codes will be used to designate samples obtained during Task 1g (X is a variable number).

Facility association--Each code will begin with a code identifying the facility it is associated with. The WIDS number will be used for those facilities assigned a number. For those facilities not assigned a WIDS number (i.e., process effluent pipelines, and electric facilities), an abbreviation will be used followed by a number if more than one of these facilities is sampled. Examples are provided below:

- 103D--the 103-D fuel element storage basin
- 120D1--the 120-D-1 ponds
- PEPX--the process effluent pipeline and number sampled
- ETX--electrical transformer and number sampled.

Depth or type of sample--The code described above will be followed by a code describing the depth or type of sample as indicated below:

- XX.X--depth to the nearest tenth of a foot for soil samples
- WSX--wipe sample and number of sample
- LSX--liquid sample and number of sample
- SLSX--sludge sample and number of sample.

Disposition of the sample--The above codes will be followed by a code describing the sample disposition (the number 2 will be appended for duplicate samples) as follows:

- MS--metals and radiation analysis
- AS--nonmetallic ion analysis
- VS--volatile organic analysis
- SVS--semi-volatile organic analysis
- R--archive.

Examples of the overall sample designation are as follows:

- 103D-WS1-SVS (wipe sample number 1, obtained from the 103-D building for semivolatile organic analysis)
- PEP1-SLS2-MS (sludge sample number 2, obtained from the first process effluent pipeline for metals and radiation analysis)

- 120D1-3.0-VS (sample obtained at a depth of 0.9 m (3.0 feet) from the 120-D-1 ponds for volatile organics analysis).

If a Hanford Site-specific sample coding system is developed prior to the initiation of field activities, this system will be used in place of the sample designation codes described above.

2.7.4 Sampling Equipment and Procedures

Details on sampling equipment and procedures for most of the work described above are contained in EII 5.2, "Soil and Sediment Sampling" (WHC 1989). Appendix E, Surface Sampling, addresses the procedures that will be used to sample the 120-D-1 (100-D) Ponds, the electric facilities, and shallow soil samples from beneath the floor of the 103-D Building (if required). Appendix F, Method for Sampling Sludges or Sediments Through Open Water, addresses the procedures that will be used for sampling the septic tanks and the 1724-DA facility.

Equipment and procedures for wipe sampling, field screening for volatile organics, coring, and sampling of sludges in pipelines will be developed. These will either be Westinghouse Hanford procedures developed in accordance with EII 1.2, "Preparation and Revision of Environmental Investigation Instructions" (WHC 1989), or participant contractor or subcontractor procedures approved and controlled as specified in Section 4.0 of the QAPP.

2.7.5 Sample Handling and Analysis

Field logs will be maintained to record all observations and activities conducted in accordance with EII 1.5, "Field Logbooks" (WHC 1989). Samples for laboratory analysis will be placed in containers and properly preserved in accordance with EII 5.2, "Soil and Sediment Sampling" (WHC 1989), and Section 4.0 of the QAPP. All samples for laboratory analysis will be transported under Chain of Custody in accordance with EII 5.1, "Chain of Custody" (WHC 1989), and Section 5.0 of the QAPP. Parameters for analysis and analytical procedures are shown in Tables 1 and 2. Additional information is also provided in Sections 3.0, and 7.0, and Table 1 of the QAPP.

Table 1. Task 1g--Sample Analysis.

Location	No. of samples/[a] sample matrix	Parameters for analysis	Analytical method/level	Rationale
Process effluent pipelines	18/sludge	radionuclides[c] TCL (organics)[d] TAL (inorganics)[d]	Westinghouse Hanford[b]/V CLP/IV CLP/IV	Sample sludges remaining in pipelines to determine presence of radioactive or hazardous substances.
103-D fuel element storage building	4+/wipe 8/soil	radionuclides[c] herbicides volatile organics	Westinghouse Hanford[b]/V 8150/III 8240/III	Determine whether releases of herbicides, VOCs or radionuclides have occurred.
Septic tanks	1/sludge	radionuclides[c] TCL (organics)[d] TAL (inorganics)[d]	Westinghouse Hanford[b]/V CLP/IV CLP/IV	Sample sludges remaining in septic tanks to determine presence of radioactive or hazardous substances.
120-D-1 (100-D) Ponds	16/soil	See Table 2	See Table 2/III	Sample for all hazardous constituents potentially released.
1724-DA underwater test facility	3/sediment 1/liquid	radionuclides[c] TCL (organics)[d] TAL (inorganics)[d]	Westinghouse Hanford[b]/V CLP/IV CLP/IV	Determine presence of radioactive or hazardous substances.
132-D-4 reactor exhaust stack	5 wipe	radionuclides[c]	Westinghouse Hanford[b]/V	Determine presence of radioactive substances.
Electric facilities	To be determined	PCBs, chlorinated benzenes	8270/III	Determine whether releases have occurred.

[a]Does not include Quality Control samples (see Section 9.0 of QAPP).
[b]Westinghouse Hanford Company or subcontractor procedures for radionuclides.
[c]^{3}H, ^{14}C, ^{60}Co, ^{63}Ni, ^{90}Sr, ^{134}Cs, ^{137}Cs, ^{152}Eu, ^{154}Eu, ^{155}Eu, ^{235}U, ^{238}U, ^{238}Pu, ^{239}Pu, ^{240}Pu, gross alpha, gross beta
[d]EPA 1988 and EPA 1989

Table 2. Task 1g--120-D-1 (100 D) Ponds Sample Analysis.

Metals	Method	Conventionals	Method	Organics	Method	Radionuclide	Method
Ag	ICP/6010	Specific conductance	9050	chlorinated	8150	gross alpha	9310
		pH	9040	herbicides			
Al	ICP/6010	total organic carbon	9060			gross beta	9310
As	GF-AA/7060			BNA extractable	8270		
Ba	ICP/6010	ammonium	ASTM-D 1426	organics		gamma scan	Westinghouse Hanford[a]
Be	ICP/6010			phosphate pesticides	8140		
Cd	ICP/6010	chloride	9250/9251/924			uranium	Westinghouse Hanford[a]
Cr	ICP/6010	cyanide	9010/9012	total organic halides	9020		
Cu	ICP/6010	fluoride	ASTM-D 4327	volatile organics	8240		
Fe	ICP/6010						
Hg	GF-AA/7471	nitrate	9200				
K	ICP/6010	phosphate	ASTM-D 4327				
Mg	ICP/6010	sulfate	9035				
		sulfide	9030				
Mn	ICP/6010						
Na	ICP/6010						
Ni	ICP/6010						
Pb	GF-AA/7421						
Se	GF-AA/7740						
Sr	ICP/6010						
Ti	ICP/6010						
V	ICP/6010						
Zn	ICP/6010						

[a]Westinghouse Hanford Company or subcontractor procedures.

3.0 PHASE I RFI TASK 2--GEOLOGICAL INVESTIGATION

The geological investigation will further characterize the geological structure and stratigraphy of the operable unit. Relevant data will be gathered under four subtasks. Because geological data needs overlap with those of the 100-DR-1 soil investigation (Task 3) and the 100-HR-3 groundwater investigation, the geological investigation subtasks involve a coordinated compilation of pertinent soil (vadose zone) and groundwater information.

3.1 TASK 2a--COLLECTION OF EXISTING DATA

This subtask does not involve any field sampling. Details of the activities that will be conducted are provided in Section 5.3.2.1 of the Work Plan.

3.2 TASK 2b--SURFACE GEOLOGIC MAPPING

Surface geologic mapping will be performed at the operable unit using the topographic map prepared for Task 1b as the base map on which data are plotted. Mapping will identify the types and areal extent of surficial deposits within and adjacent to the operable unit, including dune and sheet sand, alluvium, colluvium, and loess, as well as fly ash and backfill materials. Relevant information from the Task 3d soil boring logs will be incorporated into this mapping task.

3.3 TASK 2c--COMPILATION OF GEOLOGICAL DATA OBTAINED UNDER THE TASK 3d SOIL INVESTIGATION

Task 3d of the 100-DR-1 Phase I RFI will consist, in part, of the generation of geological and geophysical borehole logs for vadose zone borings. Physical analytical data will also be generated that is relevant to understanding the geology of the operable unit. Task 2c, therefore, is a project coordination function of obtaining such relevant soil data for use in subsequent geological data evaluation and interpretation. No field sampling or measurement activities are therefore involved.

3.4 TASK 2d--COMPILATION OF GEOLOGICAL DATA OBTAINED UNDER THE 100-HR-3 PHASE I RFI GROUND WATER INVESTIGATION

Task 2d is also a project coordination function that involves no field sampling or measurements. Geological borehole logs from the monitoring wells installed in the 100-DR-1 vicinity, and all physical analytical results from sediment samples obtained during well installation, will be gathered for subsequent geological evaluation and interpretation with respect to the operable unit.

This page intentionally left blank.

DO NOT MICROFILM
THIS PAGE

4.0 PHASE I RFI TASK 3--SOIL INVESTIGATION

This task will further define the vertical and horizontal extent of soil contamination surrounding and below hazardous waste disposal facilities in the 100-DR-1 operable unit. Investigation of vertical and horizontal contamination in subsurface soils will be performed by borehole and test pit soil sampling. The nature of the soil contamination will be determined by laboratory analysis. The task will also determine the physical characteristics of the soils. The actual techniques used to obtain samples during the soil investigation will be based on whether the method employed keeps radiation exposure to field personnel as low as reasonably achievable (ALARA) in compliance with regulatory requirements.

4.1 TASK 3a--SURFACE RADIATION SURVEY

4.1.1 Surface Radiation Survey Objectives

This activity will locate any areas of radiation in the surficial soil within the operable unit. Background surface radiation conditions will also be determined so that meaningful comparisons can be made to the data obtained in the potentially impacted areas.

4.1.2 Surface Radiation Survey Locations and Frequency

The background plot established for the 100-HR-1 RFI/CMS will be used for determining background surface radiation levels at the 100-DR-1 operable unit. This background radiation survey will be conducted on land surface approximately 2.4 km (1.5 mi) east-northeast of the 100-DR-1 operable unit boundary and approximately 500 m (1640 ft) west of 100-HR-1. The background plot will be approximately 53 m (175 ft) by 46 m (150 ft). Sampling at the background plot will be conducted at intersecting points on approximately a 7.6-m (25-ft) grid to obtain discrete readings at each point. This grid spacing may be modified if it is determined that a closer spacing is required. Approximately 56 points will be sampled using this grid spacing.

Sampling within the 100-DR-1 operable unit will be conducted along transects at a minimum of 7.6-m (25-ft) intervals to determine the location and extent of elevated radiation. This grid spacing may also be modified if it is determined that a closer spacing is required. Where an elevated level of radiation that is statistically greater than background is encountered along a transect (statistically significant levels will be determined by elevated levels above the 0.95/0.95 upper tolerance limit of the background distribution, or by other statistical methods, as appropriate), the survey will depart from the transect to locate and quantify the source of the reading. The area with elevated radiation will be staked and flagged for subsequent geodetic surveying under Task 1b and for more detailed soil inspection under Task 3d.

4.1.3 Surface Radiation Survey Background and Anomaly Designations

The grid coordinates established for the background plot will be designated A, B, C, etc., along the length of the plot, and 1, 2, 3, etc., along with width of the plot. Each point measured will be designated by the combined grid coordinates (e.g., B2, C1).

Each anomaly detected during the surface radiation survey will be identified with a unique designation number. The designation will indicate that the anomaly was identified during the surface radiation survey and include the numerical sequence of the anomaly. For example, the first anomaly detected will be SRAD #1.

4.1.4 Surface Radiation Survey Equipment and Procedures

The surface radiation survey will be conducted for alpha, beta, and gamma radiation using a portable (vehicle-mounted or hand-held, as appropriate) laboratory-quality alpha detector and a sodium-iodide, beta/gamma detector that reads in counts per minute. Any areas with values above the background upper tolerance limit will be staked for subsequent geodetic surveying under Task 1b.

Details on surface radiation survey equipment and procedures will be developed. These will either be Westinghouse Hanford procedures developed in accordance with EII 1.2, "Preparation and Revision of Environmental Investigation Instructions" (WHC 1989), or participant contractor or subcontractor procedures approved and controlled as specified in Section 4.0 of the QAPP. These procedures will include details on equipment specifications, data logging equipment, and calibration and maintenance requirements.

4.1.5 Data Collection, Reduction, and Interpretation

Continuous recording equipment will be used to generate data along the grid lines during the surface radiation survey. Records of all calibrations and procedures will be maintained in a field notebook in accordance with EII 1.5, "Field Logbooks" (WHC 1989). An individual experienced in the interpretation of surface radiation data will analyze the data to identify anomalies. Data generated during the surface radiation survey will be displayed graphically on a site map to show the areal extent of any anomalies detected.

4.2 TASK 3b--BACKGROUND SOIL CHARACTERIZATION COORDINATION WITH 100-HR-3

This activity does not involve any field sampling or measurements under the 100-DR-1 project. At least 50 discrete vadose zone samples, allocated at 1.5-m (5-ft) intervals and at any changes in lithology to a depth of approximately 3 m (10 ft) above the expected maximum groundwater level, from at least five 100-HR-3 background borings and/or groundwater monitoring wells will be obtained for 100-DR-1 background soil characterization. The background boreholes will be located near the 100-DR-1 operable unit in areas that have not been impacted by unit operational activities. All background borings will be located away from the following areas: areas of elevated surface radiation readings, actual waste management units, areas impacted by unplanned release events, areas where fill has been deposited or obtained, and all areas within a distance of 15 m (50 ft) from any engineered facilities. All sampling and analysis will be conducted under the 100-HR-3 project. If the 100-HR-3 investigation is delayed, it will be necessary to drill background borings specifically for the 100-DR-1 operable unit.

The samples will be analyzed for the 100-DR-1 parameters of interest (Table 3), and one sample per geologic stratum per borehole, randomly allocated with respect to depth prior to the initiation of drilling, will be obtained for physical characterization. Physical characterization parameters will include bulk density, permeability, porosity, moisture content, grain-size distribution, soil classification, consolidation, pH, and cation exchange capacity. In addition, changes in lithology encountered in each borehole will be recorded. The vertical sampling scheme for each background borehole is presented in Figure 12.

4.3 TASK 3c--TEST PIT SAMPLING AND ANALYSIS

4.3.1 Task 3c-1--Mobilization

This activity does not involve field sampling and is therefore not addressed in this sampling plan (see Section 5.3 of the RFI/CMS Work Plan for mobilization activities).

4.3.2 Task 3c-2--Test Pit Sampling

4.3.2.1 Sampling Objective. Test pits provide a fast and relatively inexpensive method to sample for shallow contamination. The test pit sampling activity will determine the nature and extent of potential sources of contamination at facilities where shallow, nonradioactive contamination was identified during the Task 1 source investigation.

4.3.2.2 Sample Locations. The locations of test pits will depend on the anomalies identified in the Task 1 source investigation. Test pits will be excavated at nonradiological anomalies identified by the Task 1d GPR survey that may represent buried drums, the Task 1e soil gas survey "hot spots" that may represent sources of contamination, and the Task 1g sampling and analysis. Facilities to be evaluated by test pits, depending upon the results of Task 1, include:

- The 1607-D2 septic tank
- The 1607-D4 septic tank

Table 3. Parameters of Interest for the 100-DR-1 Operable Unit and Analytical Methods and Levels (Sheet 1 of 4)

Category	Analyte of Interest	Method	Analytical Level[a]
Radiation Screening	gross alpha	b	I
	gross beta/gamma	b	I
	gross alpha	9310[c]	III
	gross beta	9310[c]	III
Radionuclide Analysis	Hydrogen-3	b	V
	Carbon-14	b	V
	Cobalt-60	b	V
	Nickel-63	b	V
	Strontium-90	b	V
	Cesium-134	b	V
	Cesium-137	b	V
	Europium-152	b	V
	Europium-154	b	V
	Europium-155	b	V
	Uranium-235	b	V
	Uranium-238	b	V
	Plutonium-238	b	V
	Plutonium-239	b	V
	Plutonium-240	b	V
Metals Analysis	Aluminum	6010[c]	III
	Arsenic	7060[c]	III
	Beryllium	6010[c]	III
	Cadmium	6010[c]	III
	Chromium (total)	6010[c]	III
	Copper	6010[c]	III
	Lead	7421[c]	III
	Nickel	6010[c]	III
	Sodium	6010[c]	III
	Zinc	6010[c]	III
	Barium	6010[c]	III
	Silver	6010[c]	III
	Iron	6010[c]	III
	Potassium	6010[c]	III

Table 3. Parameters of Interest for the 100-DR-1 Operable Unit and Analytical Methods and Levels (Sheet 2 of 4)

Category	Analyte of Interest	Method	Analytical Level[a]
Metals Analysis (cont.)	Manganese	6010[c]	III
	Selenium	7740[c]	III
	Strontium	6010[c]	III
	Titanium	6010[c]	III
	Vanadium	6010[c]	III
	Aluminum	ICP[d]	IV
	Arsenic	ICP[d]	IV
	Beryllium	ICP[d]	IV
	Cadmium	ICP[d]	IV
	Chromium (total)	ICP[d]	IV
	Copper	ICP[d]	IV
	Lead	Furnace AA[d]	IV
	Mercury	Cold Vapor[d]	IV
	Nickel	ICP[d]	IV
	Sodium	ICP[d]	IV
	Zinc	ICP[d]	IV
	Barium	ICP[d]	IV
	Silver	ICP[d]	IV
	Iron	ICP[d]	IV
	Potassium	ICP[d]	IV
	Manganese	ICP[d]	IV
	Magnesium	ICP[d]	IV
	Selenium	Furnace AA[d]	IV
	Strontium	ICP[d]	IV
	Titanium	ICP[d]	IV
	Vanadium	ICP[d]	IV
Ion Analysis	Ammonium	ASTM-D-1426 D/C	III
	Chloride	ASTM-D-4327	III
	Cyanide	9010[c]	III
	Fluoride	ASTM-D-4327	III
	Nitrate	9200[c]	III
	Phosphate	ASTM-D-4327	III
	Sulfate	9035[c]	III
	Sulfide	9030[c]	III
Organic Scan	All required per CLP TCL	CLP[e]	IV

Table 3. Parameters of Interest for the 100-DR-1 Operable Unit and Analytical Methods and Levels (Sheet 3 of 4)

Category	Analyte of Interest	Method	Analytical Level[a]
Inorganic Scan	All required per CLP TAL	CLP[e]	IV
Phosphate Pesticides Analysis	Azinphos methyl	8140[c]	III
	Bolstar	8140[c]	III
	Chlorpyrifos	8140[c]	III
	Coumaphos	8140[c]	III
	Demeton-O	8140[c]	III
	Demeton-S	8140[c]	III
	Diazinon	8140[c]	III
	Dichlorvos	8140[c]	III
	Disulfoton	8140[c]	III
	Ethoprop	8140[c]	III
	Fensulfothion	8140[c]	III
	Fenthion	8140[c]	III
	Merphos	8140[c]	III
	Mevinphos	8140[c]	III
	Naled	8140[c]	III
	Parathion methyl	8140[c]	III
	Phorate	8140[c]	III
	Ronnel	8140[c]	III
	Stirophos (Tetrachlorvinphos)	8140[c]	III
	Tokuthion (Prothiofos)	8140[c]	III
	Trichloronate	8140[c]	III
Chlorinated Herbicides	2,4-D	8150	III
	2,4-DB	8150	III
	2,4,5-T	8150	III
	2,4,5-TP (Silvex)	8150	III
	Dalapon	8150	III
	Dicamba	8150	III
	Dichloroprop	8150	III
	Dinoseb	8150	III
	MCPA	8150	III
	MCPP	8150	III

Table 3. Parameters of Interest for the 100-DR-1 Operable Unit and Analytical Methods and Levels (Sheet 4 of 4)

Category	Analyte of Interest	Method	Analytical Level[a]
Total Organic Halides	Organic halides	9020	III
Total Organic Carbon	Organic carbon	9060	III
Semivolatile Organic Scan (includes PCBs)	All detected per Method 8270	8270	III
Volatile Organic Scan	All detected per Method 8240	8240	III

Notes:

[a]Analytical levels are as defined in Section 4.3.1 of Data Quality Objectives for Remedial Response Activities: Volume 1, Development Process (EPA 1987) and Table 31 of the Work Plan for this Operable Unit.

[b]Analytical methods shall be in compliance with approved Westinghouse Hanford or Westinghouse Hanford-approved participant contractor or subcontractor procedures. All procedures shall be reviewed and approved in compliance with requirements specified in the Westinghouse Hanford QA program plan for CERCLA RI/FS activities.

[c]Methods specified are from Test Methods for Evaluating Solid Waste (SW-846) (EPA 1986).

[d]Type of CLP RAS method is from Data Quality Objectives for Remedial Response Activities: Volume 1, Development Process (EPA 1987).

[e]CLP methods shall be as specified in the analytical laboratory's negotiated Statement of Work for CLP services.

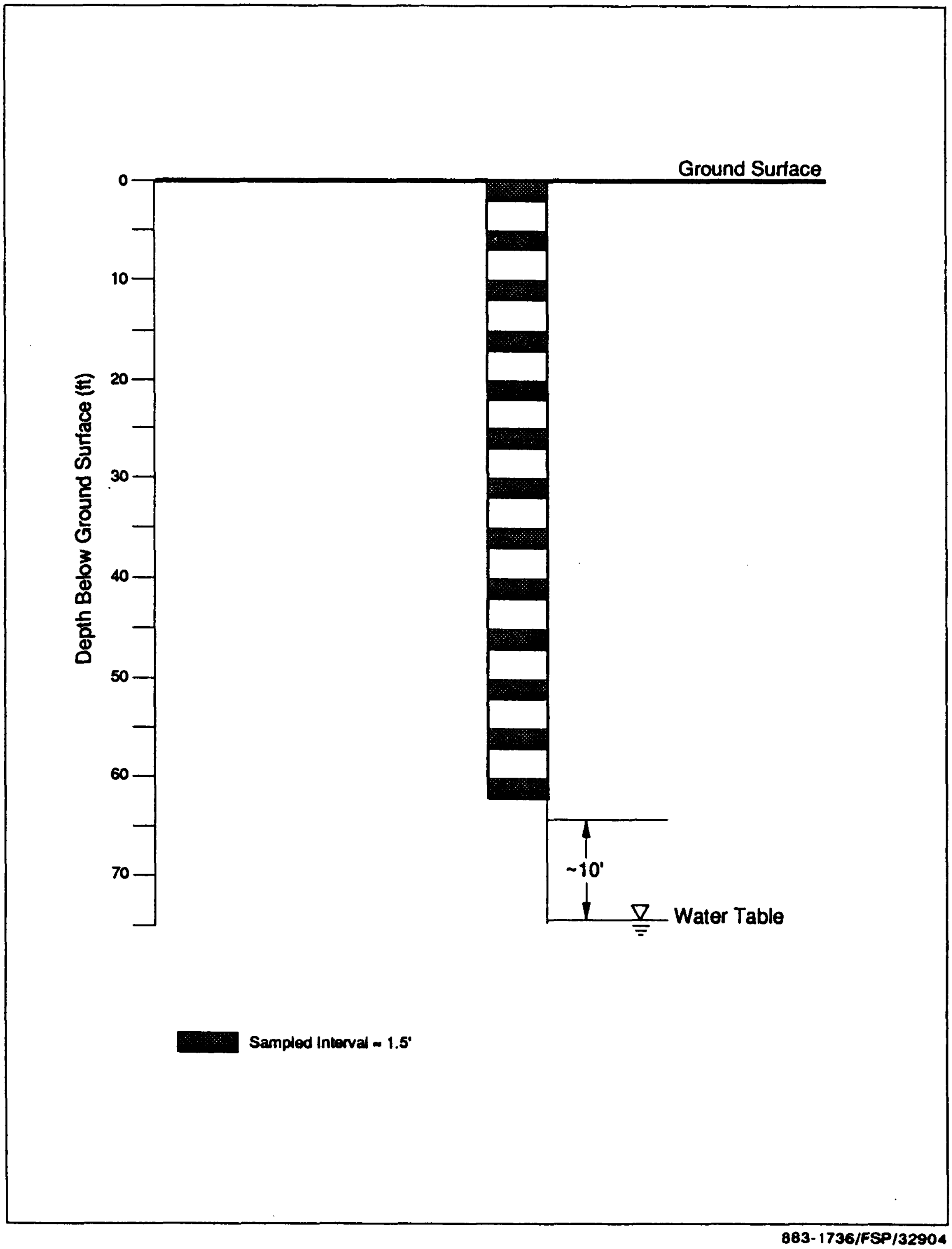


Figure 12. Background Soil Borings - Sample Locations.

- The 1607-D5 septic tank
- Septic tank at N93050/W52850
- Sanitary sewer pipelines
- Fuel oil tank west of 184-DA facility (if not previously removed)
- The 166-D fuel oil tank (at former site of this above-ground facility)
- Fuel oil pipelines
- Support facilities, if soil gas survey defines "hot spots"
  - 1713-D instrument development lab
  - 1714-D solvent storage
  - 1715-D oil and paint storage
  - 1716-D gas station
  - 1722-D equipment development lab
  - paint shop west of the 182-D reservoir
- Solid waste landfill
- Electrical facilities
- Salt dissolving pit.

Test pits at contaminated sites will be sampled at 0.3-m (1-ft), 1-m (3-ft), and 1.5-m (5-ft) depths.

If contaminants are identified in soil samples from test pits, borings will be emplaced to investigate the vertical extent of contamination. The soil boring program is described in Task 3d.

4.3.2.3 Sample Designations. The following codes will be used to designate samples obtained during the test pit sampling (X is a variable number):

Facility association--Each code will begin with a code identifying the facility it is associated with, as described in Section 2.7.3.

Type of sample--The code described above will be followed by a code describing the type of sample as indicated below:

- TPX.X--test pit sample and number, followed by soil sample number within test pit.

Depth of sample--The code described above will be followed by a code describing the depth of the sample as indicated below:

- XX.X--depth from the surface, to the nearest tenth of a foot.

Disposition of the sample--The above codes will be followed by a code describing the sample disposition (the number 2 will be appended for duplicate samples) as follows:

- MS--metals and radiation analysis
- AS--nonmetallic ion analysis
- VS--volatile organic analysis
- SVS--semi-volatile organic analysis
- R--archive.

Procedures for screening for volatile organics and radioactivity will be developed in accordance with EII 1.2, "Preparation and Revision of Environmental Investigation Instructions" (WHC 1989).

An example of the overall sample designation is as follows:

- 1714D-TP1.1-4-VS (test pit number 1 at the 1714-D solvent storage facility; soil sample number 1 at depth of 4 feet; sample sent for volatile organic analysis).

If a Hanford Site-specific sample coding system is developed prior to the initiation of field activities, this system will be used in place of the sample designation codes described above.

4.3.2.4 Sampling Equipment and Procedures. The test pits will be excavated with a backhoe or similar bucket-equipped heavy equipment that will permit excavation to a depth of 1.2 m (4 ft). Test pit sampling will be performed in accordance with EII 5.2, "Soil and Sediment Sampling, Appendix F, Surface Sampling Method (Test Pits/Trenches)" (WHC 1989). Disturbed samples will be collected from the bucket of the backhoe, with care being taken to ensure that the sample does not include slough or material scraped from the sides of the pit. Test pits will be sampled at 0.3-m (1-ft), 1-m (3-ft), and 1.2-m (4-ft) depths. Procedures for decontamination of sampling equipment are contained in EII 5.5, "Decontamination of Equipment for RCRA/CERCLA Sampling" (WHC 1989). Procedures for decontamination of the excavation equipment are addressed under the procedures described in EII 5.4, "Decontamination of Drilling Equipment" (WHC 1989). Quality control samples will be collected in accordance with Section 9.0 of the QAPP.

4.3.2.5 Sample Handling. The test pits and all samples will be screened with hand-held field instruments for alpha, beta, and gamma radiation and volatile organic compounds. Procedures for screening for volatile organics and radioactivity will be developed in accordance with EII 1.2, "Preparation and Revision of Environmental Investigation Instructions" (WHC 1989). No personnel will enter a test pit. Field logs will be maintained to record all observations and activities in accordance with EII 1.5, "Field Log-books" (WHC 1989). Depths of all pit samples from the surface will be measured and recorded in the field log book. All completed field records will be maintained and processed in accordance with EII 1.6, "Records Management" (WHC 1989). Samples for laboratory analysis will be placed in appropriate containers and properly preserved in accordance with EII 5.2, "Soil and Sediment Sampling" (WHC 1989), and in accordance with Section 4.0 of the QAPP. All samples for laboratory analysis will be transported under chain of custody in accordance with EII 5.1, "Chain of Custody" (WHC 1989).

During test pit excavation and sampling, measures will be taken to prevent migration of contamination (e.g., precipitation infiltration into the spoil pile, precipitation run-on into the pit, fugitive dust, and uncontrolled air emissions) in accordance with EII 5.2, Appendix F, "Soil and Sediment Sampling" (WHC 1989).

4.3.3 Task 3c-3--Soil Sample Analysis

Samples will be analyzed by qualified laboratories with Westinghouse Hanford-approved QA plans. Samples from the septic tanks and sewer pipelines will be analyzed for the contaminants identified in Task 1g source sampling and analysis, using CLP analytical Level IV for TCL (organics) or TAL (inorganics).

Samples from the fuel oil tanks and pipelines and the support facilities will be analyzed for volatile organics, using Method 8240 with CLP analytical Level IV equivalent protocols. Samples from the 126-D-1 solid waste landfill will be analyzed for the contaminants identified in Task 1g, using CLP analytical Level IV for TCL (organics) or TAL (inorganics).

Samples from the electrical facilities will be analyzed for PCBs and chlorinated benzenes using Method 9270 with CLP analytical Level IV equivalent protocols. Samples from the salt dissolving pit will be analyzed for TCL (organics) using CLP analytical Level IV.

4.3.4 Task 3c-4--Test Pit Abandonment

Test pits will be backfilled and properly compacted after sampling has been completed according to EII 5.2, Appendix F "Surface Sampling Method (Test Pits/Trenches)" (WHC 1989). Backfill will be covered with clean soil and graded to the original contour as necessary.

4.4 TASK 3d--BOREHOLE SOIL SAMPLING AND ANALYSIS

4.4.1 Task 3d-1--Mobilization

This activity does not involve field sampling and is therefore not addressed in this sampling plan (see Section 5.3 of the RFI/CMS Work Plan for details on mobilization activities).

4.4.2 Task 3d-2--Soil Sampling

4.4.2.1 Sampling Objectives. Borehole sampling will be the method of soil sampling implemented under this subtask. The objectives of the soil sampling activity are to:

- Determine the nature of and vertical and horizontal distribution of the contaminants present in the vadose-zone soils associated with specific 100-DR-1 waste facilities that are known or suspected to be contaminated
- Determine the nature of and vertical and horizontal distribution of potentially contaminated vadose-zone soils as determined by the EMI, MAG, GPR, soil gas, surface radiation, and remote camera surveys
- Determine the physical characteristics of the soils to evaluate contaminant movement and future corrective measures
- Obtain archive samples for potential future analytical testing of physical properties.

4.4.2.2 Sample Locations and Frequencies. Because of the nature of the facility types and operations, the flat ground surface at the operable unit, and the porous nature of the soils, soil contamination is expected to be confined primarily to areas directly beneath or adjacent to waste containment or disposal structures. However, release of contamination via the 132-D-4 reactor exhaust stack and spills from the process effluent pipelines may have extended the limits of soil contamination. Vertical soil borings will be drilled at facilities with known or potential contamination, as well as in those areas identified as potentially contaminated based on the EMI, MAG, GPR, soil gas, surface radiation, and remote camera surveys.

Subsurface soil sampling methods are described in EII 5.2, "Soil and Sediment Sampling" (WHC 1989). The sampling method used will depend on the nature of the Pasco gravels (informal name) at the operable unit, which typically contain boulders and cobbles, and the ability to obtain acceptable samples for analysis. If the nature of the soils is unacceptable for the collection of contaminated samples and undisturbed samples for physical and organic volatile analysis, this sampling program will require modification, and sampling methods other than those in EII 5.2 must be considered.

The preferred sampling method to obtain samples of highly radioactive soils (as identified from previous sampling results, knowledge of past use of the facility, or results of the surface radiation survey) is the dual-wall core-barrel sampling method (EII 5.2, Appendix A), which permits samples to be collected without releasing contamination to the general environment. Withdrawn inner tubes, in which the sample is contained, will be transported to a separate sample extraction facility for sample removal to prevent release of contaminants. The soil sampling method proposed to obtain samples from all other areas will be the drive tube sampling method (EII 5.2, Appendix D), which permits collection of relatively undisturbed geotechnical samples and samples for analysis of volatile organic compounds. A cable tool or rotarytype drill rig will be used to drive and retrieve the dual-wall sampler. Drive tube samplers will be driven with a surface or downhole weight assembly.

Unless otherwise described, all dual-wall sampling tubes will be geologically logged at the sample extraction facility and the drive-tube samples will be logged concurrently with the drilling operation. Samples for laboratory analysis will be collected at specified intervals, as described below, to a depth of approximately 3 m (10 ft) above the expected maximum groundwater level. The proposed target depth for the expected maximum groundwater level of each boring will be based upon high-river stages in the Columbia River, using records compiled since Priest Rapids dam was built, and a groundwater level data base that uses existing wells and that is updated as 100-HR-3 wells are drilled. If 100-HR-3 well data are not available, the water table depth will be based on historical river level data and existing 100-DR-1 well data only.

Borehole geologic logs will record the applicable information specified in EII 9.1, "Geologic Logging" (WHC 1989). Density measurements will be obtained during drive sampling by recording blow counts for the first 46 cm (18 in) for each sampled interval and recorded in 15-cm (6-in) increments on the borehole log, along with the hammer weight and length of the hammer fall. Each borehole will be geophysically logged prior to pulling the casing, using downhole probes for gamma-gamma, neutron-epithermal neutron, and high-resolution spectral gamma radiation.

Where soil conditions permit, two physical sample splits from each geologic unit encountered, at a location randomly allocated with respect to depth prior to the initiation of drilling, will be obtained from each boring. Additional samples will be required if major changes of lithology are encountered within a geologic unit. One sample from each unit will be collected, and splits from each dual-wall core or drive sample will be taken for laboratory determination of soil and vadose zone physical characteristics and one split will be collected for archiving. The archived samples can be used to replace any samples that are lost or broken, or for leachability/ adsorptability and soil phase mineralogy testing, if such tests become necessary. In addition, duplicate quality assurance samples for laboratory analysis will be taken at a frequency of no less than 5 percent. Procedures for the collection of samples are described in EII 5.2, "Soil and Sediment Sampling," (WHC 1989) and procedures for the archiving of samples are described in EII 5.7A, "Hanford Geotechnical Sample Library Control" (WHC 1989). Table 4 lists the soil physical parameters to be measured.

All soil samples obtained during borehole drilling will be continuously screened with hand-held field instruments for alpha, beta, and gamma radiation, and drive tube samples will be screened for volatile organic compounds. These field results will be used to select additional samples in areas between established sampling intervals that appear to be highly contaminated. Soil samples obtained for laboratory contaminant and physical properties analyses will be similarly screened for radiation and volatile organic compounds.

Table 4. Soil Physical Parameters for the 100-DR-1 Operable Unit

Parameter	ASTM Standard/Analytical Technique
Permeability	D-2434
Porosity	a
Moisture content	D-2216
Grain-size distribution, including percent clay	D-422
Soil classification	D-2487
Consolidation	D-2435[d]
Density	b
Water holding capacity	c
Cation exchange capacity	a
Pressure heads in vadose zone to general moisture characteristic curves	c
pH	a

[a]Standard analytical techniques.

[b]Standard laboratory analyses using bulk-density, soil core, or air-pressure methods.

[c]The large body of existing data collected by soil scientists at PNL will be used for this parameter. The data must be fully identified and supported.

[d]Requires an undisturbed sample for fine-grained materials. Parameter not valid for coarse-grained materials.

For cost effectiveness, the soil boring program will be conducted in phases to reduce the number of parameters to be analyzed. Two separate strategies for this phased program have been developed, based on whether the nature of contamination is unknown or has been determined by previous sampling in the Task 1g source sampling task or Task 3c test pit sampling. The phases of the boring program are identified in this Field Sampling Plan in arabic numerals to distinguish them from phases of the RCRA facility investigation, of which they are a part. This phased program is described further below. Statistically significant contamination will be determined by elevated levels of contaminants above the 0.95/0.95 upper tolerance limit of the background distribution, or by other statistical methods, as appropriate.

At facilities that are not sampled as part of the Task 1g source sampling or Task 3c test pit sampling, and for which the complete range of contaminants is unknown, a three-phased soil boring program will be carried out as follows:

Phase 1: The nature of contamination will be determined in Phase 1 by means of one shallow boring located either in an area where maximum contamination can be expected (e.g., at the beginning of the waste distribution system) or at a random location if contamination is expected to be evenly distributed. Samples for laboratory analysis will be obtained at 1.5-m (5-ft) intervals, at "hot spots" as determined by real-time screening, and at major changes in lithology, to a depth of 3 m (10 ft) below the base of the facility (Figure 13). Samples will be analyzed for the entire CERCLA target compound list (TCL) of organic compounds, and the target analyte list (TAL) of inorganics, and the full suite of radionuclides likely to be present in the operable unit. Radionuclide analysis will be analytical level V and CERCLA TCL and TAL analysis will be conducted using Level IV equivalent procedures. One physical sample from each geologic unit encountered will be archived for future analysis of physical parameters.

Following the collection of samples, the borehole will be temporarily capped until the results of laboratory analysis are received and the list of contaminant parameters can be refined. The boring program will proceed to Phase 2 if significant contamination is identified.

Phase 2: If contamination was identified in the Phase 1 shallow borings, the borehole will be reentered and deepened in Phase 2 to 3 m (10 ft) above the expected maximum groundwater level (Figure 13). At larger facilities (e.g., retention basins, tile fields), additional deep borings will be drilled in Phase 2 within the facility boundaries to further define the extent of contamination within these boundaries. Samples will be collected at 1.5-m (5-ft) intervals, at "hot spots" as determined by real-time screening, and at major changes in lithology. Phase 2 samples will be analyzed only for those contaminants detected in the Phase 1 boring program. Organics and inorganics will be analyzed by standard EPA Level III methods, unless the analysis must be conducted in a hot cell due to radioactivity. Hot cell analyses for organics or inorganics for these samples and radionuclide analyses will be Level V. Duplicates of approximately 20 percent of the samples will be analyzed using Level IV equivalent procedures for validation of the Level III analyses. Physical samples will be collected from each geologic unit encountered for physical analysis; either these samples, or the samples collected in Phase 1 will be selected for actual physical analysis.

Phase 3: Phase 3 will be conducted at those facilities where contamination was identified at depth in Phase 2 and for which the horizontal extent of contamination must be determined. These facilities will be evaluated by means of either two randomly located borings or borings at locations where the likely route to seepage is known, spaced at a distance from the facility boundaries determined by professional judgement and incorporating any available results of horizontal dispersion studies at the Hanford Site (Figure 14). The sample depth will be determined by the vertical extent of contamination identified in Phase 2. Sample intervals will be the same as those for the Phase 2 borings, and the parameters for analysis will be those contaminants

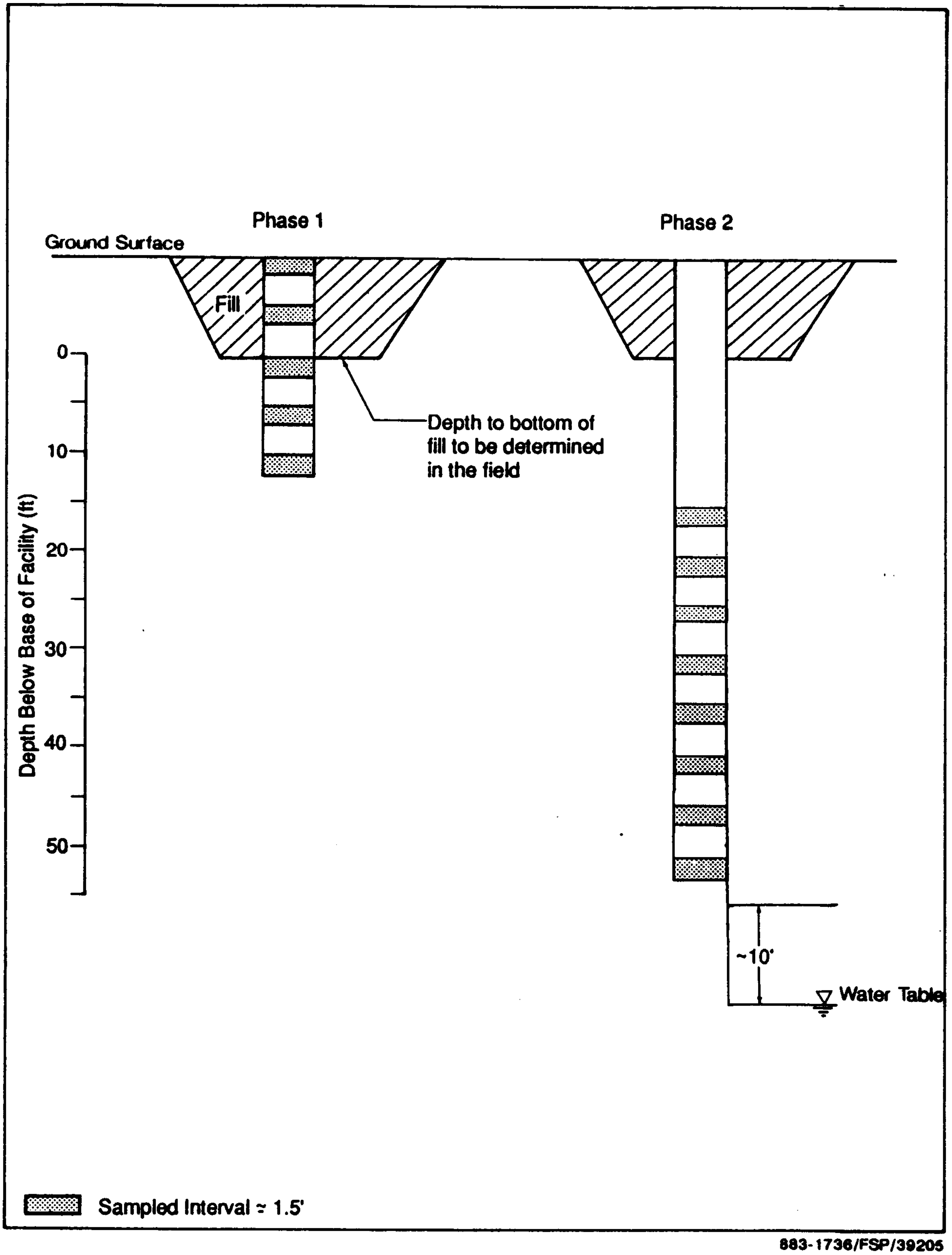


Figure 13. Phase 1 and 2 Soil Borings at Facilities Where the Complete Range of Contaminants is Unknown.

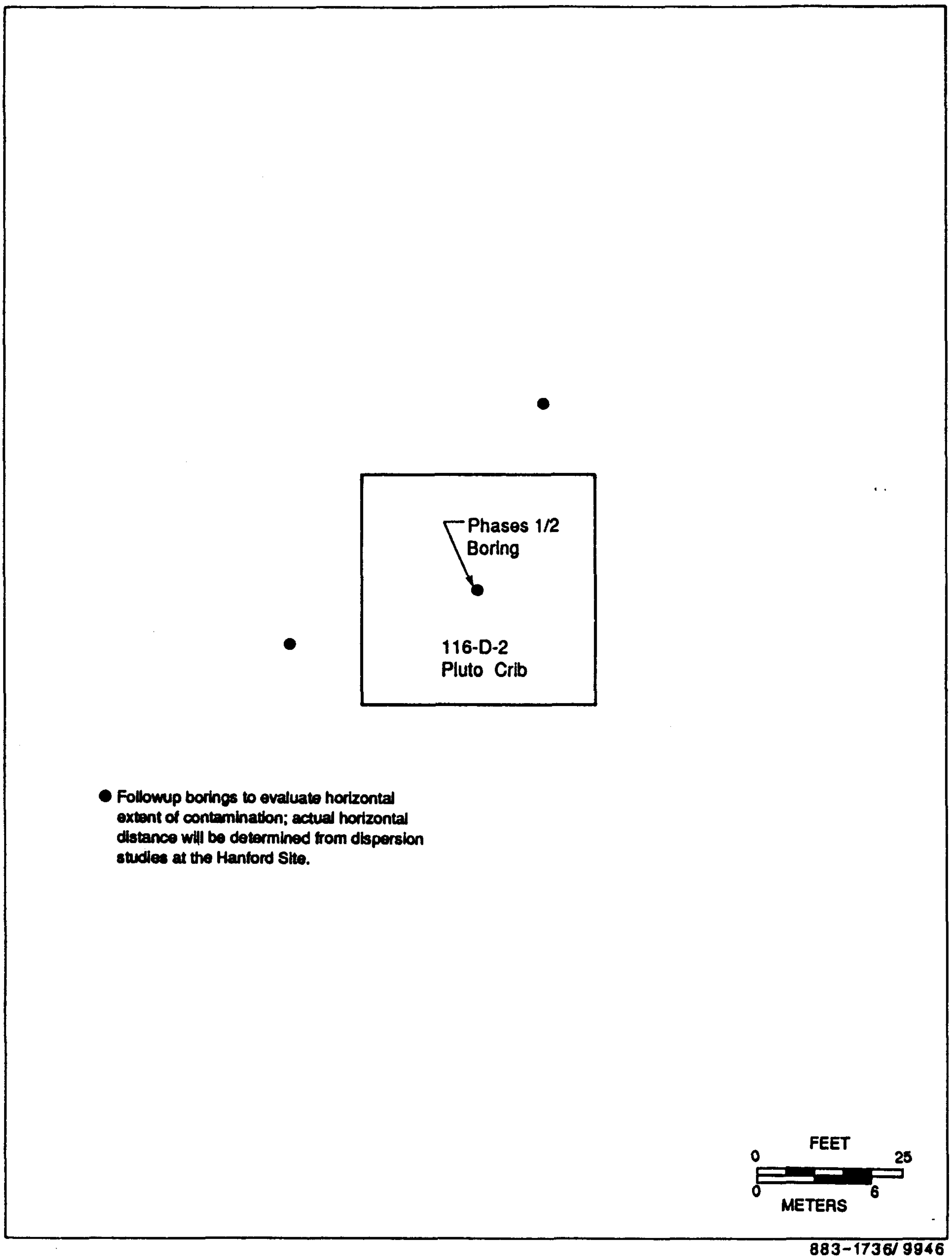


Figure 14. Plan View Showing Example of Configuration of Boreholes to Evaluate Horizontal Extent of Soil Contamintion.

identified in Phases 1 and 2 at concentrations statistically significant above background. Analytical levels will be the same as those in Phase 2. Additional sampling will be required if significant contamination is detected in these borings.

At facilities that have been sampled as part of Task 1g source sampling or Task 3c test pit sampling, and for which specific contaminants were identified, a two-phased soil boring program will be carried out as follows:

Phase 1: The vertical extent of contamination within the facility boundaries will be evaluated in Phase 1 by one or more deep borings, depending on the size of the facility. Sampling will be conducted at 1.5-m (5-ft) intervals, at "hot spots" as determined by real-time screening, and at major changes in lithology, to a depth of 3 m (10 ft) above the expected maximum groundwater level (Figure 15). Sample parameters will be those identified in Task 1g or 3c. Organics and inorganics will be analyzed by standard EPA Level III methods, unless the analysis must be conducted in a hot cell due to radioactivity. Hot cell analyses for organics or inorganics for these samples and radionuclide analyses will be Level V. Duplicates of approximately 20 percent of the samples will be sent to a CLP laboratory for Level IV validation of the Level III analyses. One physical sample from each geologic unit encountered will be collected for analysis of physical parameters.

Phase 2: If contaminants are identified in the Phase 1 deep borings, the horizontal extent of contamination beyond the facility boundaries will be evaluated either by two randomly located borings or by borings at locations where the likely route or seepage is known, spaced at distances from the facility boundaries determined by professional judgement and incorporating any available results of horizontal dispersion studies at the Hanford Site. Additional sampling will be required if significant contamination is detected in these borings. The sample depth will be determined by the vertical extent of contamination identified in Phase 1. Sample intervals will be the same as those for the Phase 1 deep borings, and the parameters for analysis will be those contaminants identified in Phase 1 at concentrations statistically significant above background. Analytical levels will be the same as those in Phase 1. One physical sample from each geologic unit encountered will be collected for analysis of physical parameters.

Additional Level II field or laboratory screening techniques, such as X-ray fluorescence, may also be used during the Phase II and III boring program if a reliable correlation can be established between this screening and Phase I CLP-equivalent sampling results. If a reliable correlation is established, this screening can be used to determine the depths of Phase II and III borings and the need for additional Phase III borings.

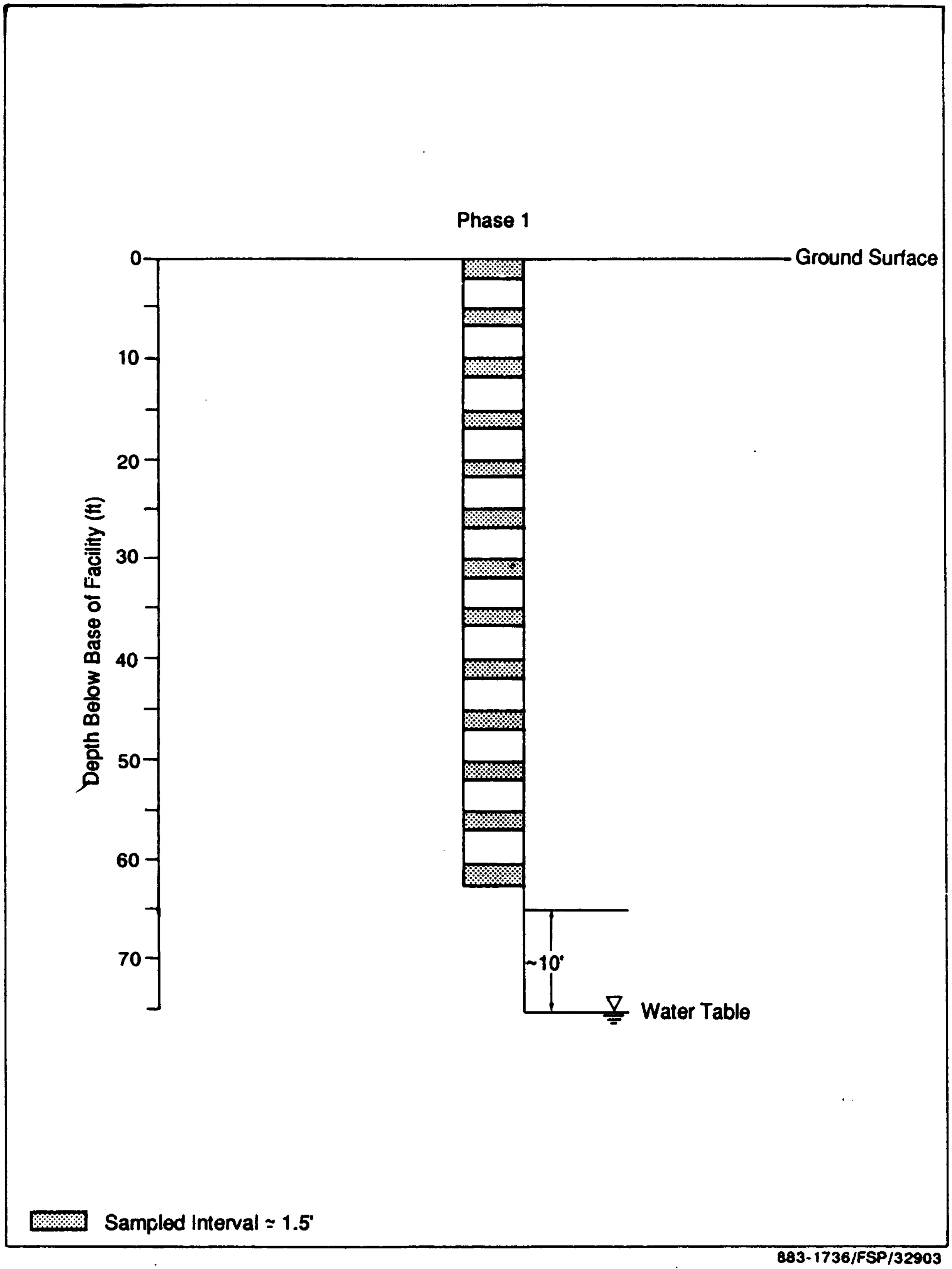


Figure 15. Phase I Soil Borings at Facilities Where Contaminants Have Been Identified From Task 1g or 3c Sampling.

Facilities have been grouped into several categories by the facility's designated use in describing the specific soil sampling program relevant to source facilities. A discussion of the facilities to be sampled and the number of borings at each category of facility follows. Table 5 summarizes the boring program by phase, including the number of boreholes and rationale, sample intervals and depths, types of analyses, and preferred sampling method for each of the facilities discussed below; borehole locations are shown in Figures 16 through 21. Unless otherwise noted, logging and screening of these samples will be carried out as described in the previous paragraphs. Facilities that have not been identified for soil sampling below are those that have been determined to pose no potential apparent threat of contamination, either because of the specific use of the facility or because a previously performed analysis indicated that no contamination was present.

Facilities Used to Dispose of Liquid Waste into the Soil Column. This category primarily includes cribs, French drains, trenches, and some of the basins. Although some data are available on the contaminants of concern at these facilities, the complete range of contaminants is unknown. These facilities will therefore be evaluated by a three-phased boring program to determine the nature and extent of contamination. The following facilities, shown in Figures 16 and 17, are included in this category.

- The 116-D-1A fuel storage basin trench No. 1
- The 116-D-1B fuel storage basin trench No. 2
- The 116-D-2 pluto crib
- The 116-D-6 cushion corridor French drain
- The 116-DR-1 liquid waste disposal trench No. 1
- The 116-DR-2 liquid waste disposal trench No. 2
- The 116-D-3 crib No. 1
- The 116-D-4 crib No. 2
- The 116-D-9 reactor confinement seal pit drainage pit.

The initial soil sampling methodology for the smaller facilities will include drilling one shallow vertical borehole to a depth of 3 m (10 ft) below the fill in the approximate center of the facility, with follow-up boreholes as necessary (see Table 5). The larger facilities will be evaluated by one shallow boring in Phase 1 at a location where the full range of contamination can be adequately determined, followed by additional deep borings in Phase 2.

Sanitary Sewage Transfer, Treatment, and Disposal Facilities. This category includes septic tanks and their associated drain fields and pipelines. The following facilities, listed in Table 5 and shown in Figures 16, 17, 18, and 21, are included in this category.

Table 5. Soil Boring Sampling Activity by Facility in 100-DR-1 Operable Unit.
(Sheet 1 of 9)

Facility	Figure in text showing Phase 1 borehole locations	Number of Phase 1 boreholes	Phase 1 rationale	Phase 1 parameters for analysis	Phase 2 program if contaminants identified in Phase 1	Phase 3 program if contamination identified at depth	Preferred sampling method[a]
Facilities used to dispose of waste into the soil column							
116-D-1A fuel storage basin trench No. 1	16	1 boring at center of small facilities; at larger facilities, one boring where the full range of contamination can adequately be determined; sample at 5-ft intervals to depth of 10 ft below fill	One borehole at each facility will be adequate to determine the nature of contamination to 10 ft below facility	Radionuclides, TCL (organics), TAL (inorganics) from each sample interval; one physical sample and one archive sample per geologic unit	Deepen Phase 1 boring to sample at 5-ft intervals to 10 ft above water table; one additional deep boring at 116-D-1A, 116-D-1B, 116-DR-1, and 116-D-2; sample for contaminants identified in Phase 1	At least 2 borings, either randomly located or where seepage likely to have occurred, away from margins of facility (distance from facility boundary to be determined) to determine horizontal distribution of contamination; sample for contaminants identified in Phases 1 and 2 at 5-ft intervals to 10 ft above water table	dual-wall core or drive tube
116-D-1B fuel storage basin trench No. 2	16						
116-D-2 pluto crib	16						
116-D-6 cushion corridor French drain	16						
116-DR-1 liquid waste disposal trench No. 1	17						
116-DR-2 liquid waste disposal trench No. 2	17						
116-D-3 crib No. 1	16						
116-D-4 crib No. 2	16						
116-D-9 reactor confinement seal drainage pit	16						
Sanitary sewage transfer, treatment, and disposal facilities							
1607-02 septic tank	17	If Task 3c test pit sampling indicates contaminants, 1 boring through center or next to tank; sample at 5-ft intervals to depth of 10 ft above water table	These facilities are small; one boring will be adequate to determine the depth of contamination	Contaminants identified during Task 3c from each sample interval; one physical sample and one archive sample per geologic unit	At least 2 borings, either randomly located or where seepage likely to have occurred, away from margins of tank (distance from tank boundary to be determined) to determine horizontal distribution of contamination; sample for contaminants identified in Phase 1, at same sample intervals	Horizontal extent of contamination will be determined in Phase 2	drive tube
1607-04 septic tank	16						
1607-05 septic tank	21						
Septic tank at N93050/W52850	18						

Table 5. Soil Boring Sampling Activity by Facility in 100-DR-1 Operable Unit.
(Sheet 2 of 9)

Facility	Figure in text showing Phase 1 borehole locations	Number of Phase 1 boreholes	Phase 1 rationale	Phase 1 parameters for analysis	Phase 2 program if contaminants identified in Phase 1	Phase 3 program if contamination identified at depth	Preferred sampling method[a]
Sanitary sewage transfer, treatment, and disposal facilities (Continued)							
Tile field associated with above septic tanks	17	1 boring at beginning of distribution system; sample at 5-ft intervals to 10 ft below facility	One boring at the beginning of the distribution system will permit determination of the nature of contamination within this rectangular facility	Radionuclides, TCL (organics), TAL (inorganics) from each sample interval; archive one physical sample and one archive sample per geologic unit	Deepen Phase 1 boring to sample at 5-ft intervals to 10 ft above water table; 4 additional deep borings at center, east, west, and north end of system; sample for contaminants identified in Phase 1	Borings randomly located at margins of field (distance from tile field boundary to be determined) to determine horizontal distribution of contamination; sample for contaminants identified in Phases 1 and 2 at 5-ft intervals to 10 ft above water table	dual-wall core or drive tube
Sanitary sewer pipelines associated with septic tanks	not shown	If Task 3c test pit sampling indicates contaminants, borings sampled at 5-ft intervals to 10 ft above water table	The actual number of borings will be determined by the number and location of contaminated areas identified in Task 3c	Contaminants identified during Task 3c test pit sampling from each sample interval; one physical sample and one archive sample per geologic unit	1 boring on each side of pipe, at each initial boring location (distance from pipe boundary to be determined) to determine horizontal distribution of contamination; sample for contaminants identified in Phase 1, at same sample intervals	Horizontal extent of contamination will be determined in Phase 2	drive tube
Facilities used to transport liquid waste							
116-D-7 and 116-DR-9 Process effluent pipelines Discharge pipelines to river (land portions only)	not shown not shown	If pipeline breaches are identified from the Task 1f pipeline integrity assessment and contaminants are identified by the Task 1g sludge sampling, borings along affected areas of pipeline; sample at 5-ft intervals to 10 ft above water table	The actual number of borings will be determined by the number of contaminated areas identified in Task 1	Contaminants identified during Task 1g from each sample interval; one physical sample and one archive sample per geologic unit	1 boring on each side of pipe, at each initial boring location (distance from pipe boundary to be determined) to determine horizontal distribution of contamination; sample for contaminants identified in Phase 1, at same sample interval	Horizontal extent of contamination will be determined in Phase 2	dual-wall core or drive tube

Table 5. Soil Boring Sampling Activity by Facility in 100-DR-1 Operable Unit.
(Sheet 3 of 9)

Facility	Figure in text showing Phase 1 borehole locations	Number of Phase 1 boreholes	Phase 1 rationale	Phase 1 parameters for analysis	Phase 2 program if contaminants identified in Phase 1	Phase 3 program if contamination identified at depth	Preferred sampling method[a]
Facilities used to transport liquid waste (Continued)							
116-D-5 outfall structure 116-DR-5 outfall structure	17 17	One at center of each outfall structure; sample at 5-ft intervals to 10 ft below facility	One borehole at the center of each outfall will be adequate to determine the nature of contamination	Radionuclides, TCL (organics), TAL (inorganics) from each sample interval; archive one physical sample and one archive sample per geologic unit	Deepen Phase 1 borings to sample at 5-ft intervals to 10 ft above water table; sample for contaminants identified in Phase 1	Borings randomly located at margins of structure (distance from boundary to be determined) to determine horizontal distribution of contamination; sample for contaminants identified in Phases 1 and 2 at 5-ft intervals to 10 ft above water table	dual-wall core or drive tube
Facilities used to retain process effluents							
116-D-7 process effluent retention basin 116-DR-9 process effluent retention basin Area around retention basins	17 17 not shown	1 boring at influent end of each of the basins' two cells; sample at 5-ft intervals to depth of 10 ft below fill	Borings at the beginning of the distribution system will permit determination of the nature contamination of these facilities to 10 ft below facility; if rubble prevents sampling, borings placed along outer margins of basins	Radionuclides, TCL (organics), TAL (inorganics) from each sample interval; archive one physical sample and one archive sample per geologic unit	Deepen Phase 1 borings to sample at 5-ft intervals to 10 ft above water table; one additional deep boring at effluent end and 2 along centerline of each of the basins' two cells; sample for contaminants identified in Phase 1	Borings either at random locations or where seepage likely to have occurred away from margins of basin (distance from basin boundary to be determined) to determine horizontal distribution of contamination; additional borings as required in area around basins; sample for contaminants identified in Phases 1 and 2 at 5-ft intervals to 10 ft above water table	dual-wall core or drive tube

Table 5. Soil Boring Sampling Activity by Facility in 100-DR-1 Operable Unit.
(Sheet 4 of 9)

Facility	Figure in text showing Phase 1 borehole locations	Number of Phase 1 boreholes	Phase 1 rationale	Phase 1 parameters for analysis	Phase 2 program if contaminants identified in Phase 1	Phase 3 program if contamination identified at depth	Preferred sampling method[a]
Tanks							
Fuel oil tank (west of 184-DA building) 166-D above-ground fuel oil tank location	19 18	If contaminants identified during Task 3c test pit sampling, 1 boring through center of each facility; sample at 5-ft intervals to 10 ft above water table	These facilities are small; one boring will be adequate to determine the depth of contamination	Contaminants identified during Task 3c test pit sampling for each sample interval; one physical sample and one archive sample per geologic unit	2 borings, either randomly located or where seepage likely to have occurred, away from margins of tank (distance from tank boundary to be determined) to determine horizontal distribution of contamination; sample for contaminants identified in Phase 1, at same sample intervals	Horizontal extent of contamination will be determined in Phase 2	drive tube
166-D fuel oil tank pipeline	not shown	If contaminants identified during Task 3c test pit sampling, borings along affected areas of pipeline; sample at 5-ft intervals to 10 ft above water table	The actual number of borings will be determined by the number of contaminated areas identified in Task 3c	Contaminants identified during Task 3c test pit sampling for each sample interval; one physical sample and one archive sample per geologic unit	1 boring on each side of pipe, at each initial boring location (distance from pipe boundary to be determined) to determine horizontal distribution of contamination; sample for contaminants identified in Phase 1, at same sample intervals	Horizontal extent of contamination will be determined in Phase 2	drive tube
130-D-1 gasoline storage tank	19	1 boring at location where contamination identified in July 1989 tank removal program; sample at 5-ft intervals to 10 ft above water table	Soil contamination has been identified as a result of July 1989 tank removal and sampling program; one deep boring will be adequate to determine the vertical extent of contamination	Contaminants identified during July 1989 tank removal program	2 borings, either randomly located or where seepage likely to have occurred, away from margins of tanks (distance from tank to be determined) to determine horizontal distribution of contamination; sample for contaminants identified in Phase 1, at same sample intervals	Horizontal extent of contamination will be determined in Phase 2	drive tube

Table 5. Soil Boring Sampling Activity by Facility in 100-DR-1 Operable Unit.
(Sheet 5 of 9)

Facility	Figure in text showing Phase 1 borehole locations	Number of Phase 1 boreholes	Phase 1 rationale	Phase 1 parameters for analysis	Phase 2 program if contaminants identified in Phase 1	Phase 3 program if contamination identified at depth	Preferred sampling method[a]
Tanks (Continued)							
Sodium dichromate tanks	locations currently unknown	One at center of former tank location, as necessary	Tank locations unknown. Site survey to find present and former tank sites; soil sampling if appropriate	TBD[b]	TBD[b]	TBD[b]	TBD[b]
Sludge disposal trenches							
Five sludge disposal trenches	17	1 boring at random location in one randomly selected trench; sample at 5-ft intervals to depth of 10 ft below fill; if contaminants identified in first trench, one boring in center of other 4 trenches at same intervals and depth	If the results of sampling of one trench shows the same levels of contamination as adjacent areas, no further sampling will be done specifically for the sludge disposal trenches	Radionuclides, TCL (organics), TAL (inorganics), and chlorine from each sample interval; archive one physical sample and one archive sample per geologic unit	Deepen Phase 1 boring to sample at 5-ft intervals to 10 ft above water table; if the borehole sampling results vary from adjacent areas, the remainder of the trenches will be sampled by one deep borehole at each trench; sample for contaminants identified in Phase 1	2 borings, either randomly located or where seepage likely to have occurred, away from margins of trench (distance from trench boundary to be determined) to determine horizontal distribution of contamination; sample for contaminants identified in Phases 1 and 2 at 5-ft intervals to 10 ft above water table	dual-wall core or drive tube
Waste acid reservoir							
Waste Acid Reservoir	19	1 boring at a location where the full range of contamination can adequately be determined; sample at 5-ft intervals to depth of 10 ft below base	One borehole will be adequate to determine the nature of contamination to a depth of 10 ft below facility	Radionuclides, TCL (organics), TAL (inorganics) from each sample interval; archive one physical sample and one archive sample per geologic unit	Deepen Phase 1 boring to sample at 5-ft intervals to 10 ft above water table; sample for contaminants identified in Phase 1	2 borings, either randomly located or where seepage likely to have occurred, away from margins of reservoir (distance from reservoir boundary to be determined) to determine horizontal distribution of contamination; sample for contaminants identified in Phases 1 and 2 at 5-ft intervals to 10 ft above water table	dual-wall core or drive tube

Table 5. Soil Boring Sampling Activity by Facility in 100-DR-1 Operable Unit.
(Sheet 6 of 9)

Facility	Figure in text showing Phase 1 borehole locations	Number of Phase 1 boreholes	Phase 1 rationale	Phase 1 parameters for analysis	Phase 2 program if contaminants identified in Phase 1	Phase 3 program if contamination identified at depth	Preferred sampling method[a]
120-D-1 (100-D) Ponds							
120-D-1 settling and percolation ponds	20	If contaminants identified during Task 1g source investigation, 1 boring at each pond where the full range of contamination can adequately be determined; sample at 5-ft intervals to 10 ft above water table	These ponds are relatively small; one borehole at each pond will be adequate to determine the nature and vertical extent of contamination	Contaminants identified during Task 1g from each sample interval; one physical sample and one archive sample per geologic unit	2 randomly located borings at margins of pond (distance from pond boundary to be determined) to determine horizontal distribution of contamination; sample for contaminants identified in Phase 1, at same sample intervals	Horizontal extent of contamination will be determined in Phase 2	drive tube
Support facilities							
Includes, but not limited to:		If Task 3c test pit sampling indicates contaminants, 1 boring through center of affected area; sample at 5-ft intervals to 10 ft above water table	These facilities are relatively small; one borehole at the center of each facility will be adequate to determine the vertical extent of contamination	Contaminants identified during Task 3c test pit sampling from each sample interval; one physical sample and one archive sample per geologic unit	2 randomly located borings at margins of affected area (distance from area boundary to be determined) to determine horizontal distribution of contamination; sample for contaminants identified in Phase 1, at same sample intervals	Horizontal extent of contamination will be determined in Phase 2	drive tube
- 1713-D instrument and electrical development laboratory	not shown						
- 1714-D solvent storage bldg	18						
- 1715-D oil and paint storage	18						
- 1716-D gas station/bus maintenance shop	19						
- 1722-D equipment development lab	18						
- Paint shop west of 182-D reservoir	21						
- Salt dissolving pit	18						
1734-D cylinder storage	not shown	TBD[b]	Additional information required from Task 1 source data compilation	TBD[b]	TBD[b]	TBD[b]	

Table 5. Soil Boring Sampling Activity by Facility in 100-DR-1 Operable Unit.
(Sheet 7 of 9)

Facility	Figure in text showing Phase 1 borehole locations	Number of Phase 1 boreholes	Phase 1 rationale	Phase 1 parameters for analysis	Phase 2 program if contaminants identified in Phase 1	Phase 3 program if contamination identified at depth	Preferred sampling method[a]
Demolished contaminated ancillary facilities							
Site of former 108-D equipment decontamination station	not shown	1 boring at 132-D-3 and 117-D facilities and at least 2 borings at 108-D and 115-D facilities; sample at 5-ft intervals to depth of 10 ft below base of facility	One boring at small facilities will be sufficient to determine the nature of contamination to 10 ft below facility; larger facilities will require additional borings; borehole locations will be based on Task 1a source data compilation and Task 3a surface radiation anomalies; if no anomalies identified, borings at random locations within facility boundaries	Radionuclides, TCL (organics), TAL (inorganics) from each sample interval; archive one physical sample and one archive sample per geologic unit	Deepen Phase 1 borings to sample at 5-ft intervals to 10 ft above water table; additional borings will be required at larger facilities; sample for contaminants identified in Phase 1	At least 2 randomly located borings at margins of affected area (distance from area to be determined) to identify horizontal distribution of contamination; sample for contaminants identified in Phases 1 and 2 at 5-ft intervals to 10 ft above water table	dual-wall core or drive tube
Site of former 132-D-3 effluent pumping station	not shown						
Site of former 115-D gas recirculation building	not shown						
Site of former 117-D exhaust air filter bldg	not shown						
Existing contaminated ancillary and support facilities							
103-D fuel element storage building	not shown	If contaminants identified during Task 1g sampling, one boring at outer margin of building where contaminants identified; sample at 5-ft intervals to 10 ft above water table	Borings will be placed on outer margins of buildings because boring through existing buildings is not feasible	Contaminants identified during Task 1g source investigation from each sample interval; one physical sample and one archive sample per geologic unit	At least 2 randomly located borings away from margins of affected area (distance of borings from outer margins of building to be determined) to determine horizontal distribution of contamination; sample for contaminants identified in Phase 1, at same sample intervals	Horizontal extent of contamination will be determined in Phase 2	drive tube
1724-DA underwater test facility	not shown						

Table 5. Soil Boring Sampling Activity by Facility in 100-DR-1 Operable Unit.
(Sheet 8 of 9)

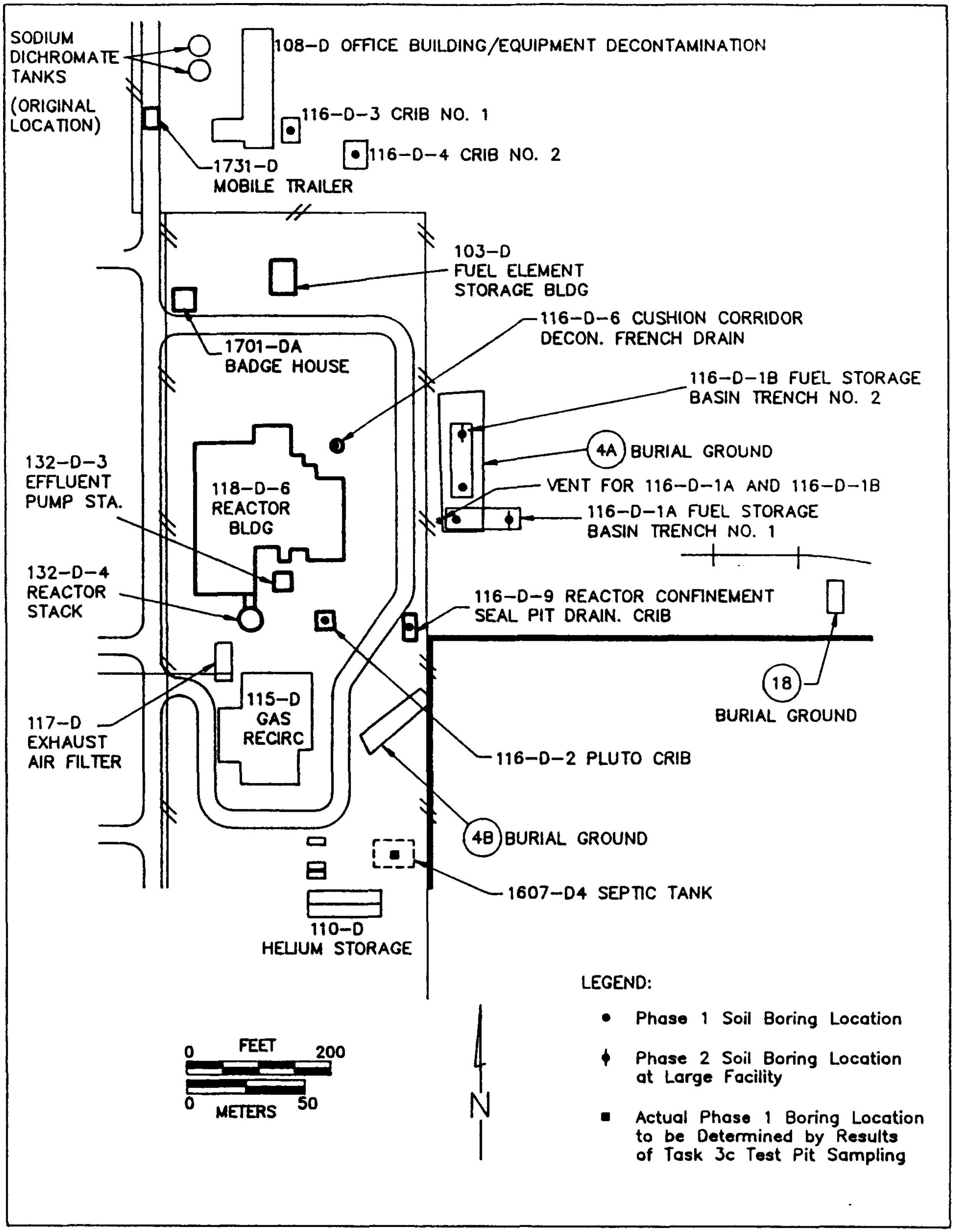
Facility	Figure in text showing Phase 1 borehole locations	Number of Phase 1 boreholes	Phase 1 rationale	Phase 1 parameters for analysis	Phase 2 program if contaminants identified in Phase 1	Phase 3 program if contamination identified at depth	Preferred sampling method[a]
Solid waste facilities							
126-D-2 Solid Waste Landfill	not shown	If Task 3c test pit sampling indicates contaminants, one boring at each test pit location; sample at 5-ft intervals to 10 ft above water table	Number and locations of borings will depend on the number of contaminated test pits identified in Task 3c	Contaminants identified during Task 3c test pit sampling from each sample interval; one physical sample and one archive sample per geologic unit	2 randomly located borings away from source (distance from margins of source to be determined) to determine horizontal distribution of contamination; sample for contaminants identified in Phase 1, at same sample intervals	Horizontal extent of contamination will be determined in Phase 2	drive tube
Burial grounds 4A, 4B, and 18	not shown	If "hot spots" identified during Task 1e soil gas survey or Task 3a surface radiation survey, boring(s) at identified anomalies; if no anomalies identified, boring(s) at random location(s) within burial ground boundaries; sample at 5-ft intervals to 10 ft below fill	Number and location of borings will depend upon the number of anomalies identified in Tasks 1e and 3a; if no anomalies identified, one or more borings, depending on size of burial ground, drilled at random locations will be adequate to the nature of contamination	Radionuclides, TCL (organics), TAL (inorganics) from each sample interval; archive one physical sample and one archive sample per geologic unit	Deepen Phase 1 borings and sample at 5-ft intervals to 10 ft above water table; sample for contaminants identified in Phase 1	1 boring on each side of contaminant source (distance from margins of source to be determined) to determine horizontal distribution of contamination; sample for contaminants identified in Phase 1 at same sample intervals	dual-wall core or drive tube

Table 5. Soil Boring Sampling Activity by Facility in 100-DR-1 Operable Unit.
(Sheet 9 of 9)

Facility	Figure in text showing Phase 1 borehole locations	Number of Phase 1 boreholes	Phase 1 rationale	Phase 1 parameters for analysis	Phase 2 program if contaminants identified in Phase 1	Phase 3 program if contamination identified at depth	Preferred sampling method[a]
Solid waste facilities (Continued							
Electrical facilities	not shown	If Task 3c test pit sampling indicates contaminants, one boring at each test pit location; sample at 5-ft intervals to 10 ft above water table	Number and locations of borings will depend on the number of contaminated test pits identified in Task 3c	Contaminants identified during Task 3c test pit sampling from each sampling interval; one physical sample and one archive sample per geologic unit	2 randomly located borings away from source; (distance from margins of source to be determined) to determine horizontal distribution of contamination; sample for contaminants identified in Phase 1, at same sample intervals	Horizontal extent of contamination will be determined in Phase 2	drive tube

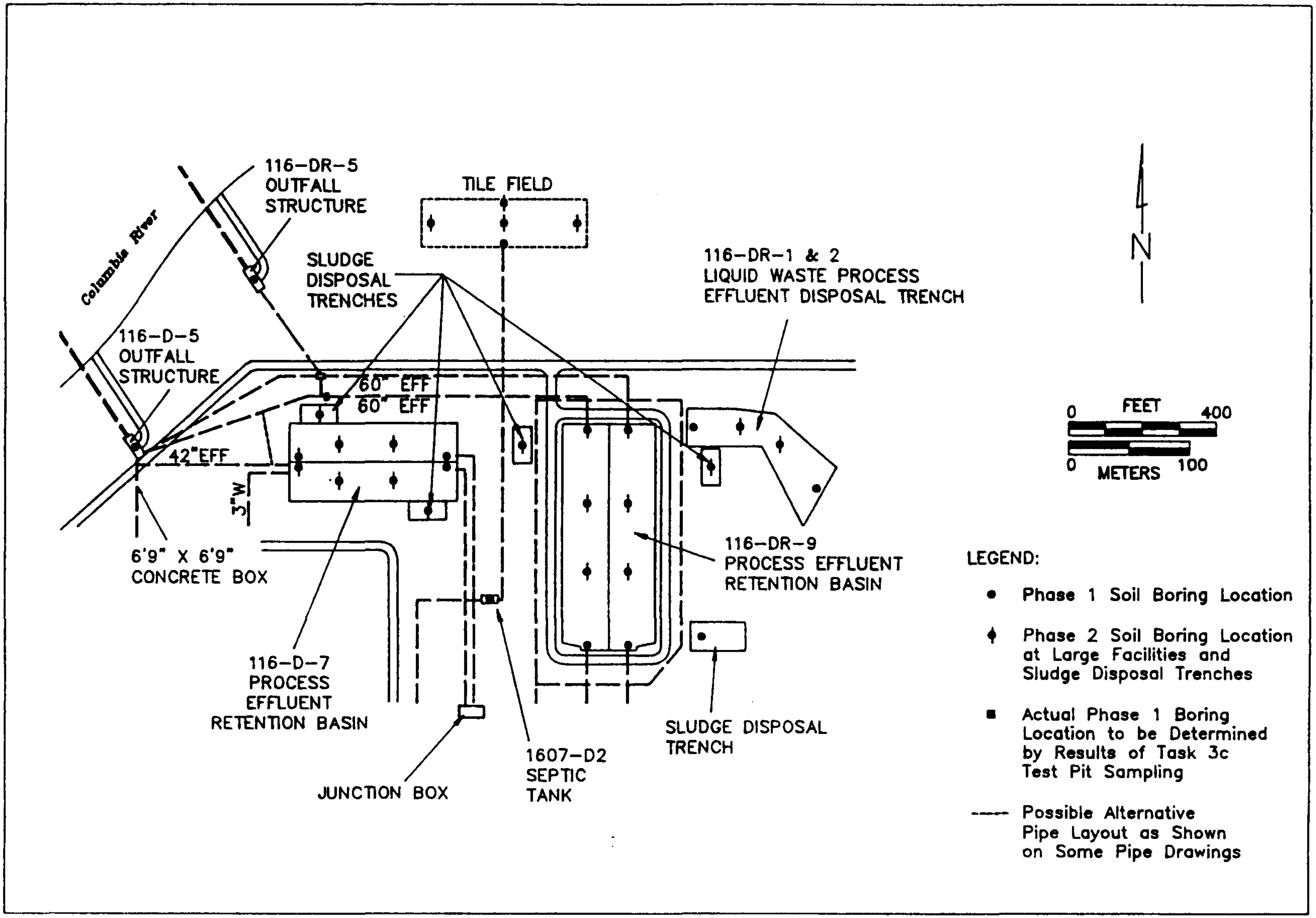
[a]The type of drilling/sampling method will depend on the nature of the sediments encountered at the site. The methods listed are the current preferred methods, but the actual site conditions may require modification of the drilling program.

[b]TBD - To be determined.



8831736\FSP\32893

Figure 16. Soil Boring Locations in Vicinity of 118-D-6 Reactor Building.



8831736\FSP\32894

Figure 17. Soil Boring Locations in Vicinity of Retention Basins.

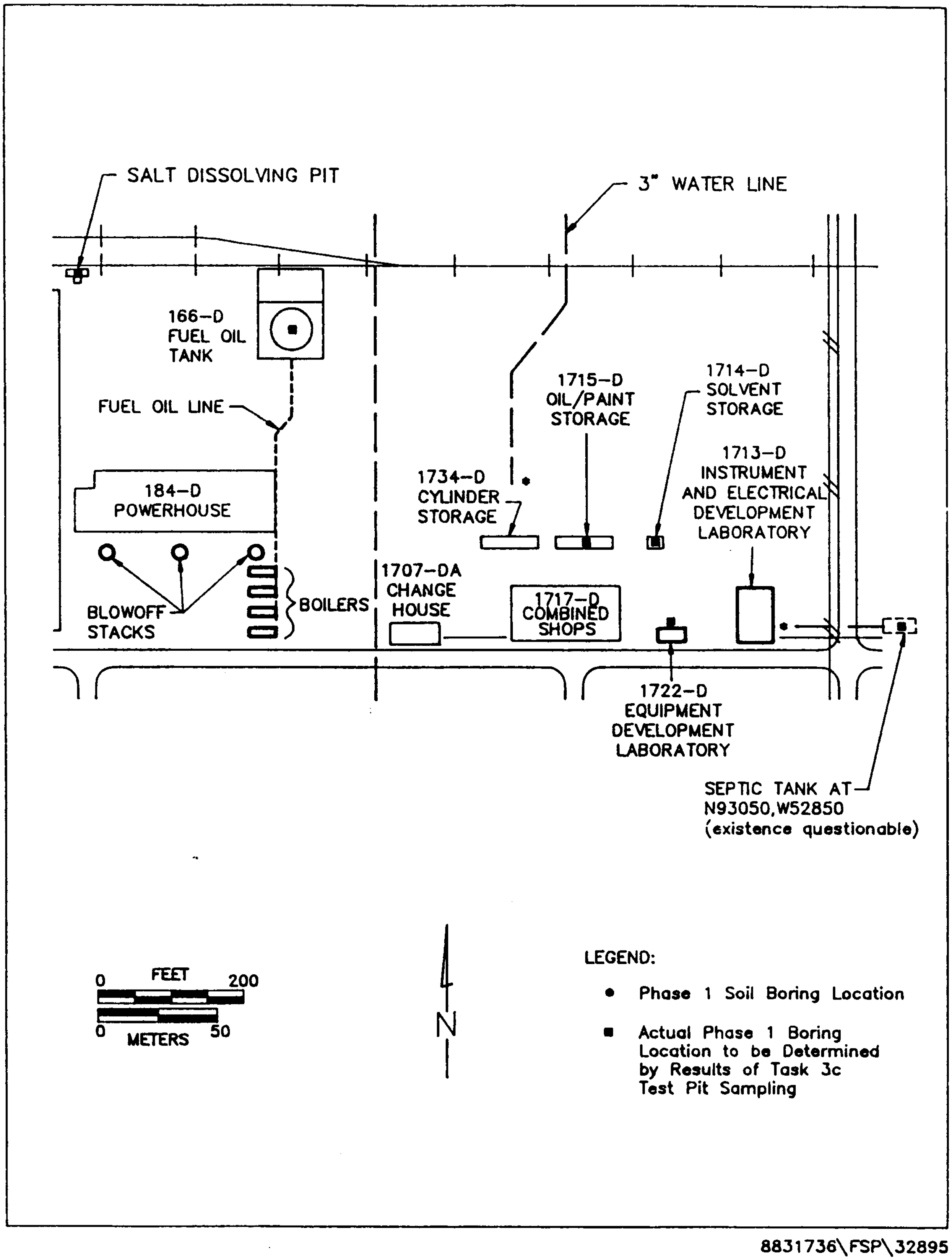
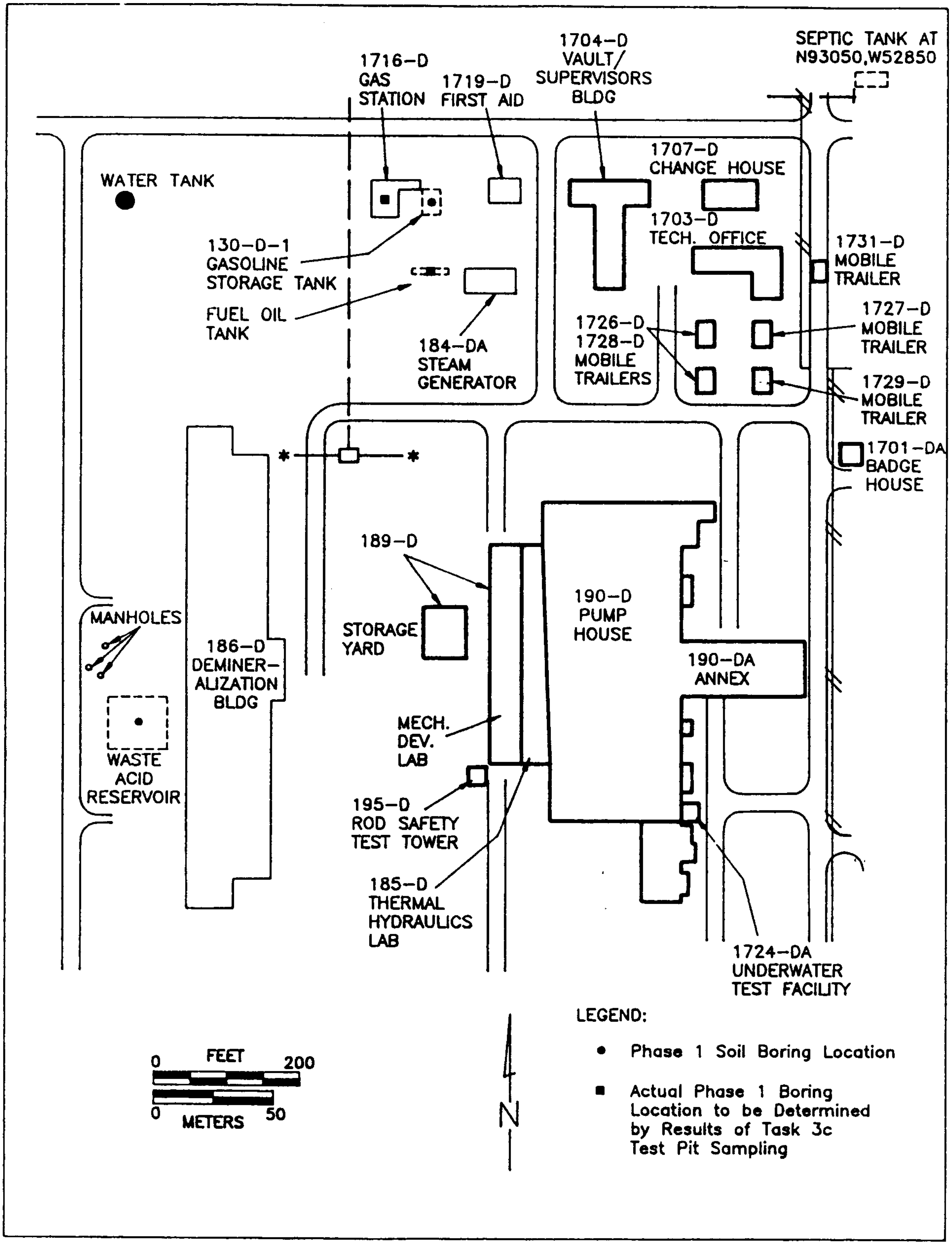


Figure 18. Soil Boring Locations East and North of 184-D Power House.



8831736\FSP\32896

Figure 19. Soil Boring Locations at Waste Acid Resevoir, 1716-D and 130-D-1 Facilities, and at Fuel Oil Tank West of 184-DA Generator.

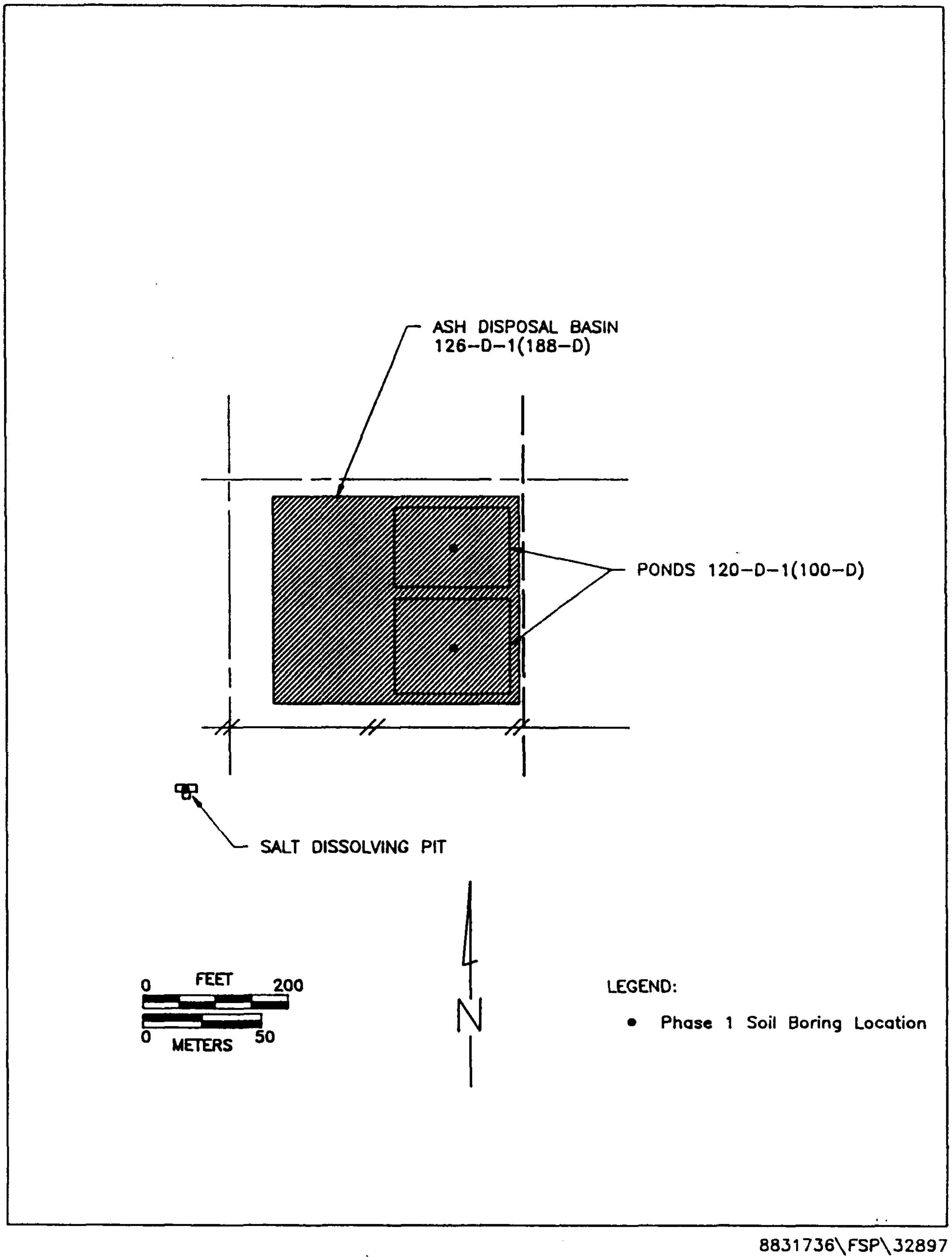


Figure 20. Soil Boring Locations at 120-D-1 Ponds and Salt Dissolving Pit.

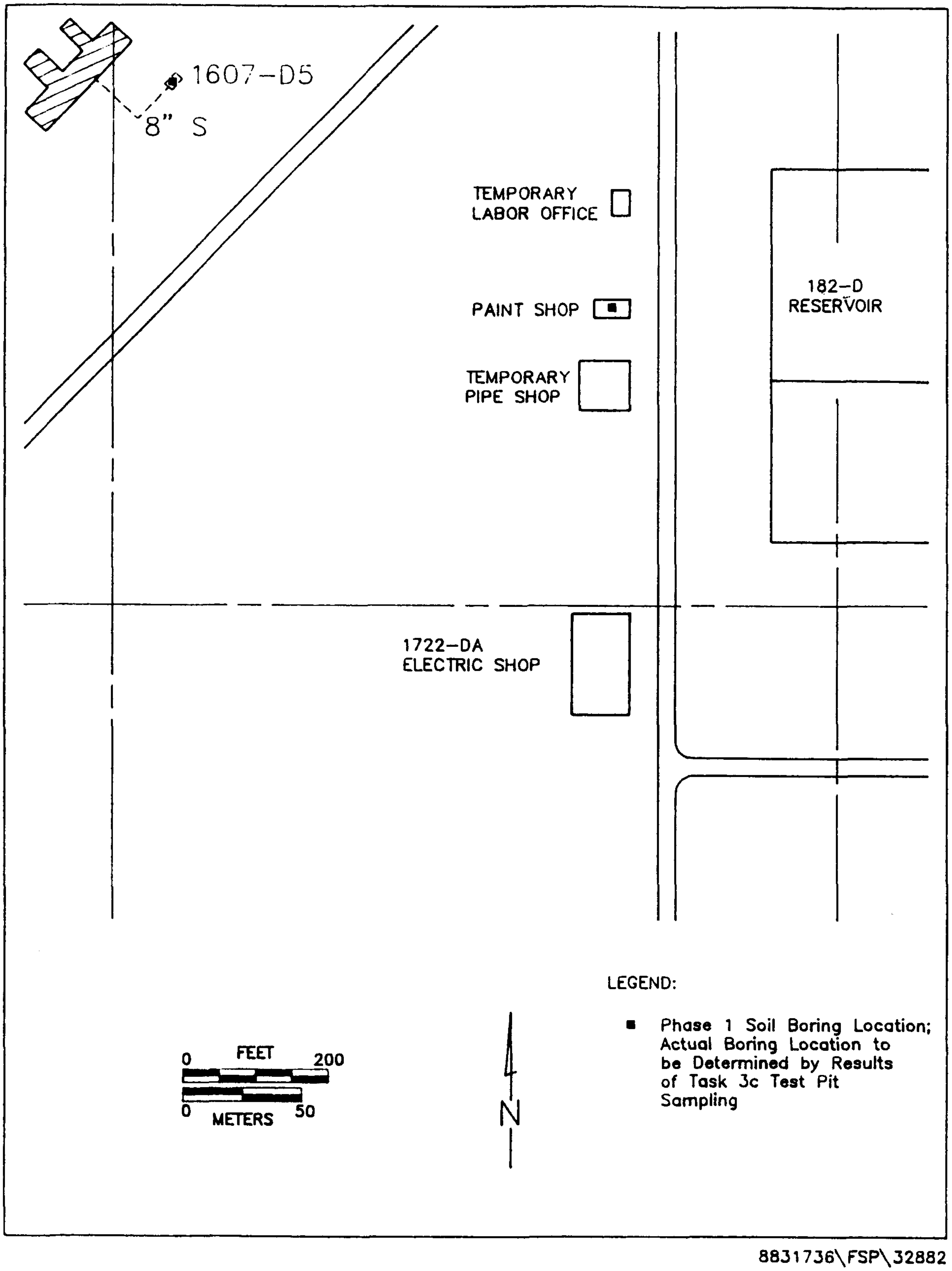


Figure 21. Soil Boring Locations at 1607-D5 Septic Tank and Paint Shop West of 182-D Reservoir.

- The 1607-D2 septic tank
- The 1607-D4 septic tank
- The 1607-D5 septic tank
- Septic tank at N93050 and W52850
- Pipelines associated with above sanitary waste facilities
- Tile field associated with above septic tanks.

The septic tanks will be sampled during the soil boring investigation only if analysis from the Task 3c test pit sampling indicates the presence of contaminants and necessitates further sampling to determine the extent of contamination. If further sampling of the septic tanks is required, one deep vertical borehole will be drilled through or next to the tank, after removal of any remaining sludge, or at the center of the former tank site if the tank has been removed. Information from the Task 3c test pit sampling will be used to determine if further sampling of the process sanitary sewage pipelines is required and the locations of deep boreholes to sample soils at depth.

Because sludges that are currently in the septic tanks may not represent all of the waste that may have entered the tile field, the complete range of contamination is unknown. The tile field will therefore be evaluated by a three-phased boring program to determine the nature and extent of contamination. In Phase 1, one shallow boring will be located at the beginning of the distribution system to determine the nature of contamination. If contamination is identified, the Phase 1 boring will be deepened in Phase 2, and four additional deep borings will be drilled, one at the center of the system, and at each end of the rectangular field. Phase 3 will determine the horizontal extent of contamination as required.

Facilities Used in Transporting Process Liquid Waste. The following facilities are included in this category:

- The 116-D-7 process effluent pipeline
- The 116-DR-9 process effluent pipeline
- Discharge pipelines to river (land portions only)
- The 116-D-5 outfall structure
- The 116-DR-5 outfall structure.

Soil sampling of the process effluent pipelines will be limited to those portions located inside of the 100-DR-1 operable unit. The discharge pipelines extend from the retention basins to the flowline of the Columbia River; sampling related to these pipelines will be limited to that portion of the pipeline on land. Both the 116-D-7 and the 116-DR-9 process effluent pipelines and the discharge pipelines are known to have had significant leaks. Information from the analyses performed under Task 1f (pipeline integrity assessment) and Task 1g (sludge sampling within the pipelines) will be used to determine the need for soil sampling and the locations for Phase 1 deep boreholes. Additional Phase 2 borings will be drilled as necessary based on the Phase 1 drilling results (Table 5).

Because the outfall structures may have received wastes other than those from the retention basins, the complete range of contamination is unknown. The outfall structures will therefore be evaluated by a three-phased boring program to determine the nature and extent of contamination. One shallow boring will be located at the center of each structure in Phase 1 (Figure 17), and followup borings will be drilled as necessary.

Facilities Used to Retain Process Effluents. The facilities in this category were used to retain process effluents until a certain degree of thermal and radioactive decay occurred. These facilities, which are shown in Figure 17, include:

- The 116-D-7 process effluent retention basin
- The 116-DR-9 process effluent retention basin
- Area around the above retention basins.

The surficial sediments in these basins have been sampled for radionuclides by shallow boreholes to a depth of approximately 8-10 m (25-33 ft) (Dorian and Richards 1978). Additional sampling is required to characterize the nature and vertical extent of soil contamination beneath the basins and the areas around the basins.

The boring program at the process effluent retention basins and the area around the basins will consist of a three-phased program. In Phase 1, one shallow boring will be located at the beginning of the distribution system for each of the basins' two cells to determine the nature of contamination. After the nature of contamination is identified, the Phase 1 borings will be deepened in Phase 2, and additional deep borings will be located within the basins, one at the effluent end of each basin and two along the centerline of each of the basins two cells. Phase 3 will determine the horizontal extent of contamination in the area around the basins, either at random locations or at locations where seepage was likely to occur away from the margins, supported by information from the Task 1a source data compilation and the Task 3a surface radiation survey.

Because the basins have been filled with soil, and most likely contain large quantities of rubble, drilling and sampling within the basins may be adversely impacted; it may therefore be necessary to sample along the outer margins of the basins instead.

Tanks. This category includes storage facilities for gasoline, fuel oil, and sodium dichromate. The need to conduct a soil boring investigation at these facilities will be determined by the results of the Task 3c test pit sampling and analysis. The facilities in this category, which are shown in Figures 18 and 19, include:

- Buried fuel oil tank west of the 184-DA building
- The 166-D aboveground fuel oil tank and associated underground pipeline
- Aboveground sodium dichromate tanks
- 130-D-1 gasoline storage tank.

If contamination is detected at these facilities during the Task 3c test pit sampling, additional deep borings will be required to determine the vertical extent of the contamination. If further sampling of the soils beneath the tanks is required, one vertical borehole will be drilled through the center of the facility. If further sampling of the soils beneath the aboveground sodium dichromate tanks is required, one vertical borehole will be drilled at the center of the former tank location.

The 130-D-1 gasoline storage tank was removed in July 1989 as part of an ongoing program at the Hanford Site to remove underground storage tanks in accordance with CERCLA/RCRA guidelines. Because contamination was found during the tank removal program, a followup deep boring program will be carried out as part of Task 3d to define the vertical extent. One Phase 1 deep boring will be drilled at the location where contamination was identified during the removal program, followed by additional Phase 2 borings as necessary.

Sludge Disposal Trenches. Five sludge disposal trenches received sludge from the 116-D-7 and 116-DR-9 retention basins. Because Dorian and Richards (1978) found that it is not possible to distinguish contamination in the sludge disposal trenches from contamination in adjacent soils, one shallow vertical borehole will be drilled in Phase 1 in a random location at one randomly selected trench to a depth of 3 m (10 ft) below the base of the fill to determine the nature of contamination. In addition to radionuclides, TCL (organics) and TAL (inorganics), samples will be collected for chlorine analysis to determine if chlorine has been concentrated in the sludges. If the results of this sampling shows the same levels of contamination as adjacent areas, no further sampling will be done specifically for the sludge disposal trenches. If the sampling results vary from adjacent areas, the remainder of the trenches will be sampled in Phase 2 by one deep borehole in each trench, with followup borings in Phase 3 as necessary.

Waste Acid Reservoir. Because the nature of contaminants at this facility is unknown, the waste acid reservoir will be evaluated by a three-phased boring program to determine the nature and extent of contamination. One shallow borehole will be drilled in Phase 1 where the full range of contamination can be adequately determined (Figure 19), with followup Phase 2 and 3 borings drilled as necessary.

The 120-D-1 (100-D) Ponds. If any contamination is detected in these ponds as a result of the Task 1g sampling, an additional two-phased soil boring program will be conducted after the south pond is dry. This sampling will be conducted by means of one deep vertical boring at each pond at a location where the full range of contamination can be determined, with follow-up borings on the margins of the ponds if contamination is detected at depth (Table 5).

Support Facilities. Support facilities are those facilities that provided support services for reactor operations. Support facilities currently considered to be potentially contaminated include the 1714-D solvent storage building, 1716-D gas station, 1715-D oil and paint storage, the salt dissolving pit, 1722-D equipment development laboratory, 1713-D instrument and electrical development laboratory, 1734-D cylinder storage, and the paint shop west of the 182-D reservoir (Figures 18, 19, and 21). Any support facilities that are identified as being contaminated, based on the Task 3c test pit sampling, will be further investigated in the subsurface in Phase 1 by one deep vertical borehole to identify the extent of contamination at depth. The specific locations of the boreholes will be determined based on the location and extent of contamination identified in Task 3c.

Demolished Contaminated Ancillary Facilities. This category includes demolished facilities involved with secondary wastes from the 118-D-6 reactor building maintenance activities that may involve irradiated products, including the following facilities:

- The 108-D equipment decontamination station
- The 132-D-3 effluent pumping station
- The 115-D gas recirculation building
- The 117-D exhaust air recirculation building.

The boring program at the demolished contaminated ancillary facilities will consist of a three-phased program. The locations of the borings will be based on information obtained during the Task 1a source data compilation and the Task 3a surface radiation survey. If these data do not identify potential areas of contamination, borings will be randomly located. In Phase 1, one shallow boring will be located at the smaller 132-D-3 and 117-D facilities, and at least two shallow borings will be located at the larger 108-D and 115-D facilities, to determine the nature of contamination. After the nature of contamination is identified, the Phase 1 borings will be deepened in Phase 2, and additional deep borings may be located within the larger facilities. Phase 3 will determine the horizontal extent of contamination. If any of these facilities were demolished in place and contain rubble, drilling and sampling may be adversely impacted; it may therefore be necessary to sample along the outer margins of the facilities.

Existing Contaminated Ancillary and Support Facilities. This category includes existing facilities involved with secondary wastes from the 118-D-6 reactor building activities or existing support facilities that may involve irradiated products. The following facilities are included:

- The 103-D fuel element storage building (Figure 16)
- The 1724-DA underwater test facility (Figure 19).

If either of these facilities is identified in Task 1g sampling as being contaminated, they will be further investigated in the subsurface in Phase 1 by means of deep borings along the outside margins of the facilities at locations where contaminants are identified, with followup Phase 2 borings as necessary.

Solid Waste Facilities. Facilities that received varying types of solid waste include:

- The 126-D-2 solid waste landfill in the former 184-D coal storage area
- Burial grounds 4A, 4B, and 18.

Deep Phase 1 borings will be drilled at the 126-D-2 solid waste landfill if contaminants are identified as a result of Task 3c test pit sampling. The number and location of the borings will be based on the results of this sampling.

A three-phased boring program will be carried out at the 4A, 4B, and 18 burial grounds to determine the nature and extent of contamination. Phase 1 shallow borings will be drilled at locations determined by the Task 1e soil gas survey and the Task 3a surface radiation survey or, if these surveys identify no anomalies, at one or more random locations depending upon the size of the burial ground. Borings will be deepened as necessary in Phase 2, and followup borings will be drilled as necessary.

Electrical Facilities. Deep Phase 1 borings will be drilled at the electrical facilities if contaminants are identified as a result of the Task 3 test pit sampling program. The number and location of borings will depend on the results of this sampling.

4.4.2.3 Sample Designations. Codes will be assigned to designate soil samples obtained during Task 3d boring program as described below. An X in the code is a variable number.

Borehole facility association will be designated with a code number identifying the facility that the borehole is associated with. The WIDS number will be used for those facilities assigned a number. For those facilities not assigned a WIDS number (e.g., process effluent pipelines, electric facilities), an abbreviation will be used followed by a borehole number. Examples of the borehole numbering system, where X is a variable borehole number, are provided below:

- 116D4-BHX--116-D-4 crib No. 2

- 1607D2-BHX--1607-D2 sanitary septic tank
- SST-BHX--sanitary septic tank at N93050/W52850
- SSP-BHX--sanitary sewer pipeline
- PEP-BHX--process effluent pipeline.

Sample depth or horizontal penetration will be designated by:

- XX.X--to the nearest tenth of a foot.

Sample disposition will be designated by the following, with the number 2 appended for duplicate samples:

- MS--metals and radiation analysis
- AS--nonmetallic ion analysis
- VS--volatile organic analysis
- SVS--semi-volatile organic analysis
- TS--physical analysis
- R--archive.

Examples of the overall sample designation are as follows:

- 116D1A-BH2-10-MS (borehole number 2 in the 116-D-1A fuel storage basin trench number 1; depth of sample is 10 feet; sample sent for metals and radiation analysis)
- 130D1-BH1-15-VS (borehole number 1 in the 130-D-1 gasoline storage tank; depth of sample is 15 feet; sample sent for volatile organic analysis).

If a Hanford Site-specific sample coding system is developed prior to the initiation of field activities, this system will be used in place of the sample designation codes described above.

4.4.2.4 Sampling Equipment and Procedures. Details on the sampling equipment and procedures for most of the work described above are contained in EII 5.2, "Soil and Sediment Sampling" (WHC 1989); Appendices A through D describe borehole sampling methods. Details on geologic logging are contained in EII 9.1, "Geologic Logging" (WHC 1989). Procedures for borehole drilling are contained in EII 6.7, "Groundwater Well and Borehole Drilling" (WHC 1989). Procedures for borehole geophysical logging are contained in EII 5.6, "Control of Geophysical Logging" (WHC 1989). Procedures for decontamination of sampling equipment are contained in EII 5.5, "Decontamination of Equipment for RCRA/CERCLA Sampling" (WHC 1989). Soil density measurements as determined by blow counts are described in American Society for Testing and Materials (ASTM) D-1586. Quality control samples will be collected in accordance with Section 9.0 of the QAPP.

Procedures for neutron-epithermal neutron and high-resolution gamma geophysical logging and field screening for volatile organics and radioactivity will be developed. Procedures may need to be developed for Level II screening techniques. These will either be Westinghouse Hanford procedures developed in accordance with EII 1.2, "Preparation and Revision of Environmental Investigation Instructions" (WHC 1989), or as a participant contractor or subcontractor procedure approved and controlled as specified in Section 4.0 of the QAPP.

4.4.2.5 Sample Handling. Field logs will be maintained to record all observations and activities conducted in accordance with EII 1.5, "Field Logbooks" (WHC 1989). Daily field drilling activities will be reported in accordance with EII 6.1, "Activity Reports of Field Operations" (WHC 1989). Borehole geologic logs and well summary sheets will be prepared in accordance with EII 9.1, "Geologic Logging" (WHC 1989). All completed field records will be maintained and processed in accordance with EII 1.6, "Records Management" (WHC 1989).

Samples for laboratory analysis will be placed in appropriate containers and properly preserved in accordance with EII 5.2, "Soil and Sediment Sampling" (WHC 1989), and in accordance with Section 4.0 of the QAPP. All samples for laboratory analysis will be transported under chain of custody in accordance with EII 5.1, "Chain of Custody" (WHC 1989), and Section 5.0 of the QAPP.

4.4.3 Task 3d-3--Soil Sample Storage and Cuttings Disposal

Soil cuttings containing unknown wastes will be stored and disposed of in accordance with EII 4.2, "Interim Control of Unknown Waste" (WHC 1989). Soil cuttings containing hazardous wastes will be stored and disposed of in accordance with EII 4.1, "Nonradioactive Hazardous Waste Disposal" (WHC 1989). Low-level radioactive and mixed waste soil cuttings will be stored and disposed of according to procedures to be developed. Storage of archive samples will be in accordance with EII 5.7A, "Hanford Geotechnical Library Sample Control" (WHC 1989).

4.4.4 Task 3d-4--Soil Sample Analysis

Soil samples will be analyzed by qualified laboratories with Westinghouse Hanford-approved QA plans. Soil physical parameters are listed in Table 4, and will be determined according to standard procedures. Table 3 lists the analytical methods for the contaminant parameters of interest at the operable unit. The analytical level, method selection, detection limit, precision, and accuracy guidelines for the parameters of interest are also listed in Table 1 of the QAPP. Analytical procedures for the analytical levels in this table are discussed in Section 7.0 of the QAPP. Analytical levels III, IV, and IV will be used for the soil boring program. Depending upon their reliability, Level II screening techniques may also be used.

Soil physical parameter analysis will include soil types (classification), consolidation, density, cation exchange capacity, permeability, porosity, pH, and moisture content. Depending on needs for risk assessment, additional testing of archive samples may be needed for leachability, adsorptability, and soil phase mineralogy.

4.4.5 Task 3d-5--Borehole Abandonment

Soil boreholes will be capped, sealed, and abandoned as required by WAC-173-160. Steel casing removed from the borehole will be decontaminated in accordance with EII 5.4, "Field Decontamination of Drilling Equipment" (WHC 1989).

This page intentionally left blank.

5.0 PHASE I RFI TASK 4--AIR INVESTIGATION

This task is designed to compile accessible climatological data under a single subtask. These data will be used to evaluate potential corrective measures during the CMS.

5.1 TASK 4a--METEROLOGICAL DATA COMPILATION

The compilation of existing meteorological data from the Hanford Meteorological Station, which is located in the 200 Area, and from the nearby 100-N wind tower and the Pasco airport, will not involve any field sampling or measurement efforts. Weather data from these stations collected during the project will also be used. Because these stations are long established and to ensure comparability with existing data, no separate meteorological measurements will be conducted under the 100-DR-1 project. Meteorological measurements performed during the project will be made as part of, and in accordance with, established station procedures and will merely be compiled for the purposes of the 100-DR-1 RFI/CMS. Therefore, no project field sampling or measurements are included under this subtask. Meteorological data to be compiled include:

- Precipitation
- Temperature
- Wind velocity and direction
- Barometric pressure
- Atmosphere stratification and inversions
- Magnitude and frequencies of extreme weather events
- Air quality (including background conditions)
- Relative humidity
- Evaporation rate.

This page intentionally left blank.

DO NOT MICROFILM
THIS PAGE

6.0 PHASE I RFI TASK 5--TERRESTRIAL BIOLOGICAL INVESTIGATION

The objective of the 100-DR-1 terrestrial biological investigation is to provide a description of the potentially impacted terrestrial ecosystem at the operable unit. Two subtasks have been established to fulfill this objective.

6.1 TASK 5a--TERRESTRIAL BIOLOGICAL DATA COMPILATION

This subtask involves the compilation of any Hanford Site terrestrial biological data that are specific to 100-DR-1 (or the 100-D/DR Area or the 100 Areas, if appropriate), as well as the compilation of general terrestrial ecological information relevant to attaining the task objectives. This subtask will focus on the use of existing ecological literature to identify major species present, feeding relationships among these species, and any potential terrestrial indicator species or ecological indicators that might be of use in future biological monitoring at 100-DR-1. As such, this subtask does not involve any field sampling or measurement activities. All such activities needed to support or confirm the findings of this subtask will be performed under Task 5b.

6.2 TASK 5b--ON-SITE TERRESTRIAL BIOLOGICAL SURVEY

6.2.1 Biological Survey Objectives

This survey will support and confirm findings of Task 5a, specifically to assist in the determination of species composition at and near the operable unit and to assist in the determination of feeding relationships within the terrestrial ecosystem. The description of the terrestrial ecosystem developed under this task will be used, in conjunction with general and site-specific ecological knowledge, to help identify any valued terrestrial biological populations and to determine whether any such populations are, or have a substantial potential to be, significantly impacted by contaminant releases from the operable unit. Any significant, potential biological impacts noted may indicate a need to incorporate mitigative measures into the corrective measure alternatives developed for the operable unit. Alternatively, such noted impacts may indicate the need for implementation of interim measures to immediately eliminate an exposure pathway. The terrestrial ecosystem description may indicate an opportunity to provide for a feasible means of ecological monitoring, focusing on indicator species or ecological indicators, during corrective measures implementation to assess the effectiveness of the corrective action. In the unlikely event of the no action alternative being granted serious consideration for this operable unit, the terrestrial ecological description may show a need to expand the terrestrial biological investigation, particularly along the lines of a biocontamination study.

Determination of species composition will be limited to major species present in and near 100-DR-1. Major species are defined here as those that fall into at least one of the following categories:

- Species that are structurally or functionally important in the terrestrial ecosystem
- Species granted protective management status
- Species providing a service to man.

Structurally or functionally important species are those that are dominant in the community in terms of productivity, relative abundance, or biomass. Key species, those whose removal from the ecosystem would result in a drastic change in the characteristics of that system, are also considered to be important.

Species that have been granted protected management status under Federal or state law are important. The Washington State Departments of Wildlife and Natural Resources are responsible for administering endangered and threatened species laws for animals and plants, respectively. Working with these two agencies will ensure compliance with both state and Federal laws because Washington State designations, with respect to endangered or threatened status of particular species, are at least as strict as the corresponding Federal designations.

Species that provide a service to man are those that are of commercial interest, of recreational interest, or that perform miscellaneous environmental services (e.g., pest control).

Once the major species associated with the operable unit have been identified, the feeding relationships among them will be defined. A knowledge of feeding relationships is important in understanding potential biocontamination transport pathways.

6.2.2 Biological Survey Locations and Frequencies

The survey will be conducted over the entire operable unit surface. The survey will be conducted if needed to support and confirm the findings of Task 5a. The biologist in charge of this task will make the decision as to if and when a field survey is required to support Task 5a, based on whether existing data are adequate to describe the potentially impacted terrestrial ecosystem at the operable unit.

6.2.3 Biological Survey Equipment and Procedures

The survey will be conducted in accordance with the procedure for performing onsite, qualitative, biological surveys, to be included in EII 5.3, "Biotic Sampling" (WHC 1989). The procedure will provide details on all required equipment.

6.2.4 Data Collection, Reduction, and Interpretation

Major species identified in and near the operable unit will be described by both common and taxonomic nomenclature. Rationale for designating a particular species as a "major species" will also be provided. If a given species is determined to inhabit a particular portion of the operable unit, that portion will be described by locational Hanford Site coordinates. The biologists performing the survey will maintain notes in a field notebook and handle these in accordance with EII 1.5, "Field Logbooks" (WHC 1989), and the DMP.

This page intentionally left blank.

7.0 PHASE I RFI TASK 6--DATA EVALUATION

Data gathered under the first five tasks will be evaluated under this task, which does not involve any field sampling or measurements. Data evaluation is further discussed in Section 5.3.6 of the Work Plan.

This page intentionally left blank.

8.0 PHASE I RFI TASK 7--VERIFICATION OF CONTAMINANT- AND LOCATION-SPECIFIC ARARS

This task is designed to provide a focus on potential applicable or relevant and appropriate requirements (ARARs) that could function as cleanup standards or limitations for the selected corrective measure. It does not involve any field sampling or measurements. Discussion of this task is found in Section 5.3.7 of the Work Plan.

This page intentionally left blank.

9.0 PHASE I RFI TASK 8--BASELINE RISK ASSESSMENT

Data collected under the first seven tasks will be used to generate a baseline risk assessment for the operable unit. This task does not involve any field sampling or measurements. Baseline risk assessment is discussed in Section 5.3.8 of the Work Plan.

This page intentionally left blank.

10.0 PHASE I RFI TASK 9--PHASE I RFI REPORT: PRELIMINARY OPERABLE UNIT CHARACTERIZATION SUMMARY

This task, which consists of preliminarily summarizing and presenting the results of Tasks 1 through 8, does not involve any field sampling or measurements. The Phase I RFI report is discussed in Section 5.3.9 of the Work Plan.

This page intentionally left blank.

11.0 COORDINATION OF 120-D-1 PONDS CLOSURE PLAN WITH RFI/CMS ACTIVITIES

This task ensures that closure activities for the 120-D-1 Ponds will be coordinated with RFI/CMS activities for the rest of the operable unit, and that changes in scheduling for one will necessitate changes in the other.

This page intentionally left blank.

12.0 REFERENCES

DOE, 1989, Draft Environmental Impact Statement, Decommissioning of Eight Surplus Production Reactors at the Hanford Site, Richland, Washington, DOE/EIS-0119D, U.S. Department of Energy, Washington, D.C.

Dorian, J.J. and V.R. Richards, 1978, Radiological Characterization of the Retired 100 Areas, UNI-946, United Nuclear Industries Inc., Richland, Washington.

EPA, 1986, Test Methods for Evaluating Solid Waste (SW-846), Third Edition; EPA/Office of Solid Waste and Emergency Response, Washington, D.C.

EPA, 1987, Data Quality Objectives for Remedial Response Activities: Volume I, Development Process: EPA/Office of Solid Waste and Emergency Response, Washington, D.C.

EPA, 1988, Laboratory Data Validation Functional Guidelines for Evaluating Organics Analyses, U.S. Environmental Protection Agency/Hazardous Site Evaluation Division, Washington, D.C.

EPA, 1989, Laboratory Data Validation Functional Guidelines for Evaluating Inorganics Analyses, U.S. Environmental Protection Agency/Hazardous Site Evaluation Division, Washington, D.C.

WHC, 1989, Environmental Investigations and Site Characterization Manual, WHC-CM-7-7, Westinghouse Hanford Company, Richland, Washington.

This page intentionally left blank.

QUALITY ASSURANCE PROJECT PLAN

This page intentionally left blank.

QUALITY ASSURANCE PROJECT PLAN FOR RFI PHASE 1 INVESTIGATIONS IN THE 100-DR-1 OPERABLE UNIT

Revision -A-

Westinghouse Hanford Company
Environmental Engineering and Technology Function
Richland, Washington

Approved by:

US EPA Unit Manager________________________________ Date:__________

US EPA QA Officer__________________________________ Date:__________

State of Washington Department of
Ecology Unit Manager_______________________________ Date:__________

State of Washington Department of
Ecology QA Officer_________________________________ Date:__________

US DOE Unit Manager________________________________ Date:__________

US DOE QA Officer__________________________________ Date:__________

Westinghouse Hanford/EE&T
Technical Lead:____________________________________ Date:__________

Westinghouse QA Officer: ___________________________ Date:__________

CONTENTS

CONTENTS (Cont.)

LIST OF FIGURES

LIST OF TABLES

1.0 PROJECT DESCRIPTION

1.1 PROJECT OBJECTIVE

The primary objective of the environmental investigations in the 100-DR-1 Operable Unit (100-DR-1) is to further define the extent and location of sources of radioactive, inorganic, organic, and other type of contaminants in the vadose zone. Data resulting from this investigation will be evaluated to determine the most feasible options for additional investigation, remediation, or closure.

1.2 BACKGROUND INFORMATION

100-DR-1 is located within the 100 Area of the Hanford Site, as shown in Figure 1. Detailed background information regarding the history and present use of the unit is provided in Section 2.0 of the 100-DR-1 Work Plan.

1.3 QUALITY ASSURANCE PROJECT PLAN SCOPE AND RELATIONSHIP TO WESTINGHOUSE HANFORD QUALITY ASSURANCE PROGRAM

This quality assurance project plan (QAPP) applies specifically to the field activities and laboratory analyses performed as part of the RFI Phase I Characterization of 100-DR-1. It is an element of the Sampling and Analysis Plan (SAP) prepared specifically for this phase of investigation, and is prepared in compliance with the Westinghouse Hanford QA program plan for CERCLA RI/FS activities. As noted in Section 1.4 of the Work Plan, this plan describes the means selected to implement the overall QA program requirements defined by the "Westinghouse Hanford Company Quality Assurance Manual" (WHC-CM-4-2) (WHC 1989a), as applicable to CERCLA RI/FS environmental investigations, while accommodating the specific requirements for project plan format and content agreed upon in the "Hanford Federal Facility Agreement and Consent Order" (Ecology et al. 1989). Although specific to CERCLA RI/FS activities, the guidance provided by this document has been interpreted to be equally applicable to RCRA RFI/CMS activities under the terms of the "Hanford Federal Facility Agreement and Consent Order." It contains a matrix of procedural resources [from WHC-CM-4-2 and from the "Westinghouse Hanford Environmental Investigations and Site Characterization Manual" (WHC-CM-7-7) (WHC, 1989b)] that have been drawn upon to support the 100-DR-1 QAPP. This plan is subject to mandatory review and revision prior to use on subsequent phases of the investigation. Distribution and revision control of the QAPP will be performed in compliance with WHC-CM-4-2 procedures QR 6.0, "Document Control," and QI 6.1, "Quality Assurance Document Control," (WHC 1989a). QAPP distribution shall routinely include all review/approval personnel indicated on the title page of the document and all other individuals designated by the Westinghouse Hanford Technical Lead. All plans and procedures referenced in the QAPP are available for regulatory review on request by the direction of the Technical Lead.

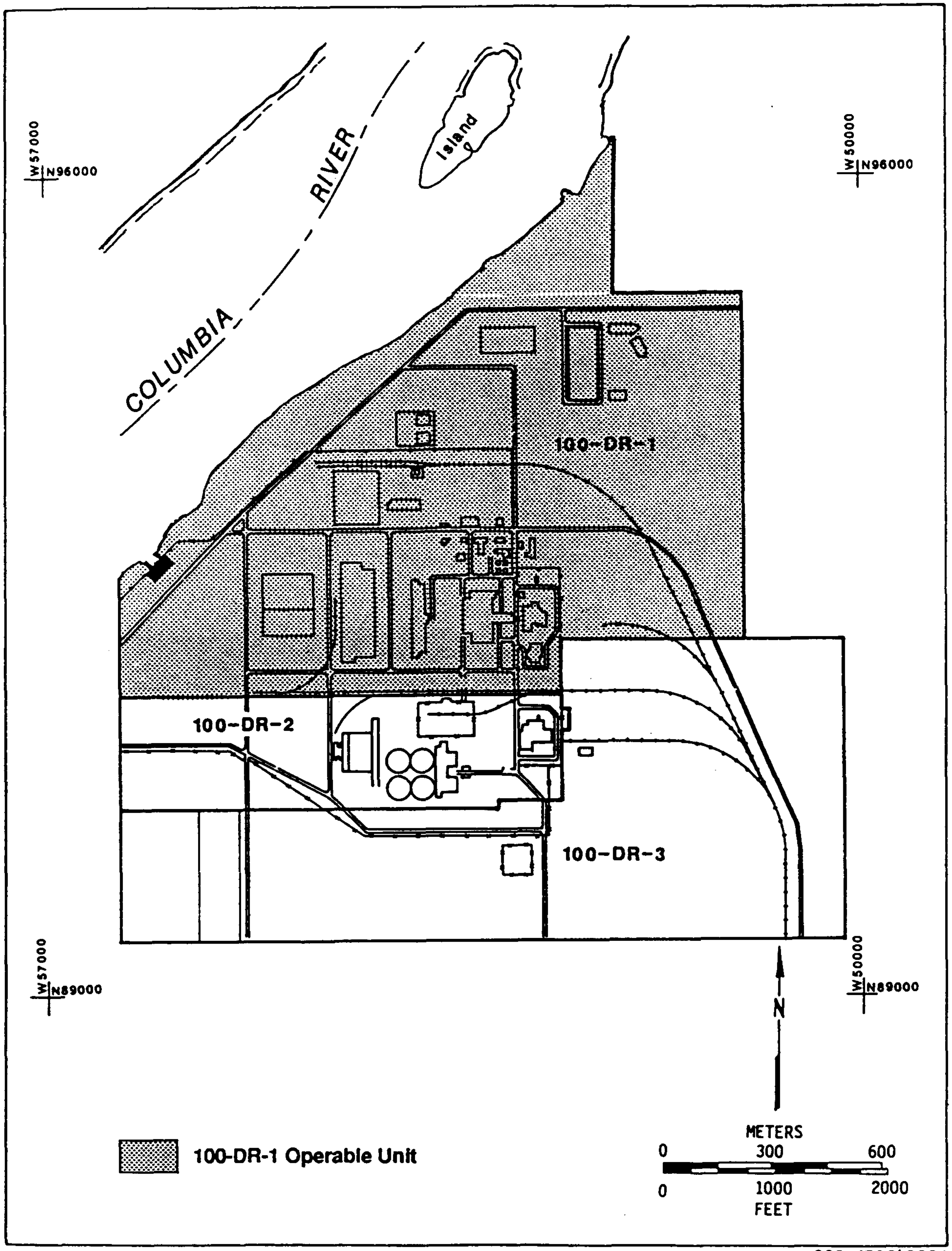


Figure 1. The 100-D/DR Area Operable Units.

1.4 SCHEDULE OF ACTIVITIES

The investigations that will be conducted in the 100-DR-1 operable unit will be subdivided into discrete phases and a number of individual tasks. This version of the QAPP applies specifically to Phase I of the RCRA facility investigation (RFI).

Individual task scopes for Phase I are listed and briefly described below; more detailed discussions are contained in Section 5.0 of the Work Plan. Procedures directly applicable to the tasks described here are discussed in Section 4.0. Sample analyses will be conducted as described in Sections 3.0 and 7.0 and Table 1:

- Task 1--Source Investigation. Task 1 consists of compilation of source data; an electromagnetic induction/magnetometer (EMI/MAG) survey; a ground penetrating radar (GPR) survey; a soil gas survey; development of a topographic base map; preliminary sampling and analysis from soil, tank, and pipeline waste sources; evaluation of the integrity of the process effluent discharge pipeline; and various geodetic surveys.

- Task 2--Geological Investigation. Task 2 involves compilation of existing data, surface geologic mapping, and collection of geologic data obtained during Phase I of the 100-HR-3 RFI and the data obtained during the Task 3 soil investigation for the 100-DR-1 operable unit.

- Task 3--Soil Investigation. Task 3 consists of test pit, septic tank and borehole soil sampling and analysis, and a surface radiation survey.

- Task 4--Air Investigation. Task 4 consists of compilation of current meteorological data.

- Task 5--Terrestrial Biological Investigation. Task 5 will consist of a compilation of terrestrial biological information and an onsite terrestrial biological survey by qualified biologists.

- Task 6--Data Evaluation. Task 6 is an evaluation of the data obtained in subtasks 1 through 5.

- Task 7--Verification of ARARs (applicable or relevant and appropriate requirements). Task 7 consists of verification of contaminant- and location-specific ARARs by project staff in cooperation with the various regulatory agencies.

- Task 8--Baseline Risk Assessment. Task 8 is a study designed to identify and assess the risks associated with various potential corrective measures.

- Task 9--Phase I RCRA Facility Investigation Report. Task 9 involves the preparation of a report summarizing the preliminary characterization of the operable unit, and will include summaries of all quality audit, surveillance, and instruction change activity that may have occurred during the course of the investigation.

2.0 PROJECT ORGANIZATION AND RESPONSIBILITIES

2.1 TECHNICAL LEAD RESPONSIBILITIES

The Environmental Engineering and Technology (EE&T) function of Westinghouse Hanford has primary responsibilities for conducting this investigation. Organizational charts are included in Figures 1 and 3 through 6 of the 100-DR-1 Project Management Plan (PMP), which define personnel assignments and individual Westinghouse Hanford field team structures applicable to the various types of tasks included in Phase I.

External participant contractors or subcontractors shall be evaluated and selected for certain portions of task activities at the direction of the Technical Lead in compliance with procedures QR 4.0, "Procurement Document Control;" QI 4.1, "Procurement Document Control;" QI 4.2, "External Services Control;" QR 7.0, "Control of Purchased Items and Services;" QI 7.1, "Procurement Planning and Control;" and QI 7.2, "Supplier Evaluation" (WHC 1989a). Major participant contractor and subcontractor resources are listed in Figure 2 of the PMP. All contractor plans and procedures shall be approved prior to use, and shall be available for regulatory review after Westinghouse Hanford approval. All analytical procedures shall be reviewed and approved by the Westinghouse Hanford Analytical Laboratories organization.

2.2 ANALYTICAL LABORATORIES

The appropriate Westinghouse Hanford field sampling team will be responsible for screening all samples for radioactivity and separating samples into two groups for further analysis. Samples with activity greater than or equal to 200 counts per minute will normally be routed to a Westinghouse Hanford or Hanford Site participant contractor laboratory equipped and qualified to handle analysis of radioactive samples. Samples with activity below 200 counts per minute shall be routed to an approved Westinghouse Hanford, participant contractor, or subcontractor analytical laboratory. All analyses shall be coordinated through the Westinghouse Hanford Office of Sample Management (OSM) and shall be performed in compliance with Westinghouse Hanford-approved laboratory quality assurance (QA) plans and analytical procedures, subject to the surveillance controls invoked by QI 7.3, "Source Surveillance and Inspection" (WHC 1989a). For subcontractors or participant contractors, applicable quality requirements shall be invoked as part of the approved procurement documentation or work order; see Section 4.1.2 below. Services of alternate qualified laboratories shall be procured for radioactive samples analysis (if onsite laboratory capacity is not available) and for the performance of split sample analysis at the Technical Lead's direction. If such an option is selected, the laboratory QA plan and applicable analytical procedures from the alternate laboratory shall be approved by Westinghouse Hanford prior to their use as noted in 4.1.2 below.

2.3 OTHER SUPPORT CONTRACTORS

Procurement of all other contracted field activities shall be in compliance with standard Westinghouse Hanford procurement procedures as discussed in Sections 2.1 and 4.1. All work shall be performed in compliance with Westinghouse Hanford-approved QA plans and/or procedures, subject to the controls of QI 7.3, "Source Surveillance and Inspection" (WHC 1989a). Applicable quality requirements shall be invoked as part of the approved procurement documentation or work order as noted in 4.1 below.

3.0 QUALITY ASSURANCE OBJECTIVES FOR MEASUREMENTS

Data quality objectives for the 100-DR-1 operable unit are summarized, to the extent possible, in Table 31 of the Work Plan and Table 1 of this QAPP; additional analytical data from waste source and soil sampling activities will be obtained and evaluated to further characterize the extent and nature of radioactive and hazardous contamination, and to determine the most feasible options for corrective measures. Analytical data will be obtained at several different levels, based on the criteria provided in "Data Quality Objectives for Remedial Response Activities: Volume 1, Development Process" (EPA 1987a), and are described below:

- Level V. Nonstandard methods will be required for analysis of radionuclides. Depending on the level of radioactivity noted in the Level I screening discussed below, analysis will either be performed on site by a qualified Westinghouse Hanford or participant contractor laboratory, or offsite by an approved subcontractor or participant contractor. Alternate offsite subcontractor laboratories may be used for radioactive sample analysis at the Technical Lead's direction if onsite laboratory capacities are inadequate. Laboratories may or may not be Contract Laboratory Program (CLP) laboratories, and new or modified analytical methods will be required. Detection limits, precision, and accuracy will be specific to individual methods, which must be prepared, reviewed, and approved prior to use as noted in 4.1 below.

- Level IV. CLP routine analytical services (RAS) methods will be required for selected organic and inorganic analyses as indicated in Table 1. All such analyses shall be performed on site or off site by a CLP-qualified laboratory, based on the results of Level I radiation screening as described below. Participant contractor or subcontractor services shall be controlled through applicable Westinghouse Hanford procurement and work control procedures as noted in 4.1 below.

- Level III. Level III analyses shall be acceptable for selected analytes as shown in Table 1; data validation shall be as defined in Section 8.0. Detection limits, precision, and accuracy shall be specified in the applicable standard analytical method, which shall be reviewed and approved prior to use as noted in 4.1 below.

- Level II. Level II analyses will be performed in the field using mobile gas chromatography (GC) equipment. Definition of detection limits and appropriate controls for precision and accuracy shall be specified in applicable GC procedures, which shall be reviewed and approved prior to use in compliance with applicable Westinghouse Hanford procedures as noted in Section 4.1.

- Level I. Soil samples shall undergo field screening to determine levels of gross alpha and beta/gamma radiation. Samples exhibiting radioactivity greater than 200 counts per minute will be automatically routed to an appropriately equipped laboratory qualified to perform analysis of radioactive samples. Coordination of sample tracking and analyses shall be provided by the Westinghouse Hanford OSM. Screening shall be performed by qualified Westinghouse Hanford radiation protection technologists as specified in governing procedures.

As noted in Section 4.6 of "<u>Data Quality Objectives for Remedial Response Activities: Volume 1, Development Process</u>" (EPA 1987a), universal goals for precision, accuracy, representativeness, completeness, and comparability (PARCC) parameters cannot be practically established at the beginning of an investigation. Historical data for precision and accuracy are available, however, that may be used as minimum guidelines for selection or preparation of analytical methods appropriate for this investigation. Table 1 provides general guidelines and reference sources for method detection limits, precision, and accuracy as available for each analyte of interest. Once individual laboratory statements of work are negotiated and methods are approved in compliance with standard procurement control procedures (as noted in Section 4.1), Table 1 shall be revised to reference approved detection limit, precision, and accuracy criteria as project requirements.

Table 1. Analytical Level, Method Selection, Detection Limit, Precision, and Accuracy Guidelines for the 100-DR-1 Operable Unit.
(Sheet 1 of 5)

Category	Analyte of interest	Analytical level[a]	Analytical method	MDC[b]	Precision (soil)	Accuracy (soil)	MDL[b]	Precision (water)	Accuracy (water)	Comments
Radiation screening	gross alpha	I	c	N/A	d	d	N/A	d	d	Performed by RPT
	gross beta/ gamma	I	c	N/A	d	d	N/A	d	d	Performed by RPT
	gross alpha	III	9310[f]	d	d	d	d	d	d	e
	gross beta	III	9310[f]	d	d	d	d	d	d	e
Radionuclide analysis	Hydrogen-3	V	c	d	d	d	N/A	N/A	N/A	e
	Carbon-14	V	c	d	d	d	N/A	N/A	N/A	e
	Cobalt-60	V	c	d	d	d	N/A	N/A	N/A	e
	Nickel-63	V	c	d	d	d	N/A	N/A	N/A	e
	Strontium-90	V	c	d	d	d	N/A	N/A	N/A	e
	Cesium-134	V	c	d	d	d	N/A	N/A	N/A	e
	Cesium-137	V	c	d	d	d	N/A	N/A	N/A	e
	Europium-152	V	c	d	d	d	N/A	N/A	N/A	e
	Europium-154	V	c	d	d	d	N/A	N/A	N/A	e
	Europium-155	V	c	d	d	d	N/A	N/A	N/A	e
	Uranium-235	V	c	d	d	d	d	d	d	e
	Uranium-238	V	c	d	d	d	d	d	d	e
	Plutonium-238	V	c	d	d	d	N/A	N/A	N/A	e
	Plutonium-239	V	c	d	d	d	N/A	N/A	N/A	e
	Plutonium-240	V	c	d	d	d	N/A	N/A	N/A	e
Metals analysis	Aluminum	III	6010[f]	d	g	h	N/A	N/A	N/A	e
	Arsenic	III	7060[f]	1 ug/l prepared sample	per. meth. 206.2/.3[i]	per. meth 206.2/.3[i]	N/A	N/A	N/A	e
	Beryllium	III	6010[f]	d	g	h	N/A	N/A	N/A	e
	Cadmium	III	6010[f]	d	g	h	N/A	N/A	N/A	e
	Chromium (total)	III	6010[f]	d	g	h	N/A	N/A	N/A	e
	Copper	III	6010[f]	d	g	h	N/A	N/A	N/A	e

Table 1. Analytical Level, Method Selection, Detection Limit, Precision, and Accuracy Guidelines for the 100-DR-1 Operable Unit. (Sheet 2 of 5)

Category	Analyte of interest	Analytical level [a]	Analytical method	MDC [b]	Precision (soil)	Accuracy (soil)	MDL [b]	Precision (water)	Accuracy (water)	Comments
Metals analysis (cont.)	Lead	III	7421[f]	1 ug/l	per. meth. 239.2[i]	per. meth. 239.2[i]	N/A	N/A	N/A	e
	Nickel	III	6010[f]	d	g	h	N/A	N/A	N/A	e
	Sodium	III	6010[f]	d	g	h	N/A	N/A	N/A	e
	Zinc	III	6010[f]	d	g	h	N/A	N/A	N/A	e
	Barium	III	6010[f]	d	g	h	N/A	N/A	N/A	e
	Silver	III	6010[f]	d	g	h	N/A	N/A	N/A	e
	Iron	III	6010[f]	d	g	h	N/A	N/A	N/A	e
	Potassium	III	6010[f]	d	g	h	N/A	N/A	N/A	e
	Maganese	III	6010[f]	d	g	h	N/A	N/A	N/A	e
	Selenium	III	7740[f]	0.002 mg/l (prepared sample)	per. meth. 270.3[i]	per. meth. 270.3[i]	N/A	N/A	N/A	e
	Strontium	III	6010[f]	d	g	h	N/A	N/A	N/A	e
	Titanium	III	6010[f]	d	g	h	N/A	N/A	N/A	e
	Vanadium	III	6010[f]	d	g	h	N/A	N/A	N/A	e
	Aluminum	IV	ICP[j]	2-22600[j]	14.4[k]	-78.8[l]	N/A	N/A	N/A	e
	Arsenic	IV	ICP[j]	d	d	d	N/A	N/A	N/A	e
	Beryllium	IV	ICP[j]	d	d	d	N/A	N/A	N/A	e
	Cadmium	IV	ICP[j]	5.5-20[j]	33.3[k]	+2.9[l]	N/A	N/A	N/A	e
	Chromium (total)	IV	ICP[j]	8.5-29000[j]	7.8[k]	-6.1[l]	N/A	N/A	N/A	e
	Copper	IV	ICP[j]	33-109[j]	11.2[k]	-2.5[l]	N/A	N/A	N/A	e
	Lead	IV	Furnace AA[j]	11.5-714[j]	9.2[k]	-2.2[l]	N/A	N/A	N/A	e
	Mercury	IV	Cold vapor[j]	1.1-26.5[j]	25.0[k]	-9.1[l]	N/A	N/A	N/A	e
	Nickel	IV	ICP[j]	44-67	15.0[k]	-17.0[l]	N/A	N/A	N/A	e
	Sodium	IV	ICP[j]	d	d	d	N/A	N/A	N/A	e
	Zinc	IV	ICP[j]	19-1720[j]	5.8[k]	-6.2[l]	N/A	N/A	N/A	e
	Barium	IV	ICP[j]	d	d	d	N/A	N/A	N/A	e
	Silver	IV	ICP[j]	d	d	d	N/A	N/A	N/A	e
	Iron	IV	ICP[j]	5028-113000[j]	10.7[k]	-27.0[l]	N/A	N/A	N/A	e
	Potassium	IV	ICP[j]	d	d	d	N/A	N/A	N/A	e
	Manganese	IV	ICP[j]	73.5-785[j]	9.4[k]	-15.1[l]	N/A	N/A	N/A	e
	Magnesium	IV	ICP[j]	2428-7799[j]	7.5[k]	-10.6[l]	N/A	N/A	N/A	e
	Selenium	IV	Furnace AA[j]	d	d	d	N/A	N/A	N/A	e
	Strontium	IV	ICP[j]	d	d	d	N/A	N/A	N/A	e
	Titanium	IV	ICP[j]	d	d	d	N/A	N/A	N/A	e
	Vanadium	IV	ICP[j]	d	d	d	N/A	N/A	N/A	e

Table 1. Analytical Level, Method Selection, Detection Limit, Precision, and Accuracy Guidelines for the 100-DR-1 Operable Unit.
(Sheet 3 of 5)

Category	Analyte of interest	Analytical level [a]	Analytical method	MDC[b]	Precision (soil)	Accuracy (soil)	MDL[b]	Precision (water)	Accuracy (water)	Comments
Ion analysis	Ammonium	III	ASTM-D-1426 D/C	0.5[m]	per 1426	per 1426	N/A	N/A	N/A	e
	Chloride	III	ASTM-D-4327	1.0[m]	per 4327	per 4327	N/A	N/A	N/A	e
	Cyanide	III	9010[f]	d	d	d	N/A	N/A	N/A	e
	Fluoride	III	ASTM-D-4327	1.0[m]	per 4327	per 4327	N/A	N/A	N/A	e
	Nitrate	III	9200[f]	d	d	d	N/A	N/A	N/A	e
	Phosphate	III	ASTM-D-4327	2.0[m]	per 4327	per 4327	N/A	N/A	N/A	e
	Sulfate	III	9035[f]	d	per. meth.	per. meth.	N/A	N/A	N/A	e
					375.1[l]	375.1[l]	N/A	N/A	N/A	e
	Sulfide	III	9030[f]	d	d	d	N/A	N/A	N/A	e
Organic scan	All required per CLP TCL	IV	CLP[n]	n	n	n	n	n	n	e
Inorganic scan	All required per CLP TAL	IV	CLP[n]	n	n	n	n	n	n	e
Phosphate pesticides analysis	Azinphos methyl	III	8140[f]	d	d	d	N/A	N/A	N/A	e
	Bolstar	III	8140[f]	d	d	d	N/A	N/A	N/A	e
	Chlorpyrifos	III	8140[f]	d	d	d	N/A	N/A	N/A	e
	Coumaphos	III	8140[f]	d	d	d	N/A	N/A	N/A	e
	Demeton-O	III	8140[f]	d	d	d	N/A	N/A	N/A	e
	Demeton-S	III	8140[f]	d	d	d	N/A	N/A	N/A	e
	Diazinon	III	8140[f]	d	d	d	N/A	N/A	N/A	e
	Dichlorvos	III	8140[f]	d	d	d	N/A	N/A	N/A	e
	Disulfoton	III	8140[f]	d	d	d	N/A	N/A	N/A	e
	Ethoprop	III	8140[f]	d	d	d	N/A	N/A	N/A	e
	Fensulfothion	III	8140[f]	d	d	d	N/A	N/A	N/A	e
	Fenthion	III	8140[f]	d	d	d	N/A	N/A	N/A	e
	Merphos	III	8140[f]	d	d	d	N/A	N/A	N/A	e
	Mevinphos	III	8140[f]	d	d	d	N/A	N/A	N/A	e
	Naled	III	8140[f]	d	d	d	N/A	N/A	N/A	e
	Parathion methyl	III	8140[f]	d	d	d	N/A	N/A	N/A	e
	Phorate	III	8140[f]	d	d	d	N/A	N/A	N/A	e
	Ronnel	III	8140[f]	d	d	d	N/A	N/A	N/A	e
	Stirophos (Tetrachlorvinpho)	III	8140[f]	d	d	d	N/A	N/A	N/A	e
	Tokuthion (Prothiofos)	III	8140[f]	d	d	d	N/A	N/A	N/A	e
	Trichloronate	III	8140[f]	d	d	d	N/A	N/A	N/A	e

Table 1. Analytical Level, Method Selection, Detection Limit, Precision, and Accuracy Guidelines for the 100-DR-1 Operable Unit. (Sheet 4 of 5)

Category	Analyte of interest	Analytical level [a]	Analytical method	MDC [b]	Precision (soil)	Accuracy (soil)	MDL [b]	Precision (water)	Accuracy (water)	Comments
Chlorinated herbicides	2,4-D	III	8150	d	d	d	N/A	N/A	N/A	e
	2,4-DB	III	8150	d	d	d	N/A	N/A	N/A	e
	2,4,5-T	III	8150	d	d	d	N/A	N/A	N/A	e
	2,4,5-TP (Silvex)	III	8150	d	d	d	N/A	N/A	N/A	e
	Dalapon	III	8150	d	d	d	N/A	N/A	N/A	e
	Dicamba	III	8150	d	d	d	N/A	N/A	N/A	e
	Dichloroprop	III	8150	d	d	d	N/A	N/A	N/A	e
	Dinoseb	III	8150	d	d	d	N/A	N/A	N/A	e
	MCPA	III	8150	d	d	d	N/A	N/A	N/A	e
	MCPP	III	8150	d	d	d	N/A	N/A	N/A	e
Total organic halides	Organic halides	III	9020	5 mg/l (prepared samples)	d	d	N/A	N/A	N/A	e
Total organic carbon	Organic carbon	III	9060	1 mg/l (prepared samples)	per. meth. 415.1[1]	per. meth. 415.1[1]	N/A N/A	N/A N/A	N/A N/A	e e
Semivolatile organic scan	All detected per method 8270	III	8270	d	per 8270, 8.0, Table 7	per 8270, 8.0, Table 7	N/A	N/A	N/A	e
Volatile organic scan	All detected per method 8240	III	8240	d	per 8240, 8.0, Table 7	per 8240, 8.0, Table 7	N/A	N/A	N/A	e

Table 1. Analytical Level, Method Selection, Detection Limit, Precision, and Accuracy Guidelines for the 100-DR-1 Operable Unit.
(Sheet 5 of 5)

[a]Analytical levels are as defined in Section 4.3.1 of Data Quality Objectives for Remedial Response Activities: Volume 1, Development Process (EPA 1987a) and Table 31 of the Work Plan for this operable unit.

[b]MDC refers to minimum detectable concentration in soil; MDL refers to minimum detection limit in water.

[c]Analytical methods shall be in compliance with approved Westinghouse Hanford or Westinghouse Hanford-approved participant contractor or subcontractor procedures. All procedures shall be reviewed and approved in compliance with procedural requirements specified in the Westinghouse Hanford QA program plan for CERCLA RI/FS activities; see QAPP Section 2.1 and 4.1.

[d]Detectible concentrations, detection limits, and/or values for precision and accuracy will be matrix-and method-specific. Minimum values shall be negotiated and established as part of the procedure review and approval process.

[e]All analyses shall be performed by an approved Westinghouse Hanford participant, contractor, or subcontractor laboratory.

[f]Methods specified are from Test Methods for Evaluating Solid Waste (EPA 1986).

[g]Precision shall be ± 20% of actual value, see paragraph 8.6.4 and 8.6.3 of method 6010.

[h]Accuracy shall be ± 20% of true value, see paragraphs 8.6.2 and 8.6.3 of method 6010.

[i]Guidelines are from Methods for Chemical Analysis of Water and Waste (EPA 1982).

[j]Type of CLP RAS method and historical minimum detection limit information are from Data Quality Objectives for Remedial Response Activities: Volume 1, Development Process (EPA 1987a). All units are expressed as micrograms per kilogram.

[k]Precision data is from Data Quality Objectives for Remedial Response Activities: Volume 1, Development Process (EPA 1987a), and is reported as percentage of relative standard deviation (RSD). The lower the percentage of RSD, the more precise the data.

[l]Accuracy data is from Data Quality Objectives for Remedial Response Activities: Volume 1, Development Process (EPA 1987a) and is reported as percentage bias. As percentage bias approaches zero, accuracy increases.

[m]Typical detection limits are as specified in the associated ASTM methods from 1988 Annual Book of ASTM Standards (ASTM 1987).

[n]CLP methods, MDCs, MDLs, and minimum values for precision and accuracy shall be as specified in the analytical laboratory's negotiated SOW for CLP services.

Goals for data representativeness are addressed qualitatively by the specification of sampling locations and intervals within the Field Sampling Plan (FSP) for this operable unit. Objectives for completeness for this investigation shall require that contractually or procedurally established requirements for precision and accuracy be met for at least 90% of the total number of requested determinations. Failure to meet this criterion shall be documented as a nonconformance, in compliance with QR 15.0, "Control of Nonconforming Items;" QI 15.1, "Nonconforming Item Reporting," and QI 15.2, "Nonconformance Report Processing" (WHC 1989a); and shall be subject to corrective action measures as discussed in Section 13.0. Approved analytical procedures shall require the use of the reporting techniques and units specified in the EPA reference methods in order to facilitate the comparability of data sets in terms of precision and accuracy.

4.0 SAMPLING PROCEDURES

4.1 PROCEDURE APPROVALS AND CONTROL

4.1.1 Westinghouse Hanford Procedures

The Westinghouse Hanford procedures cited in this QAPP have been selected from the Quality Assurance Program Index (QAPI) included in the Westinghouse Hanford quality assurance program plan for CERCLA RI/FS activities. Selected procedures include Environmental Investigations Instructions (EIIs) from the "Environmental and Site Characterization Manual" (WHC 1989b), and Quality requirements (QRs) and Quality Instructions (QIs), from the "Westinghouse Hanford Quality Assurance Manual" (WHC 1989a). Procedure approval, revision, and distribution control requirements applicable to EIIs are addressed in EII 1.2, "Preparation and Revision of Environmental Investigation Instructions" (WHC 1989b); requirements applicable to QIs and QRs are addressed in QR 5.0, "Instructions, Procedures, and Drawings;" QI 5.1, "Preparation of Quality Assurance Documents;" QR 6.0, "Document Control;" and QI 6.1, "Quality Assurance Document Control" (WHC 1989a). Other procedures applicable to the preparation, review, approval, and revision of Hanford Analytical Laboratories organization procedures shall be as defined in the various procedures and manuals identified in the QAPI under criteria 5.00 and 6.00. All procedures are available for regulatory review on request at the direction of the Westinghouse Hanford Technical Lead.

4.1.2 Participant Contractor/Subcontractor Procedures

As noted in Section 2.1 above, participant contractor and/or subcontractor services shall be procured under the applicable requirements of QR 4.0, "Procurement Document Control;" QI 4.1, "Procurement Document Control;" QI 4.2, "External Services Control;" QR 7.0, "Control of Purchased Items and Services;" QI 7.1, "Procurement Planning and Control;" and/or QI 7.2, "Supplier Evaluation" (WHC 1989a). Whenever such services require procedural controls, requirements for submittal of procedures for Westinghouse Hanford review and approval prior to use shall be included in the procurement document or work order, as applicable. In addition to the submittal of analytical procedures, analytical laboratories shall be required to submit the current version of their internal QA program plans. All analytical laboratory plans and procedures shall be reviewed and approved prior to use by qualified personnel from the Westinghouse Hanford Analytical Laboratories organization, or other qualified personnel, as directed by the Technical Lead; all reviewers shall be qualified under the requirements of EII 1.7, "Indoctrination, Training, and Qualification" (WHC 1989b). All participant contractor or subcontractor procedures, plans, and/or manuals shall be retained as project quality records in compliance with EII 1.6, "Records Management" (WHC 1989b); QR 17.0, "Quality Assurance Records;" and QI 17.1, "Quality Assurance Records Control" (WHC 1989a). All such documents are available for regulatory review on request, at the direction of the Westinghouse Hanford Technical Lead.

4.2 SAMPLING PROCEDURES

4.2.1 Soil Sampling

All soil sampling shall be performed in accordance with EII 5.2, "Soil and Sediment Sampling" (WHC 1989b). All drilling activities shall be in compliance with EII 6.7, "Groundwater Well and Borehole Drilling" (WHC 1989b). All boreholes shall be logged in compliance with EII 9.1, "Geologic Logging" (WHC 1989b). Sampling procedure applicability to individual Phase I tasks is shown in Table 2. Sample numbers, types, location, and other site-specific considerations shall be as defined by the FSP prepared for this operable unit. Documentation requirements are contained within individual EIIs and the Data Management Plan (DMP).

4.2.2 Sample Container Selection

Sample container types, preservation requirements, preparation requirements, and special handling requirements are defined in EII 5.2, "Soil and Sediment Sampling" (WHC 1989b) or EIIs (or subcontractor/participant contractor procedures) subsequently developed for other unique types of sampling. Container codes are specified in the FSP.

4.3 OTHER INVESTIGATIVE AND SUPPORTING PROCEDURES

Other procedures that will be required in this phase of the investigation are identified in Table 2, referenced to individual tasks as applicable. Documentation requirements shall be addressed within individual procedures and/or the DMP as appropriate.

Table 2. Sampling and Investigative Procedures for RFI Phase I Investigations in the 100-DR-1 Operable Unit.
(Sheet 1 of 3)

Procedure title or subject[a]		Task 1 Source Investigation	Task 2 Geological Investigation	Task 3 Soil Investigation	Task 4 Air Investigation	Task 5 Terrestrial Biological Investigation	Task 6 Data Evaluation	Task 7 Verification of ARARs	Task 8 Baseline Risk Assessment	Task 9 Phase I RFI Report
EII 1.2	Preparation and Revision of Environmental Investigation Instructions	X		X		X				
EII 1.4	Deviation from Environmental Investigation Instructions	X		X		X				
EII 1.5	Field Logbooks	X	X	X		X				
EII 1.6	Records Management	X	X	X	X	X	X	X	X	X
EII 1.7	Indoctrination, Training and Qualification	X	X	X	X	X	X	X	X	X
EII 1.8	Controlled Notebooks	X	X	X	X	X	X			
EII 2.1	Preparation of Health and Safety Plans	X		X		X				
EII 2.2	Occupational Health Monitoring	X		X		X				
EII 3.1	User Calibration of Health & Safety M&TE	X		X		X				

Table 2. Sampling and Investigative Procedures for RFI Phase I Investigations in the 100-DR-1 Operable Unit.
(Sheet 2 of 3)

Procedure title or subject[a]		Task 1 Source Investigation	Task 2 Geological Investigation	Task 3 Soil Investigation	Task 4 Air Investigation	Task 5 Terrestrial Biological Investigation	Task 6 Data Evaluation	Task 7 Verification of ARARs	Task 8 Baseline Risk Assessment	Task 9 Phase I RFI Report
EII 4.1	Nonradioactive Hazardous Waste Disposal	X		X		X				
EII 4.2	Interim Control of Unknown Waste	X		X						
EII 5.1	Chain of Custody	X		X		X				
EII 5.2	Soil and Sediment Sampling	X		X						
EII 5.3	Biotic Sampling					X				
EII 5.4	Decontamination of Drilling Equipment			X						
EII 5.5	Decontamination of Equipment for RCRA/CERCLA Sampling	X		X						
EII 5.6	Control of Geophysical Logging			X						
EII 5.7A	Hanford Geotechnical Library Control	X		X						
EII 6.1	Activity Reports of Field Operations	X		X		X			X	
EII 6.7	Groundwater Well and Borehole Drilling			X						
EII 7.1	Pest Control Administration and Operations	X		X		X			X	
EII 9.1	Geologic Logging			X						

Table 2. Sampling and Investigative Procedures for RFI Phase I Investigations in the 100-DR-1 Operable Unit.
(Sheet 3 of 3)

Procedure title or subject[a]	Task 1 Source Investigation	Task 2 Geological Investigation	Task 3 Soil Investigation	Task 4 Air Investigation	Task 5 Terrestrial Biological Investigation	Task 6 Data Evaluation	Task 7 Verification of ARARs	Task 8 Baseline Risk Assessment	Task 9 Phase I RFI Report
Geophysical Logging[b]			X						
Ground-Penetrating Radar[b]	X								
Pipeline Sludge Sampling[b]	X								
Septic Tank Sampling[b]	X		X						
EMI/MAG Surveying[b]	X								
Underground Pipeline Inspection	X								
Surface Radiation Surveying[b]			X						
Soil Gas (GC) Surveying[b]	X								
Geodetic Surveying[b]	X								
Wipe Sampling[b]	X								
Use of Health and Safety Instruments[b]	X		X						
Calibration Coordination[b]	X		X						
Soil-Gas Sampling[b]	X								
Sample Numbering[b]	X		X		X				
Sample Packaging and Shipping[b]	X		X		X				
Radioactive and Mixed Waste Disposal[b]	X		X						

[a]Procedures are latest versions of Westinghouse Hanford Environmental Investigations Instructions (EII) selected from WHC-CM-7-7, Environmental Investigations and Site Characterization Manual (WHC 1988a), unless otherwise indicated.

[b]Procedures shall be developed by the Westinghouse Hanford Environmental Engineering Group as EIIs in compliance with EII 1.2, "Preparation and Revision of Environmental Investigation Instructions", or shall be developed by other Westinghouse Hanford participating organizations, participant contractors or subcontractors in compliance with appropriate procedures invoked by the QA program plan for CERCLA RI/FS activities; see section 4.1 of the QAPP.

Analytical procedures required for Phase I of this investigation are listed in Table 1. All computer models developed for use in Task 7 shall be documented and verified in compliance with procedure QI 3.2, "Software Quality Assurance Requirements," or QI 3.3, "Minimum Documentation for Existing Computer Software" (WHC 1989a), as applicable.

4.4 PROCEDURE CHANGES

Should deviations from established EIIs be required to accommodate unforseen field situations, they may be authorized by the field team leader in accordance with the requirements specified in EII 1.4, "Deviation from Environmental Investigation Instructions" (WHC 1989a). Documentation, review, and disposition of instruction change authorization forms shall be defined by EII 1.4. Other types of procedure change requests shall be documented as required by QR 6.0, "Document Control" and QI 6.1, "Quality Assurance Document Control" (WHC 1989a).

5.0 SAMPLE CUSTODY

5.1 CHAIN OF CUSTODY PROCEDURES

All samples obtained during the course of this investigation shall be controlled as required by EII 5.1, "Chain of Custody" (WHC 1989b), from the point of origin to the analytical laboratory. Laboratory chain of custody procedures shall be reviewed and approved in compliance with the requirements of Section 4.1 of this QAPP, and shall ensure the maintenance of sample integrity and identification throughout the analytical process. At the direction of the Technical Lead, requirements for return of residual sample materials after completion of analysis shall be defined in accordance with procedures defined in the procurement documentation to subcontractor or participant contractor laboratories. Chain of custody forms shall be initiated for returned residual sample as required by the approved procedures applicable within the laboratory. Results of analyses shall be traceable to original samples through the unique code or identifier specified in the FSP. All analytical results shall be controlled as permanent project quality records as required by QR 17.0, "Quality Assurance Records" (WHC 1989a), EII 1.6, "Records Management" (WHC 1989b), and the DMP.

5.2 SAMPLE FLOW PROCESS

Sample flow activity applicable to this investigation shall be coordinated with the Westinghouse Hanford Office of Sample Management (OSM). All soil samples shall be screened for alpha, beta, and gamma radiation in compliance with approved Level I procedures as noted in Section 3.0. If elevated radiation levels are indicated, the inner core barrels, drive sampler, or other sampler assembly will be bagged and sealed on site and delivered to an appropriate facility for sample extraction in a hot cell or other controlled area. All samples with activity greater than or equal to 200 counts per minute shall be analyzed by an appropriately equipped and qualified Westinghouse Hanford or onsite participant contractor laboratory for radionuclide and hazardous constituents as described by Sections 3.0 and 7.0 and Table 1. Alternate offsite subcontractor laboratories may be used for radioactive sample analysis at the Technical Lead's direction if onsite laboratory capabilities are inadequate. Samples with activity less than 200 counts per minute activity may be transported off site to approved subcontractors or participant contractors for radionuclide and hazardous constituent analysis as described by Sections 3.0 and 7.0 and Table 1. All analyses shall be performed in compliance with Westinghouse Hanford-approved laboratory QA plans and analytical procedures, subject to standard Westinghouse Hanford surveillance controls as noted in Section 4.1 above. Applicable quality requirements shall be invoked as part of the approved procurement documentation or work order.

6.0 CALIBRATION PROCEDURES

Calibration of all Westinghouse Hanford measuring and test equipment, whether in existing inventory or purchased for this investigation, shall be controlled as required by QR 12.0, "Control of Measuring and Test Equipment;" QI 12.1, "Acquisition and Calibration of Portable Measuring and Test Equipment" (WHC 1989a); QI 12.2, "Measuring and Test Equipment Calibration by User" (WHC 1989a); and/or EII 3.1, "User Calibration of Health and Safety Measuring and Test Equipment" (WHC 1989b). Routine operational checks for Westinghouse Hanford field equipment shall be as defined within applicable EIIs or procedures; similar information shall be provided in Westinghouse Hanford-approved participant contractor or subcontractor procedures.

All calibration of laboratory equipment used for Level IV analysis shall be as required by the existing CLP scope of work, without modification. Calibration of Westinghouse Hanford, participant contractor, or subcontractor laboratory equipment used for Level III analysis shall be as defined by applicable standard analytical methods, subject to Westinghouse Hanford review and approval. Calibration of Westinghouse Hanford, participant contractor, or subcontractor laboratory equipment used for Level V analysis shall be as defined by the Westinghouse Hanford-approved analytical method.

7.0 ANALYTICAL PROCEDURES

Analytical methods or procedures for each analytical level identified in Table 31 of the Work Plan and Section 3.0 shall be selected or developed and approved prior to use in compliance with appropriate Westinghouse Hanford procedure and/or procurement control requirements. As noted in Section 4.6 of "Data Quality Objectives for Remedial Response Activities: Volume 1, Development Process" (EPA 1987a), universal goals for precision, accuracy, representativeness, completeness, and comparability (PARCC) parameters cannot be practically specified at the beginning of an investigation. Historical data for precision and accuracy are available for many analytes of interest, however, and shall be used as minimum guidelines for selection or preparation of analytical methods appropriate for this investigation. Table 1 provides general guidelines and reference sources for method detection limits, precision, and accuracy as available for each analyte of interest, sorted by the required analytical level. Once individual laboratory statements of work are negotiated, and procedures are approved in compliance with the requirements of Section 4.1 above, Table 1 shall be revised to include actual method references and approved detection limit, precision, and accuracy criteria as project requirements.

All analytical procedures approved for use in this investigation shall require the use of standard reporting techniques and units to facilitate the comparability of data sets in terms of precision and accuracy. All approved procedures shall be retained in the project quality records and shall be available for review on request at the direction the Westinghouse Hanford Technical Lead.

8.0 DATA REDUCTION, VALIDATION, AND REPORTING

8.1 DATA REDUCTION AND DATA PACKAGE PREPARATION

All analytical laboratories (including field GC laboratories) shall be responsible for preparing a report summarizing the results of analysis and for preparing a detailed data package that includes identification of samples, sampling and analysis dates, raw analytical data, reduced data, data outliers, reduction formulas, recovery percentages, quality control check data, equipment calibration data, supporting chromatograms or spectrograms, and documentation of any nonconformances affecting the measurement system in use during the analysis of the particular group of samples. Data reduction schemes shall be contained within individual laboratory analytical methods and/or QA manuals, subject to Westinghouse Hanford reviewed and approval as discussed in Section 4.1. The completed data package shall be reviewed and approved by the analytical laboratory's QA Manager (or Field Team Leader for Level II GC analysis) prior to submittal to the Westinghouse Hanford Technical Lead for validation. The requirements of this section shall be included in procurement documentation or work orders, as appropriate, in compliance with the standard Westinghouse Hanford procurement control procedures noted in Section 4.1.

8.2 VALIDATION

Validation of the completed data package may be performed by qualified Westinghouse Hanford personnel (from the OSM or other organizations) by a qualified independent participant contractor or subcontractor analytical laboratory, or by qualified independent reviewers within the laboratory generating the analysis. Selection of qualified reviewers and assignment of validation responsibilities shall be at the discretion of the Westinghouse Hanford Technical Lead. Validation responsibilities shall be defined in procurement documentation or work orders as appropriate.

8.2.1 Level II Validation Report Preparation

Level II analyses performed for this investigation will be confined to field gas chromatography (GC) screening, as noted in Section 3.0. GC procedures shall include specific validation report preparation requirements, which shall be reviewed and approved by Westinghouse Hanford prior to use as noted in Section 4.1.

8.2.2 Level III Validation Report Preparation

All Level III analyses shall be validated in compliance with the guidelines established for Level IV (CLP) analysis. For organic analyses, validation reports shall be prepared documenting overchecks of the following areas, as recommended in "Laboratory Data Validation Functional Guidelines for Evaluating Organics Analyses" (EPA 1988a):

- Sample holding times
- Gas chromatograph/mass spectrometer tuning or adjustment requirements
- Initial and continuing calibration requirements
- Blank sample requirements
- Surrogate recover requirements
- Matrix spike/matrix spike duplicate requirements
- Field duplicate requirements
- Internal standards performance requirements
- Target compound identification requirements
- Compound quantitation requirements and reported detection limits
- Any tentatively identified compounds library search and assessment requirements
- Overall data assessment requirements.

For inorganic analyses, validation reports shall be prepared documenting overchecks of the following areas, as recommended in "Laboratory Data

Validation Functional Guidelines for Evaluating Inorganics Analyses" (EPA 1988c):

- Sample holding times
- Calibration requirements
- Blank sample requirements
- Interference check sample requirements
- Laboratory control sample requirements
- Duplicate sample analysis
- Matrix spike sample requirements
- Furnace atomic absorption quality control requirements
- Inductively couple plasma serial dilution requirements
- Field duplicate sample requirements
- Overall data assessment requirements.

8.2.3 Level IV Validation Report Preparation

All Level IV analyses shall be validated in compliance with the requirements of the laboratory's existing CLP contract, without modification.

8.2.4 Level V Validation Report Preparation

All validation of Level V radionuclide analysis (and, if required by Level I screening, other Level V radioactive sample analysis) shall be established as method-specific requirements, but shall follow the general guidance provided in 8.2.2 above.

8.3 FINAL REVIEW AND RECORDS MANAGEMENT CONSIDERATIONS

All validation reports and supporting analytical data packages shall be subjected to a final technical review by a qualified reviewer at the direction of the Westinghouse Technical Lead, prior to submittal to the regulatory agencies or inclusion in reports or technical memoranda. All validation reports, data packages, and review comments shall be retained as permanent project quality records in compliance with EII 1.6, "Records Management (WHC 1989b)," QR 17.0, "Quality Assurance Records (WHC 1989a)," and the DMP.

9.0 INTERNAL QUALITY CONTROL

All analytical samples shall be subject to in-process quality control measures in both the field and laboratory. Unless otherwise specified in the approved Field Sampling Plan (FSP), the following minimum field quality control requirements apply for Level III, IV, and V analyses. These requirements are adapted from "Test Methods for Evaluating Solid Waste" (SW-846) (EPA 1986), as modified by the proposed rule changes included in the "Federal Register," Volume 54, No. 13 (EPA 1989).

- Field duplicate samples. For each shift of sampling activity under an individual sampling subtask, a minimum of 5% of the total collected samples shall be duplicated, or one duplicate shall be collected for every 20 samples, whichever is greater. Duplicate samples shall be retrieved from the same sampling location using the same equipment and sampling technique, and shall be placed into two identically prepared and preserved containers. All field duplicates shall be analyzed independently as an indication of gross errors in sampling techniques.

- Split samples. At the Technical Lead's direction, field or field duplicate samples may be split in the field and sent to an alternative laboratory as a performance audit of the primary laboratory. Frequency shall meet the minimum schedule requirements of Section 10.0 below.

- Blind samples. At the Technical Lead's direction, blind reference samples may be introduced into any sampling round as a performance and audit of the primary laboratory. Blind sample type shall be as directed by the Technical Lead; frequency shall meet the minimum schedule requirements in Section 10.0.

- Field blanks. Field blanks shall consist of pure deionized distilled water, transferred into a sample container at the site and preserved with the reagent specified for the analytes of interest. Field blanks are used as a check on reagent and environmental contamination, and shall be collected at the same frequency as field duplicate samples.

- Equipment blanks. Equipment blanks shall consist of pure deionized distilled water washed through decontaminated sampling equipment and placed in containers identical to those used for actual field samples. Equipment blanks are used to verify the adequacy of sampling equipment decontamination procedures, and shall be collected at the same frequency as field duplicate samples.

- Trip blanks. Trip blanks consist of pure deionized distilled water added to one clean sample container, accompanying each batch of containers shipped to the sampling activity. Trip blanks shall be returned unopened to the laboratory, and are prepared as a check on possible contamination originating from container preparation methods, shipment, handling, storage, or site conditions. In compliance with standard Westinghouse Hanford procurement procedures, requirements for trip blank preparation shall be included in procurement documents of work orders to the sample container supplier and/or preparer.

Internal quality control checks for Level IV analyses shall be as specified by the laboratory's existing CLP contract, without modification. The internal quality control checks performed by analytical laboratories for Level III and Level V laboratory analyses shall meet the following minimum requirements:

- Matrix spiked samples. Matrix spiked samples require the addition of a known quantity of a representative analyte of interest to the sample as a measure of recovery percentage. The spike shall be made in a replicate of a field sample. Replicate samples are separate aliquots removed from the same sample container in the laboratory. Spike compound selection, quantities, and concentrations shall be described in the analytical procedures submitted for Westinghouse Hanford review and approval. One sample shall be spiked per analytical batch, or once every 20 samples, whichever is greater.

- Quality control reference samples. A quality control reference sample shall be prepared from an independent standard at a concentration other than that used for calibration, but within the calibration range. Reference samples are required as an independent check on analytical technique and methodology, and shall be run with every analytical batch, or every 20 samples, whichever is greater.

Other requirements specific to laboratory analytical equipment calibration are included in Section 6.0.

For Level II GC analysis, at least one duplicate sample per shift shall be routed to a qualified laboratory as an overcheck on the proper use and functioning of field GC procedures and equipment. Duplicates shall be selected, whenever possible, from samples in which significant readings have been observed during field analysis.

The minimum requirements of this section shall be invoked in procurement documents or work orders in compliance with standard Westinghouse Hanford procedures as noted in Section 4.1 above.

10.0 PERFORMANCE AND SYSTEM AUDITS

As noted in Section 5.12 and Appendix A of "Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans" (QAMS-005) (EPA, 1983), audits in environmental investigations are considered to be systematic checks that verify the quality of operation of one or more elements of the total measurement system. In the sense intended by QAMS-005, audits may be of two types: (1) performance audits, in which quantitative data are independently obtained for comparison with data routinely obtained by the measurement system; or (2) system audits, involving a qualitative on-site evaluation of laboratories (or other organizational elements of the measurement system) for compliance with established quality assurance program and procedure requirements. For this investigation, performance audit requirements shall be met by the analysis of a minimum of one blind or one split sample for each analytical method identified in Table 1. Blind samples shall not be identified as such to the primary laboratory, and may be made from traceable standards or from routine samples spiked with a known concentration of a known compound. Split samples shall be analyzed by an independent laboratory in compliance with approved methods based on the same reference standards as are invoked for the primary laboratory. All analytical procedures shall be approved by Westinghouse Hanford prior to use as described in Section 4.1 of this QAPP. System audit requirements shall be implemented through the use of procedure QI 10.4, "Surveillance" (WHC 1989a). At a minimum, at least two system audits shall be performed; in order that any required corrective action may be implemented in time to have a beneficial effect on project quality, one audit shall be performed shortly after the initiation of project activity and one approximately midway in the investigation.

Additional performance and system audits may be scheduled as a consequence of corrective action requirements (see Section 13.0 below), or may be performed upon request by the QA Coordinator, the Technical Lead, DOE-RL, Ecology, or the EPA. Any discrepancies observed during the evaluation of performance audit results or during system audit surveillance activities that cannot be immediately corrected to the satisfaction of the investigator shall be documented as nonconformances and resolved in compliance with procedures QI 15.1, "Nonconforming Item Reporting," and QI 15.2, "Nonconformance Report Processing" (WHC 1989a). In addition, at the direction of the Westinghouse Hanford Environmental Engineering Group (EEG) QA Officer, all aspects of 100-DR-1 project activities may also be evaluated as part of environmental restoration program-wide QA audits under the procedural requirements of WHC-CM-4-2 (WHC 1989a). Program audits shall be conducted in compliance with QR 18.0, "Audits;" QI 18.1, "Audit Programming and Scheduling;" and QI 18.2, "Planning, Performing, Reporting, and Follow-up of Quality Audits" by auditors qualified in compliance with QI 2.5, "Qualification of Quality Assurance Program Audit Personnel" (WHC 1989a).

11.0 PREVENTIVE MAINTENANCE

All measurement and testing equipment used in the field and laboratories that directly affect the quality of the field and analytical data shall be subject to preventive maintenance measures that ensure minimization of measurement system downtime and corresponding schedule delays. Laboratories shall be responsible for performing or managing the maintenance of their analytical equipment; maintenance requirements, spare parts lists, and instructions shall be included in individual methods or in laboratory QA plans, subject to Westinghouse Hanford review and approval. Westinghouse Hanford field equipment shall be drawn from inventories subject to standard preventive maintenance procedures. Field procedures submitted for Westinghouse Hanford approval by participant contractors or subcontractors shall contain provisions for preventive maintenance schedules and spare parts lists in order to ensure minimization of equipment downtime.

12.0 DATA ASSESSMENT PROCEDURES

Characterization data from this phase of the 100-DR-1 investigation will be assessed at two levels. As previously discussed in Section 8.0, analytical data shall first be compiled and reduced by the laboratory, and validated in a manner appropriate for the individual analytical level. As part of Task 6, the validated data shall be evaluated against the source background data compiled in Task 1; the information resulting from the various surveys conducted in Task 1, 3, and 6; the compiled geological data from Task 2; and, the meteorological data compiled in Task 4. As discussed in Section 5.0 of the 100-DR-1 Work Plan, and as directed by the Technical Lead, various statistical and probabilistic techniques may be selected for use in the process of data comparison and analysis. Statistical methods may include one or more of the standard methods and formulae discussed in Appendix C of this QA Project Plan, or other appropriate methods at the discretion of the Technical Lead. In all cases, however, the statistical methodologies and assumptions to be used in the evaluation shall be defined by written directions that are signed, dated, and retained as project quality records in compliance with EII 1.6, "Records Management" (WHC 1989b), and QR 17.0, "Quality Assurance Records" (WHC 1989a). Applicable directions shall be documented in the interim report produced at the conclusion of Task 6, for eventual consideration in the risk assessment performed in Task 8 and the final report for this phase of the characterization of 100-DR-1 produced in Task 9.

13.0 CORRECTIVE ACTION

Corrective action requests required as a result of surveillance reports, nonconformance reports, or audit activity shall be documented and dispositioned as required by QR 16.0, "Corrective Action;" QI 16.1, "Trending/Trend Analysis;" and QI 16.2, "Corrective Action Reporting" (WHC 1989a). Other measurement systems, procedures, or plan corrections that may be required as a result of data assessment or routine review processes shall be resolved as required by governing procedures or shall be referred to the Technical Lead for resolution. Copies of all surveillance, nonconformance, audit, and corrective action documentation shall be placed with the project quality records on completion or closure.

14.0 QUALITY ASSURANCE REPORTS

As previously stated in Sections 10.0 and 13.0, project activities shall be regularly assessed by performance and system auditing and associated corrective action processes. Surveillance, nonconformance, audit, and corrective action documentation shall be routed to the project quality records on completion or closure of the activity. A report summarizing all audit, surveillance, and instruction change authorization activity (see Section 4.4), as well as any associated corrective actions, shall be prepared for the Technical Lead by the QA Coordinator at the completion of Phase I. Such information will become an integral part of the Data Evaluation and Phase I RCRA Facility Investigation Report prepared under Task 8; see Section 1.0. The final report shall include an assessment of the overall adequacy of the total measurement system with regard to the data quality objectives of the investigation.

15.0 REFERENCES

See Appendix B.

APPENDIX A:

GLOSSARY

Accuracy: For the purposes of environmental investigations, accuracy may be interpreted as the measure of the bias in a system. Sampling accuracy is normally assessed through the evaluation of matrix spiked samples and reference samples.

Arithmetic Mean: The arithmetic mean is the average of the sum of a set of n values divided by n; the mathematical formula for calculating the arithmetic mean is provided in Section 2.1 of Appendix C.

Audit: For the purposes of environmental investigations, audits are considered to be systematic checks to verify the quality of operation of one or more elements of the total measurement system. In this sense, audits may be of two types: (1) performance audits, in which quantitative data are independently obtained for comparison with data routinely obtained in a measurement system, or (2) system audits, involving a qualitative on-site evaluation of laboratories or other organizational elements of the measurement system for compliance with established quality assurance program and procedure requirements. For environmental investigations at the Hanford Site, performance audit requirements are fulfilled by periodic submittal of blind samples to the primary laboratory, or the analysis of split samples by an independent laboratory. System audit requirements are implemented through the use of standard surveillance procedures.

Bias: Bias represents a systematic error that contributes to the difference between a population mean of a set of measurements and an accepted reference or true value.

Blind Sample: A blind sample refers to any type of sample routed to the primary laboratory for purposes of auditing performance relative to a particular sample matrix and analytical method. Blind samples are not specifically identified as such to the laboratory; they may be made from traceable standards, or may consist of sample material spiked with a known concentration of a known compound. See the glossary entry for audit above.

Coefficient of Variation: The coefficient of variation is the standard deviation divided by the mean, and is multiplied by 100 if expressed as a percentage.

Comparability: For the purposes of environmental investigations, comparability is an expression of the relative confidence with which one data set may be compared with another.

Completeness: For the purposes of environmental investigations, completeness may be interpreted as a qualitative parameter expressing the confidence with which one data set can be compared with another.

Confidence Interval: Confidence intervals are applied to bound the value of a population parameter within a specified degree of confidence (i.e., the confidence coefficient), usually 90, 95, or 99%. The form of a confidence interval depends on the underlying assumptions and intentions. It assumes different values for different random samples, and requires specification of the number of observations on which the interval is based. See Section 2.4 of Appendix C for further discussion.

Deviation: For the purpose of environmental investigations, deviation refers to a planned departure from established criteria that may be required as a result of unforeseen field situations or that may be required to correct ambiguities in procedures that may arise in practical applications.

Equipment Blanks: Equipment blanks consist of pure deionized, distilled water washed through decontaminated sampling equipment and placed in containers identical to those used for actual field samples; they are used to verify the adequacy of sampling equipment decontamination procedures, and are normally collected at the same frequency as field duplicate samples.

Field Blanks: Field blanks consist of pure deionized, distilled water, transferred to a sample container at the site and preserved with the reagent specified for the analytes of interest; they are used to check for possible contamination originating with the reagent or the sampling environment, and are normally collected at the same frequency as field duplicate samples.

Field Duplicate Sample: Field duplicate samples are samples retrieved from the same sampling location using the same equipment and sampling technique, placed in separate identically prepared and preserved containers, and analyzed independently. Field duplicate samples are generally used to verify the repeatability or reproduceability of analytical data, and are normally analyzed with each analytical batch or every 20 samples, whichever is greater.

Geometric Mean: For a set of n positive numbers, the geometric mean is defined as the nth root of the product of the value. The geometric mean is used as a measure of central tendency for data from a log normal distribution. See Section 2.1 of Appendix C for formulae and further discussion.

Matrix Spiked Samples: Matrix spiked samples are a type of laboratory quality control sample; they are prepared by splitting a sample received from the field into two homogenous aliquots (i.e., replicate samples), and adding a known quantity of a representative analyte of interest to one aliquot in order to calculate percentage of recovery.

Nonconformance: A nonconformance is a deficiency in characteristic, documentation, or procedure that renders the quality of material, equipment, services, or activities unacceptable or indeterminate. When the deficiency is of a minor nature, does not effect a permanent or significant change in quality if it is not corrected, and can be brought into conformance with immediate corrective action, it shall not be categorized as a nonconformance. However, if the nature of the condition is such that it cannot be immediately and satisfactorily corrected, it shall be documented in compliance with approved procedures and brought to the attention of management for disposition and appropriate corrective action.

Precision: Precision is a measure of the repeatability or reproducibility of specific measurements under a given set of conditions. Specifically, it is a quantitative measure of the variability of a group of measurements compared to their average value. Precision is normally expressed in terms of standard deviation, but may also be expressed as the coefficient of variation (i.e., relative standard deviation) and range (i.e., maximum value minus minimum value). Precision is assessed by means of duplicate/replicate sample analysis.

Quality Assurance: For the purposes of environmental investigations, QA refers to the total integrated quality planning, quality control, quality assessment, and corrective action activities that collectively ensure that the data from monitoring and analysis meets all end user requirements and/or the intended end use of the data.

Quality Assurance Project Plan: The QAPP is an orderly assembly of management policies, project objectives, methods, and procedures that defines how data of known quality will be produced for a particular project or investigation.

Quality Control: For the purposes of environmental investigations, QC refers to the routine application of procedures and defined methods to the performance of sampling, measurement, and analytical processes.

Range: Range refers to the difference between the largest and smallest reported values in a sample, and is a statistic for describing the spread in a set of data.

Reference Samples: Reference samples are a type of laboratory quality control sample prepared from an independent, traceable standard at a concentration other than that used for analytical equipment calibration, but within the calibration range. Such reference samples are required for every analytical batch or every 20 samples, whichever is greater.

Relative Error: Relative error refers to the mean error of a set of measured data values as a percentage of the true value. See Section 2.2 of Appendix C for the formula and further discussion.

Replicate Sample: Replicate samples are two aliquots removed from the same sample container in the laboratory and analyzed independently.

Representativeness: For the purposes of environmental investigations, representativeness may be interpreted as the degree to which data accurately and precisely represent a characteristic of a population parameter, variations at a sampling point, or an environmental condition. Representativeness is a qualitative parameter which is most concerned with the proper design of a sampling program.

Significance Tests: Significance tests refer to a variety of methods used to check statistical hypotheses. See Section 2.3 of Appendix C for formulae and further discussion.

Skewness: Skewness is a measure of the asymmetry of a frequency distribution; the mathematical formula is provided in Section 2.1 of Appendix C.

Split Sample: A split sample is produced through homogenizing a field sample and separating the sample material into two equal aliquots. Field split samples are usually routed to separate laboratories for independent analysis, generally for purposes of auditing the performance of the primary laboratory relative to a particular sample matrix and analytical method. See the glossary entry for audit above. In the laboratory, samples are generally split to create matrix spiked samples; see the glossary entry above.

Standard Deviation: The standard deviation is the positive square root of the variance. See Section 2.1 of Appendix C for formulae and further discussion.

Trip Blanks: Trip blanks are a type of field quality control sample, consisting of pure deionized distilled water in a clean, sealed sample container, accompanying each batch of containers shipped to the sampling site and returned unopened to the laboratory. Trip blanks are used to identify any possible contamination originating from container preparation methods, shipment, handling, storage, or site conditions.

Validation: For the purposes of environmental investigations, validation refers to a systematic process of reviewing a body of data against a set of criteria to provide assurance that the data are acceptable for their intended use. Validation methods may include review of verification activities, editing, screening, cross-checking, or technical review.

Variance: Sample variance is a measure of the dispersion of a set of measurements; it is further defined as the sum of the squares of the individual deviations from the sample mean divided by one less that the number of results involved. See Section 2.1 of Appendix C for the formula and further discussion.

Verification: For the purposes of environmental investigations, verification refers to the process of determining whether procedures, processes, data, or documentation conform to specified requirements. Verification activities may include inspections, audits, surveillances, or technical review.

APPENDIX B

REFERENCES

American Society for Testing and Materials, 1987, 1988 Annual Book of ASTM Standards, ASTM, Philadelphia, Pennsylvania.

Beyer, W.H., ed., 1973, Standard Mathematical Tables, Twenty-fourth edition, CRC Press, Cleveland, Ohio.

EPA, 1983, Interim Guidelines and Specifications for Preparation of Quality Assurance Project Plans, QAMS-005/80, U.S. Environmental Protection Agency/Office of Exploratory Research, Washington, D.C.

EPA, 1988c, Laboratory Data Validation Functional Guidelines for Evaluating Inorganics Analyses, U.S. Environmental Protection Agency/Hazardous Site Evaluation Division, Washington, D.C.

EPA, 1986, Test Methods for Evaluating Solid Waste (SW-846), Third Edition, U.S. Environmental Protection Agency/Office of Solid Waste and Emergency Response, Washington, D.C.

EPA, 1982, Methods for Chemical Analysis of Water and Waste, EPA-600/4-79-020, U.S. Environmental Protection Agency, Environmental Monitoring and Support Laboratory, Cincinnati, Ohio.

EPA, 1987b, Quality Assurance Handbook for Air Pollution Measurement Systems, Volume 1: Principles, EPA-600/9-76-005, U.S. Environmental Protection Agency/Office of Research and Development, Environmental Monitoring and Support Laboratory, Research Triangle Park, North Carolina.

EPA, 1988a, Laboratory Data Validation Functional Guidelines for Evaluating Organics Analyses, U.S. Environmental Protection Agency/Hazardous Site Evaluation Division, Washington, D.C.

EPA, 1988b, Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA (OSWER directive 9335.3-01, Draft), EPA/540/G-89/004, U.S. Environmental Protection Agency/Office of Solid Waste and Emergency Response, Washington, D.C.

EPA, 1987a, Data Quality Objectives for Remedial Response Activities: Volume I, Development Process, EPA/540/6-87/003, U.S. Environmental Protection Agency/Office of Solid Waste and Emergency Response, Washington, D.C.

EPA, 1989, "Hazardous Waste Management System; Testing and Monitoring Activities (Proposed Rule);" in Federal Register, Vol. 54, No. 13, pp 3212-3228.

EPA, 1979, Handbook for Analytical Quality Control in Water and Wastewater Laboratories, EPA-600/4-79-019, U.S. Environmental Protection Agency/Office of Research and Development, Environmental Monitoring and Support Laboratory, Cincinnati, Ohio.

Lapin, L.L. 1983, Probability and Statistics for Modern Engineering; Brooks/Cole Publishing Co., Monterey, California.

Miller, I. and J.E. Freund 1965, Probability and Statistics for Engineers; Prentice-Hall, Inc., Englewood Cliffs, New Jersey.

Snedecor, G.W., and Cochran, W.G., 1980, Statistical Methods, Iowa State University Press, Ames, Iowa.

Washington State Department of Ecology, U.S. Environmental Protection Agency, and U.S. Department of Energy, 1989, Hanford Federal Facility Agreement and Consent Order, Washington State Department of Ecology, U.S. Environmental Protection Agency, and U.S. Department of Energy.

WHC, 1989a, Westinghouse Hanford Company Quality Assurance Manual, WHC-CM-4-2, Westinghouse Hanford Company, Richland, Washington.

WHC, 1989b, Environmental Investigations and Site Characterization Manual, WHC-CM-7-7, Westinghouse Hanford Company, Richland, Washington.

APPENDIX C

STATISTICAL METHODS

1.0 SCOPE

This attachment discusses various statistical methods suitable for assessing the precision, accuracy, or completeness of data, or for the comparison and evaluation of validated data sets. The information provided by this appendix is intended for guidance only. All methods selected or proposed by an individual analytical laboratory for the assessment of data precision, accuracy, and completeness are subject to review and approval prior to use, as are the methods defined within DIs for data evaluation (see Section 12.0 of the 100-DR-1 QAPP).

2.0 STATISTICAL METHODS AND FORMULAE

2.1 CENTRAL TENDENCY AND DISPERSION

Methods for determining central tendencies and dispersion of data may include determination of various statistical values. The **arithmetic mean** is the average of the sum of a set of **n** values divided by **n**:

$$\overline{X} = \frac{\sum_{i=1}^{n} X_i}{n} \qquad \text{(EPA 1979)}$$

Range simply refers to the difference between the largest and smallest values reported for a sample (EPA 1979). The **standard deviation** is the positive square root of the variance of the population:

$$\sigma = \sqrt{\frac{\sum_{i=1}^{n} X_i^2 - \left(\sum_{i=1}^{n} X_i\right)^2 / N}{N}} \qquad \text{(EPA 1979)}$$

Median refers to the middle value of all data, ranked in ascending order. If there are two middle values, the median is the mean of these values. (EPA 1979) A **mode** M_0 of a sample size n is a value which occurs with greatest frequency; i.e., it is the most common value (Beyer 1973).

The **standard deviation estimate** is the most widely used measure to describe the dispersion of a set of data, and is expressed as follows:

$$S = \sqrt{\frac{\sum_{i=1}^{n} X_i^2 - \left(\sum_{i=1}^{n} X_i\right)^2 / n}{n-1}} \qquad \text{(EPA 1979)}$$

The **relative standard deviation** is the ratio of the standard deviation **S** of a set of numbers to their mean **X̄**, expressed as a percentage; it relates the standard deviation (or precision) of a set of data to the size of the numbers:

$$CV = RSD\ (\text{percent}) = 100\frac{S}{\overline{X}} \qquad \text{(EPA 1979)}$$

The **coefficient of skewness** is a measure of the asymmetry of a frequency distribution:

$$K = \frac{\Sigma[(x-\mu)^3]}{\sigma^3} \qquad \text{(Snedecor and Cochran 1980)}$$

The **geometric mean** is a measure of central tendency for data from a positively skewed distribution (log normal):

$$\overline{X}_g = \sqrt[n]{(X_1)(X_2)...(X_n)}$$

$$\overline{X}_g = \text{antilog} \frac{\sum_{i=1}^{n} \log X_i}{n} \qquad \text{(EPA 1979)}$$

Variance: Sample **variance** is a measure of the dispersion of a set of measurements; it is further defined as the sum of the squares of the individual deviations from the sample mean divided by one less that the number of results involved, as expressed by the following equation:

$$S^2 = \frac{\sum_{i=1}^{n} (X_i - \overline{X})^2}{n-1} \qquad \text{(ASTM 1988)}$$

where:

s = the sample variance of the measurements,
n = the number of measurements obtained,
$\underline{X}_i$ = the ith individual measurement, and
$\overline{X}$ = the sample mean of the measurements.

2.2 ASSESSMENT OF DATA QUALITY

Accuracy may be interpreted as the measure of the **bias** in a measurement system. Accuracy may be expressed as: (a) the difference between the measurement (X) with the reference value (T) (i.e., X-T), or (b) the difference between the two values as a percentage of the reference value (i.e., 100(X-T)/T). For the purposes of environmental investigations, **precision** may be interpreted as a measure of repeatability or reproducibility between individual measurements made with a common set of parameters or conditions. Precision is normally expressed in terms of the **standard deviation**, but may also be expressed as the **relative standard deviation** (coefficient of variation) or **range** (maximum value minus minimum value; see the discussion in Section 2.1). **Relative error** (RE) refers to the mean error of a series of measured data values as a percentage of the true value **XT**:

$$RE = 100 \frac{|x-T|}{T} \qquad \text{(EPA 1979)}$$

For the purposes of environmental investigations, **comparability** is an expression of the relative confidence with which one data set may be compared with another. **Completeness** is expressed as follows:

$$\text{Completeness (\%)} = \frac{\text{Number of valid analyses (for each parameter)}}{\text{Number of samples analyzed (for each parameter)}} \quad 100$$

For the purposes of environmental investigations on the Hanford Site, completeness is defined as an objective of meeting established requirements for precision and accuracy for at least 90% of the requested determinations.

2.3 SIGNIFICANCE TESTS

Significance or hypothesis testing refers to the various means used to check statistical hypotheses. Such tests include the **Student-t test**, the **chi-squared test**, the **F-test** and various other non-parametric tests. The selection of test type should suit the specific characteristics of the hypothesis being tested. Detailed discussions of these types of tests may be found in standard statistics texts such as "Probability and Statistics in Modern Engineering" (Lapin 1983) or "Probability and Statistics for Engineers" (Miller and Freund 1965), or "Statistical Methods" (Snedecor and Cochran 1980).

2.4 CONFIDENCE LIMITS

Confidence limits refer to the boundaries of a value interval with a designated confidence (the **confidence coefficient**) of including some defined parameter of the population. The **confidence coefficient** is the probability that the value interval has of including the sample population values. The confidence coefficient is normally expressed as a percentage; for a given sample size, the distance between the confidence limits increases as the coefficient increases. The guidelines, tables, formulae, and figures of Appendix E, "Estimation Procedures," from "Quality Assurance Handbook for Air Pollution Measurement Systems" (EPA 1987b) are recommended for selection of appropriate methods.

2.5 TESTING FOR OUTLIERS

Statistical tests are recommended for the screening of data sets for unusually large or small data values for elimination prior to the analysis or processing of data. The guidelines, tables, formulae, and figures of Appendix F, "Outliers," from "Quality Assurance Handbook for Air Pollution Measurement Systems" (EPA 1987b) are recommended for selection of appropriate methods. Statistical tests for detecting outlier data should only be performed after the accuracy of data recording and/or data reduction is verified and it is determined that proper QA/QC procedures have been followed. If a data recording/reduction error is found and can be corrected, the corrected value should be used.

3.0 MATHEMATICAL TERMS

Mathematical terms used in the formulae discussed previously are as follows:

K = skewness (EPA 1979)

N = population size (if finite) or lot size (EPA 1987b)

n = number of items in the sample or test (EPA 1987b)

S = standard deviation estimate (EPA 1987b)

S_p = pooled standard deviation estimate (Larsen and Marx 1986)

$\bar{X}$ = arithmetic mean (EPA 1987b)

$\bar{X}_g$ = geometric mean of sample measurements (EPA 1987b)

X_i = ith measurement, or the ith smallest measurement of a set of measurements arranged in ascending order (EPA 1987b)

σ = population standard deviation (EPA 1987b)

μ = population mean (Larsen and Marx 1986).

4.0 REFERENCES

See Appendix B.

This page intentionally left blank.

HEALTH AND SAFETY PLAN

This page is intentionally left blank.

CONTENTS

CONTENTS (Cont.)

LIST OF FIGURES

LIST OF TABLES

1.0 GENERAL CONSIDERATIONS AND REQUIREMENTS

1.1 INTRODUCTION

The purpose of this Health and Safety Plan (HSP) is to establish standard health and safety procedures for Westinghouse Hanford Company (Westinghouse Hanford) employees and contractors engaged in RCRA facility investigation activities in the 100-DR-1 operable unit. These activities will include surface investigation, drilling and sampling boreholes, and environmental sampling in areas known to contain chemical and radiological contamination.

A brief pre-job safety plan (PJSP) will be prepared for each work site (e.g., pond, trench, ditch, etc.) that will identify the specific hazards and procedures for that site and task(s) including:

1. Inventory of suspected chemical and/or radiological hazards
2. Discussion of existing and potential physical hazards
3. Specific procedures to be followed to mitigate known and potential site-specific hazards.

Each PJSP will be reviewed by the Geotechnical Engineering Unit (GEU), Industrial Safety and Fire Protection (ISFP), and Engineering Field Services (EFS) prior to start up, and will serve as the agenda for a mandatory "tail-gate" safety meeting prior to each task. Each PJSP must be read and signed by all involved site personnel.

Specific procedures will vary from one site and/or task to another depending on the nature and extent of potential hazards associated with the individual task, and the task itself. Levels of personal protective clothing, respiratory protection, air monitoring requirements, and decontamination procedures are discussed in a general way in Section 4.0 and (to the extent possible at this time) on a task-specific basis in Section 5.0. A task-specific radiation work permit (RWP) must be obtained for each operation conducted within a radiation zone. The RWP will specify radiological air monitoring requirements and action levels. In addition, an as low as reasonably achievable (ALARA) plan must be prepared indicating the task-specific procedures that will be employed to keep radiation exposure ALARA in compliance with Federal regulatory requirements. This plan must also be read and signed by project personnel.

The levels of protection and procedures specified in this plan are based on the best information available at this time and represent the minimum health and safety requirements to be observed by Westinghouse Hanford employees and contractors while engaged in tasks associated with this project. Unknown conditions undoubtedly exist, and known conditions may change. Should any situation arise that is obviously beyond the scope of the monitoring, personal protection, and decontamination procedures specified herein, work activities shall be halted pending discussion with the Westinghouse Hanford site safety officer and Westinghouse Hanford management, and revision of specified health and safety procedures.

All Westinghouse Hanford employees and contractors must read this document and sign and return an acknowledgement form to the Health and Safety Officer prior to engaging in any onsite activities in the 100-DR-1 operable unit. Employees are encouraged to bring any questions or concerns to the attention of the field team leader or the Site Safety Officer. Personnel should:

- Read this document carefully.
- Follow all specified health and safety procedures.
- Do not lose sight of the "everyday" hazards associated with all ("non-hazardous") field work (i.e., falls, slips, trips, cuts, overhead hazards, moving machinery, etc.).
- Most importantly, use your own common sense and exercise reasonable caution at all times.

2.0 SITE BACKGROUND

2.1 LOCATION

The 100-DR-1 operable unit is one of three operable units within the 100-D/DR Area of the U.S. Department of Energy's (DOE) Hanford Site. The 100-D/DR Area is located in Benton County along the south bank of the Columbia River in the north-central part of the Hanford Site, approximately 50 kilometers (31 mi) north-northwest of the City of Richland, Washington (Figure 1). It is situated on an essentially flat, semiarid bench within the Pasco Basin immediately southeast of a portion of the free-flowing Hanford reach of the Columbia River.

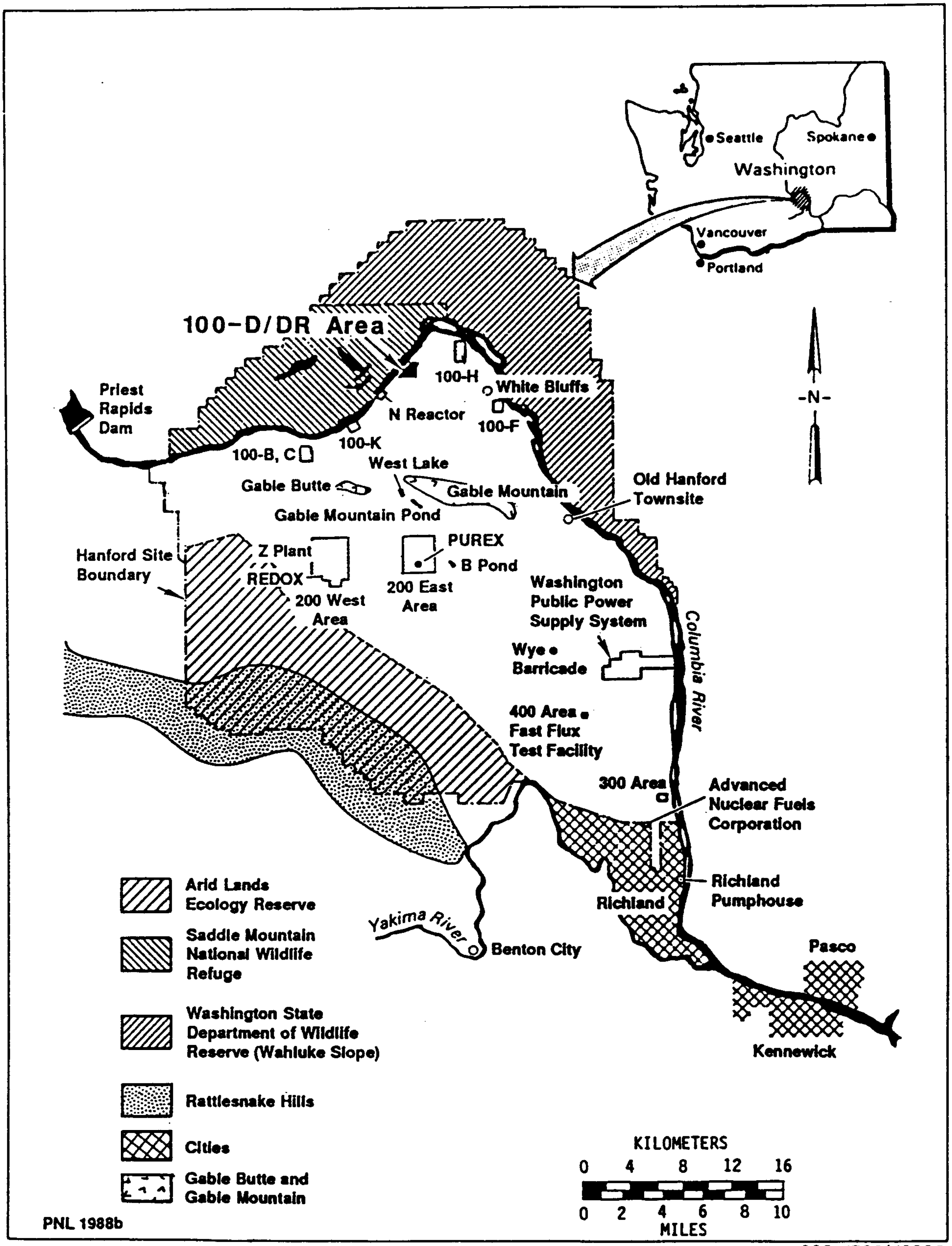
The elevation of the land surface near the center of the 100-D/DR Area is approximately 142 m (466 ft) above mean sea level (amsl). The land surface slopes gently to the northeast (about 1% gradient) to an elevation of approximately 134 m (440 ft) amsl. A steep embankment of about 18 m (60 ft) is present at the river's edge along the northwestern margin of the unit. The Columbia River lies at an elevation of approximately 119 m (390 ft) amsl.

The 100-DR-1 operable unit is immediately adjacent to the Columbia River and north-northwest of the 100-DR-2 and 100-DR-3 operable units as shown in Figure 2. The 100-DR-1 area encompasses approximately 1.5 km^2 (0.59 mi^2) and lies predominantly within the southeast quadrant of Sec. 15 and the southwest quadrant of Sec. 14 of T.14N., R.26E., between north/south Hanford plant coordinates N91000 and N96500 and east/west Hanford plant coordinates W51000 and W57000.

2.2 HISTORY OF OPERATIONS

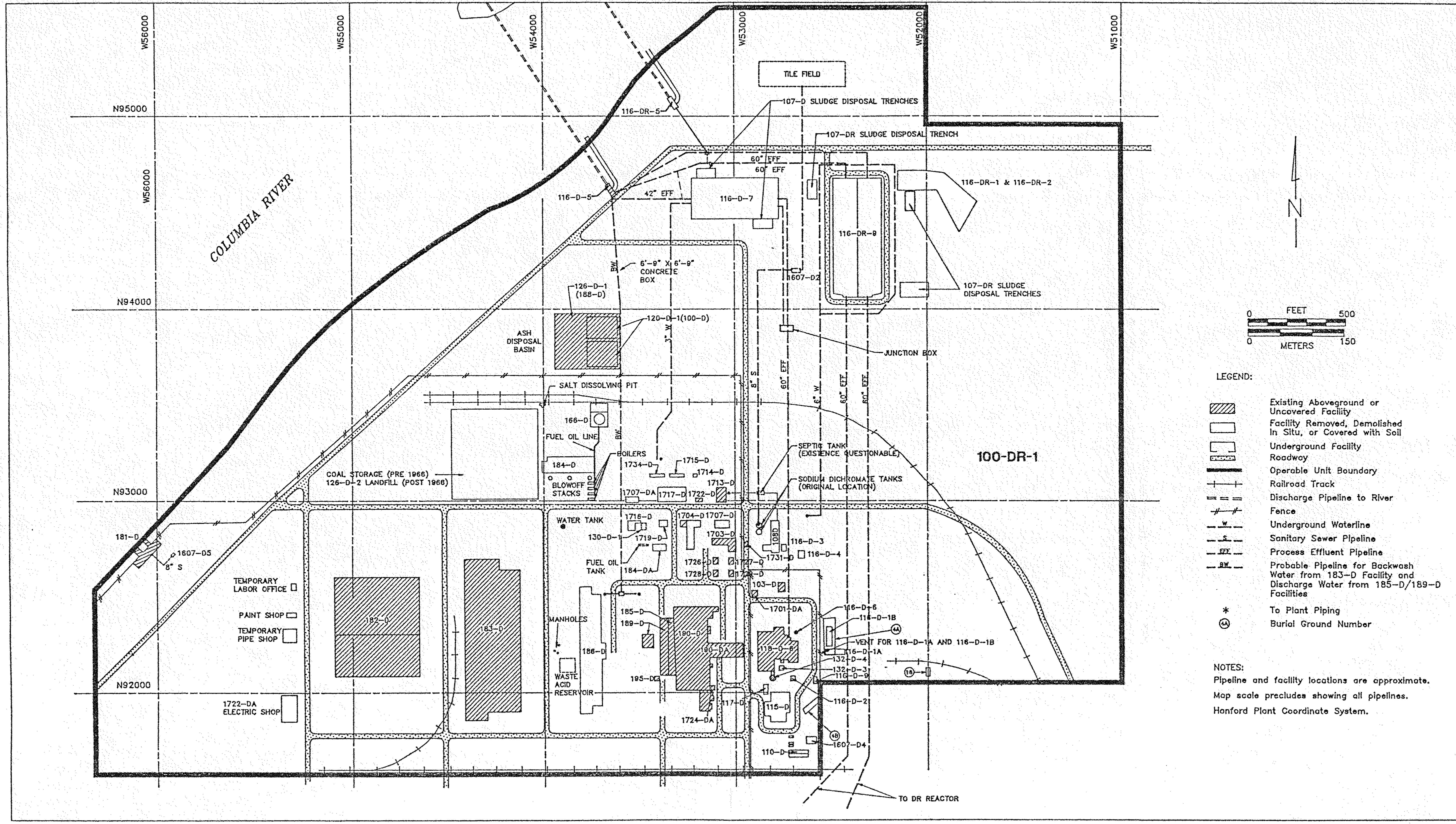
Between the years 1943 and 1963, nine water-cooled graphite-moderated, plutonium production reactors were built within the 100 Area. Eight of the reactors (B, C, D, DR, F, H, KE, and KW) have been retired from service and are under evaluation for decommissioning.

The 100-DR-1 operable unit contains the D Reactor and its operational support facilities. The D Reactor operated from 1944 to 1967. Support facilities included an access road, a rail spur, offices, warehouses, a laboratory, a major substation located within the 100-DR-2 operable unit and several intermediate smaller substations located throughout both 100-DR-1 and 100-DR-2, maintenance shops, a fallout shelter, a powerhouse with optional coal-fired or fuel-fired boilers, coal storage, and fly ash disposal facilities. Additional facilities include the river pumphouse, water reservoir, filter plant, a sanitary water supply system, a process effluent system, a subsurface sanitary sewage disposal system, and a solid waste landfill. Most of the aboveground facilities have undergone some degree of decommissioning, and in many instances facilities no longer exist. The layout of the 100-DR-1 operational unit shown in Figure 5 in Work Plan illustrates both present and past conditions.



883-1736/13265

Figure 1. The Hanford Site.



8831736\WP\32848

Figure 2. 100-DR-1 Operable Unit. (Sheet 1 of 2)

WIDS Site Designation Number (Alias)	Facility Description
116-D-1A (105-D)	Fuel Storage Basin Trench No. 1
116-D-1B (105-D)	Fuel Storage Basin Trench No. 2
116-D-2 (105-D)	Pluto Crib
116-D-3 (108-D)	Crib No. 1
116-D-4 (108-D)	Crib No. 2
116-D-5 (1904-D)	Outfall Structure
116-D-6 (105-D)	Cushion Corridor Decontamination French Drain
116-D-7 (107-D)	Process Effluent Retention Basin
116-D-9 (117-D)	Reactor Confinement Seal Pit Drainage Crib
116-DR-1 (107-DR)	Liquid Waste Process Effluent Disposal Trench No. 1
116-DR-2 (107-DR)	Liquid Waste Process Effluent Disposal Trench No. 2
116-DR-5 (1904-DR)	Outfall Structure
116-DR-9 (107-DR)	Process Effluent Retention Basin
118-D-6 (105-D)	Reactor Building
120-D-1 (100-D)	Ponds
126-D-1 (188-D)	Ash Disposal Basin
126-D-2	Solid Waste Landfill
130-D-1 (1716-D)	Gasoline Storage Tank
132-D-3 (1608-D)	Effluent Pumping Station
132-D-4 (116-D)	Reactor Exhaust Stack
1607-D2	Septic Tank
1607-D4	Septic Tank
1607-D5	Septic Tank

Non-WIDS Site Designation Number	Facility Description
103-D	Fuel Element Storage Building
107-D and 107-DR	Five Sludge Disposal Trenches
108-D	Office Building and Equipment Decontamination Station
110-D	Helium Storage Tanks
115-D	Gas Recirculation Building
117-D	Reactor Exhaust Air Filter Building
166-D	Fuel Oil Tank
181-D	River Pumphouse (Serves D and DR)
182-D	Reservoir and Pumphouse
183-D	Filter Plant Operations Building
184-D	Powerhouse

Non-WIDS Site Designation Number (Cont.)	Facility Description
184-DA	Steam Generating Facility
185-D	Thermal Hydraulics Building
186-D	Demineralization Building
189-D	Mechanical Development Lab
189-D	Storage Yard
190-D	Pump House
190-DA	Pump House Annex
195-D	Vertical Rod Safety Test Tower
1701-DA	Office Building/Badge House
1703-D	Technical Office Building
1704-D	Vault/Supervisor's Office
1707-D	Change House
1707-DA	Change House
1713-D	Instrument and Electrical Development Lab
1714-D	Solvent Storage
1715-D	Oil and Paint Storage
1716-D	Gas Station
1717-D	Combined Shops/Change Room
1719-D	First Aid
1722-D	Equipment Development Lab
1724-DA	Underwater Test Facility
1726-D	Mobile Office Trailer
1727-D	Mobile Office Trailer
1728-D	Mobile Office Trailer
1729-D	Mobile Office Trailer
1731-D	Mobile Office Trailer
1734-D	Cylinder Storage

No Site Designation Number	Facility Description
	Three 1.52 m (60 in) process effluent pipelines
	15 cm (6 in) and 7.6 cm (3 in) waterline near retention basins
	Discharge Pipelines to Columbia River
	Sanitary Sewer Pipelines
	Probable pipeline for backwash water from 183-D facility and discharge water from 185-D/189-D facilities
	Septic Tank at N93050, W52850
	Paint Shop (West of 182-D Reservoir)
	Waste Acid Reservoir
	Underground Fuel Oil Tank (west of 184-DA steam generating facility)
	Fuel Oil Line Associated with 166-D Tank
	Sodium Dichromate Tanks
	Burial Grounds 4A, 4B, 18
	Salt Dissolving Pit
	Sanitary Sewer Tile Field (north of retention basins)

883-1736/HSP/20241

Figure 2. 100-DR-1 Operable Unit. (Sheet 2 of 2)

2.3 PROCESSES WHICH GENERATED WASTES

Wastes present at the 100-DR-1 operable unit have been generated by several processes that can be categorized as follows:

- Process liquid wastes and sludges
- Reactor exhaust stack emissions
- Radioactive solid wastes
- Sanitary liquid wastes
- Non-radioactive solid wastes
- Other liquid waste
- Hazardous waste.

2.3.1 Reactor Process Liquid Wastes

2.3.1.1 Reactor Cooling. Reactor process wastes were generated as a result of reactor cooling, reactor and equipment decontamination, and scrubbing of reactor exhaust stack emissions.

The D Reactor used a once-through cooling process whereby water from the Columbia River was circulated through the reactor one time before it was ultimately discharged back to the river or to soil column disposal facilities.

Before being introduced into the reactor, river water was treated in a large, onsite water treatment plant. Treatment included flocculation and settling of suspended particulates using hydrated aluminum sulfate (alum). The water was then filtered through charcoal beds. Prior to introduction into the reactor, sodium dichromate was added to the cooling water to prevent corrosion of the aluminum process tubes that held the uranium fuel elements. Sulfuric acid was added to adjust the pH, and chlorine and copper sulfate were added from time to time to prevent algal growth.

Cooling water was irradiated while in the reactor. This led to the formation of activation products and various short-lived radionuclides. On exiting the reactor, cooling water was usually held for a time in a retention basin to allow for thermal cooling and radioactive decay before being discharged to the river.

In the event of a fuel element cladding rupture within the process tubes, cooling water would directly contact the uranium fuel and pick up fission and activation products. These products included ^{60}Co, ^{63}Ni, ^{90}Sr, ^{134}Cs, ^{137}Cs, ^{152}Eu, ^{154}Eu, ^{155}Eu, ^{235}U, ^{238}U, ^{238}Pu, ^{239}Pu, and ^{240}Pu. Cooling water contaminated as a result of ruptured fuel elements was segregated and disposed of in designated percolation trenches and cribs.

2.3.1.2 Decontamination. Decontamination solutions were routinely used to remove radionuclides from equipment and facility surfaces. Large quantities of decontamination solutions were also used during shutdown and standby periods of the D Reactor. Decontamination solutions included chromic, citric, oxalic, and sulfuric acids (neutralized with sodium carbonate prior to disposal), sodium fluoride, and various proprietary compounds. Some decontamination wastes were disposed of in percolation cribs and trenches. Others were pumped into the cooling waste stream that was ultimately discharged into the Columbia River.

2.3.1.3 Air Filtration. Confinement system seal water (used to isolate the reactor exhaust stack filtration system for periodic maintenance) contained very low levels of contamination. This waste water was disposed of in a percolation trench. Radionuclides included ^{90}Sr, ^{152}Eu, and ^{239}Pu.

2.3.2 Reactor Exhaust Stack Emissions

Filtered gaseous and particulate wastes were discharged to the atmosphere through the 132-D-4 (116-D) reactor exhaust stack. Filters in the 117-D filter building removed particulate matter and gaseous waste from the exhaust air stream before it entered the exhaust stack, and radioactive detection systems continuously monitored radiation levels of airborne particulate matter in exhaust air before and after filtering. No available information was found on the composition of typical stack emissions.

2.3.3 Radioactive Solid Wastes

Radioactive solid wastes generated in the 100-D/DR Area consisted mainly of neutron-activated reactor parts containing ^{60}Co. Most radioactive solid wastes from the 100-D/DR Area were discarded in burial grounds in the 100-DR-2 operational unit.

2.3.4 Sanitary Liquid Wastes

Sanitary liquid wastes from the 100-D/DR Area were treated in the 1607-D2, 1607-D4, and 1607-D5 septic tanks and disposed of in associated tile fields (a fourth septic tank may be located approximately at N93050 and N52850, but this has not been confirmed). There are no records of hazardous or radioactive wastes being disposed of in these systems. However, 1607-D2 is located in the vicinity of the large-diameter process effluent lines that were reported to have leaked. This liquid may have infiltrated the pipeline.

2.3.5 Non-Radioactive Solid Waste

Non-radioactive solid waste generated within the 100-D/DR Area primarily includes decommissioning wastes such as scrap metal, concrete, and other building materials.

2.3.6 Other Liquid Waste

Other liquid wastes include all non-radioactive and non-sanitary liquid wastes, such as potential releases of gasoline or oil from underground or aboveground storage tanks, potential polychlorinated biphenyl (PCB) contamination from electrical facilities, and potential acid leachate from the waste acid reservoir.

2.3.7 Hazardous Waste

Hazardous wastes include herbicides, insecticides, solvents, paints, and other chemicals generated either by industrial or support services operations.

3.0 SCOPE OF WORK AND POTENTIAL HAZARDS

The emphasis of the RCRA facility investigation in the 100-DR-1 operable unit will be to characterize the nature and extent of contamination on the surface and in the vadose zone (unsaturated subsurface soil) associated with past disposal of wastes generated by the processes described in Section 2.

The Phase I RCRA facility investigation (RFI) will include the following tasks:

- Task 1--Source Investigation
- Task 2--Geological Investigation
- Task 3--Soil Investigation
- Task 4--Air Investigation
- Task 5--Terrestrial Biological Investigation
- Task 6--Data Evaluation
- Task 7--Verification of Contaminant- and Location-Specific ARARs (applicable or relevant and appropriate requirements)
- Task 8--Baseline Risk Assessment
- Task 9--Phase I RFI Report.

3.1 POTENTIALLY HAZARDOUS TASKS

Each of the above tasks are further divided into subtasks. From a health and safety standpoint, tasks and subtasks can be broadly categorized as offsite tasks such as review of documents, assessment of data, etc.; non-invasive onsite tasks that are not likely to require entering surface radiation zones; non-invasive onsite tasks which are likely to require entering a surface radiation zone; and invasive onsite procedures such as soil boring, sampling, etc. All employees engaged in any onsite activities associated with the Phase I RFI must meet all of the requirements and follow all of the general procedures discussed in Section 4.0. Tasks of most concern from a health and safety standpoint are those that involve invasive procedures and/or entry into a surface radiation zone. These tasks are identified below and are discussed in greater detail in Section 5.0.

3.1.1 Task 1--Source Investigation

The Task 1 source investigation includes the following subtasks:

- Task 1c--Electromagnetic Induction/Magnetometer Survey
- Task 1d--Ground Penetrating Radar Survey
- Task 1e--Soil Gas Survey
- Task 1f--Process Effluent Pipelines and Discharge Pipelines Integrity Assessment
- Task 1g--Sampling and Analysis.

3.1.2 Task 2--Geological Investigation

The Task 2 geological investigation will include geologic mapping of surficial materials.

3.1.3 Task 3--Soil Investigation

The Task 3 soil investigation applies to the following subtasks and facilities:

- Task 3a--Surface Radiation Sampling
- Task 3c-2--Test Pit Sampling
- Task 3c-4 Test Pit Abandonment
- Task 3d-2--Borehole Soil Sampling
- Task 3d-5--Borehole Abandonment
- The 116-D-1A fuel storage basin trench no. 1
- The 116-D-1B fuel storage basin trench no. 2
- The 116-D-2 pluto crib
- The 116-D-6 cushion corridor french drain
- The 116-DR-1 liquid waste disposal trench no. 1
- The 116-DR-2 liquid waste disposal trench no. 2
- Waste Acid Reservoir
- The 116-D-3 crib no. 1
- The 116-D-4 crib no. 2
- The 116-D-9 reactor confinement seal pit drainage pit
- The 116-D-7 process effluent retention basin
- The 116-DR-9 process effluent retention basin
- Five sludge disposal trenches
- Contaminated ancillary facilities.

Contingent upon sampling results of Task 1, sampling may be conducted at:

- The 1607-D2 septic tank and associated tile field
- The 1607-D4 septic tank and associated tile field
- The 1607-D5 septic tank
- Septic tank at N93050 and W52850
- Sanitary sewer pipelines
- Process effluent and discharge pipelines
- The 130-D-1 gasoline storage tank
- Waste acid reservoir
- Fuel oil tank west of the 184-DA building
- The 166-D fuel oil tank and pipeline
- Sodium dichromate tanks
- The 120-D-1 (100-D) Ponds
- Outfall structures
- The 126-D-2 solid waste landfill
- Burial grounds 4A, 4B, and 18.
- Support Facilities
- Electrical Facilities.

3.2 POTENTIAL HAZARDS

Onsite tasks will involve non-invasive surface sampling procedures and invasive soil sampling either directly in or immediately adjacent to areas known or suspected to contain potentially hazardous chemical substances, toxic metals, and radioactive materials.

Surface radiological contamination and fugitive dust will be the potential hazards of primary concern during non-invasive mapping and sampling activities.

Existing data indicate that hazardous substances that may be encountered during invasive sampling include radionuclides, heavy metals, and corrosives. In addition, volatile organics may also be associated with certain facilities such as the solvent storage building, underground storage tanks, etc.

Potential hazards include:

- External radiation (gamma irradiation) from radioactive materials in the soil
- Internal radiation due to radionuclides present in contaminated soil entering the body by inadvertent ingestion or through open cuts and scratches
- Internal radiation due to inhalation of particulate (dust) contaminated with radioactive materials
- Inhalation of organic vapors
- Inhalation or ingestion of particulate (dust) contaminated with inorganic or organic chemicals and toxic metals
- Dermal exposure to soil and/or groundwater contaminated with radionuclides
- Dermal exposure to soil and/or groundwater contaminated with corrosives, inorganic or organic chemicals, and toxic metals
- Physical hazards such as noise and heat stress
- Slips, trips, falls, bumps, cuts, pinch points, falling objects, other overhead hazards, crushing injuries, etc., typical of every construction-related job site
- Unknown and/or unexpected underground utilities (drilling and trenching).

3.3 ASSESSMENT AND MITIGATION OF POTENTIAL HAZARDS

The likelihood of receiving an excessive dose of ionizing radiation as a result of external radiation exposure is remote and can be readily monitored with direct-reading instruments, and controlled by limiting exposure time, increasing distance, and employing shielding as required.

Internal radiation hazards via inhalation or inadvertent ingestion of contaminated dust is a realistic concern and must be continuously evaluated by the radiation protection technologist (RPT). Appropriate respiratory protection, protective clothing, and decontamination procedures will be implemented as necessary to reduce potential inhalation, ingestion, and dermal exposure to acceptable levels.

Exposure to toxic chemical substances via the dermal exposure route is not expected to pose a significant problem for the identified tasks given the use of the designated protective clothing. The appropriate level of personal protective clothing and respiratory protection may vary from "B-1" for soil sampling during drilling operations, to "D-3" (see Section 4.9) for non-invasive sampling. Task-specific levels of personal protective equipment are discussed in Section 5.0. These levels of protection will be upgraded where appropriate based on real-time hazard evaluation and action levels discussed in Sections 4.8 and 5.0.

Chemical exposure via inhalation of contaminated dust is not expected to pose a significant hazard during non-invasive operations due to the relatively low concentrations of chemicals in soil and low concentration of dust in the ambient air. Activities that result in high concentrations of airborne particulates (i.e., dusty operations) <u>will</u> require respiratory protection as discussed below.

Similarly, airborne concentrations of toxic gases/vapors are not expected to exceed applicable threshold limit values (TLV) or National Institute of Occupational Safety and Health (NIOSH) recommended exposure limits (RELs). As mentioned previously, however, the interactions and fate of these compounds are not well characterized. The Site Safety Officer will periodically monitor airborne levels of volatile organic vapors and gases with an HNU-PI-101 and, where other specific contaminants are expected, with appropriate calorimetric detector tubes. Air monitoring with direct-reading instruments will be conducted continuously in the event of the detection of breathing zone concentrations greater than background levels. Respiratory protection will be employed as appropriate. Warning levels and action levels, if different than those established in Section 5.0, will be designated in the PJSPs.

The project manager must make every effort to identify any and all underground utilities in the vicinity of all intrusive operations such as drilling or trenching. Should the work crew encounter an unanticipated underground utility, work shall be halted until the nature and status of the line is determined.

4.0 GENERAL REQUIREMENTS AND PROCEDURES

The following general procedures and work practice guidelines represent the minimum standard procedures for reducing potential risks associated with this project and are to be followed by Westinghouse Hanford employees at all times.

4.1 DESIGNATED SAFETY PERSONNEL

The following personnel are responsible for site safety and health. This safety plan will not be considered complete until these positions are assigned by project management.

Field Team Leader ______________________

Site Safety Officer ______________________

Radiation Protection Technologists (RPT) ______________________

____

All activities on site must be cleared through the field team leader. The field team leader has responsibility for the following:

- Allocating and administering resources to successfully comply with all technical and health and safety requirements
- Verifying that all permits, supporting documentation, and clearances are in place (i.e., electrical outage requests, welding permits, excavation permit, HSP, sampling plan, RWP, onsite/offsite radiation shipping records (RSR), etc.;
- Providing technical advice during routine operations and emergencies
- Informing the appropriate site management and safety personnel of the activities to be performed each day
- Resolving any conflicts that may arise between RWPS and implementation of the HSP
- Handling any emergency response situations that may arise
- Conducting pre-job and periodic tail-gate safety meetings.

The Site Safety Officer shall act as the site safety and health supervisor and is primarily responsible for implementing the HSP at the site. The Site Safety Officer must be on site at all times during work activities.

The Site Safety Officer shall:

- Secure the necessary personal protective equipment
- Monitor hazards (including organic vapor detection) to assess the degree of hazard present
- Determine appropriate levels of protective clothing and equipment needed to ensure the safety of personnel in conjunction with the RPT
- Monitor performance of all personnel to ensure that the required safety procedures are followed
- Halt operations immediately, if necessary
- Conduct safety briefings as necessary and document the attendance of all field personnel.

The RPT is responsible for ensuring that all radiological monitoring and protection procedures are being followed as specified in the Westinghouse Hanford RWP.

Industrial Safety and Fire Protection personnel will provide technical advice as required.

Occupational safety ultimately is a matter of each individual making a conscious effort to perform his or her job duties in a safe manner. Safety is indeed a "state of mind." There is no safety program, no manager, and no written standard operating procedure that can make an employee "safe" unless that employee <u>chooses</u> to work safely. Consequently, the ultimate responsibility and ultimate authority for employee health and safety lies with the employee himself, and his or her colleagues. Each employee is responsible for exercising the utmost care and good judgment in protecting his or her own health and safety and that of fellow employees. Should any employee observe a potentially unsafe condition or situation, it is the responsibility of that employee to immediately bring the observed condition to the attention of the appropriate health and safety personnel as designated above. In the event of an immediately dangerous or life-threatening situation, the employee automatically has "stop-work" authority and the responsibility to immediately notify the field team leader or Site Safety Officer.

4.2 MEDICAL SURVEILLANCE

All Westinghouse Hanford personnel and contractors engaged in onsite activities on the 100-DR-1 operable unit must have baseline physical examinations and be participants in Westinghouse Hanford's (or an equivalent) medical surveillance program.

Medical examinations will be designed to identify any pre-existing conditions that may place an employee at increased risk, and to verify that each employee is physically capable of performing the tasks required by this

Work Plan without undue risk to his or her health. The physician shall determine the existence of conditions that may reduce the effectiveness or prevent the employee's use of self-contained breathing apparatus. The physician shall also assess potential conditions that may pose undue risk to the employee while performing the physical tasks of this Work Plan where Level B personal protection equipment may be required. This would include any condition that increases the employee's susceptibility to heat stress. Medical surveillance shall also include a whole body count and/or urinalysis for mixed fission and activation products, plutonium, and uranium prior to (baseline) and on completion of onsite remedial investigation activities.

The examining physician's report will not include any non-occupational diagnoses unless directly applicable to the employee's fitness for the work required.

4.3 TRAINING

Prior to engaging in any onsite RCRA facility investigation activities, each team member is required to have received the equivalent of 40 hours of health and safety training related to hazardous waste site operations as specified in OSHA 29 CFR 1910.120 Hazardous Waste Operations and Emergency Response. At a minimum, this training must include the following topics:

- Employee rights and responsibilities under Occupational Safety and Health Act (OSHA).
- Personal protection equipment (PPE) and clothing, use and care, particularly fitting, operation, and use of cascade breathing air systems and self-contained breathing apparatus (SCBA)
- Chemical and radiological hazard recognition
- All requisite Westinghouse Hanford radiation worker training
- Emergency response, self-rescue, and first aid
- Vehicle operation; mandatory rules and regulations
- Safe use of drilling and sampling equipment
- Handling, storage, and transportation of hazardous chemical and radioactive materials
- Site control and management
- Safe sampling techniques
- Site surveillance, observation, and safety plan development
- Proper decontamination methods for personnel, protective clothing and equipment

- Use of field test equipment for radioactivity, explosivity, and other measurements as needed
- Communication procedures.

The field team leader and Site Safety Officer will provide site-specific instructions regarding anticipated hazards, levels of protection, site monitoring, and operation of equipment as appropriate. In addition, each inexperienced employee will be accompanied by an employee experienced in characterization activities for a minimum of three complete field procedures.

The field team leader and the Site Safety Officer will receive an additional 8 hours of training to cover the following topics:

- Management of restricted and safe zones
- Rules for handling untrained site visitors
- Site management
- Other environmental, safety, and health topics that relate to the sampling and characterization effort.

4.4 RADIATION DOSIMETRY

All personnel engaged in onsite activities shall be assigned Hanford multipurpose dosimeters (HMPD) that are to be exchanged quarterly, and pocket dosimeters that are to be read daily.

All visitors to the operable unit shall be assigned basic dosimeters, exchanged annually.

4.5 REQUIREMENTS FOR THE USE OF RESPIRATORY PROTECTION

All employees who may be required to use air-purifying or air-supplied respirators must be included in the medical surveillance program and be approved for the use of respiratory protection by a licensed physician. Each team member must be trained in the selection, limitations, and proper use and maintenance of respiratory protection. Existing respiratory protection training may be applicable towards the 40-hour training requirement.

Finally, prior to using any air-purifying respirator, each employee must be fit-tested for the specific make, model, and size of respirator he or she will be using according to the qualitative and/or quantitative fit testing procedures set forth in Appendix C of the OSHA 29 CFR 1910.1001 for asbestos, tremolite, anthophyllite and actinolite. Beards (including a few days growth), large sideburns, or moustaches that may interfere with a proper respirator seal are not permitted.

4.6 CONFINED SPACE ENTRY PROCEDURES

The following procedures apply to the entry of any confined space that for the purpose of this document, shall be defined as any space having limited egress (access to an exit) and the potential for the presence or accumulation of a toxic or explosive atmosphere. This includes manholes, certain trenches (particularly those through waste disposal areas), and all test pits greater than 4 feet in depth in potentially contaminated soil.

The identified RCRA facility investigation activities on the 100-DR-1 operable unit should not require any employee to enter any confined space. Several of the designated tasks may, however, present the opportunity for an employee to inadvertently enter a confined or partially confined space. The hazards associated with confined spaces are of such severity that all employees should be alert to potential confined space situations and be familiar with the general precautions and procedures discussed below.

No employee shall enter any test pit or trench greater than 4 feet in depth unless the sides are shored or laid back to a stable slope as specified in OSHA 29 CFR 1926.652 specific trenching requirements or equivalent State Occupational Health and Safety Regulations. When an employee is required to enter a pit or trench four or more feet in depth, an adequate means of access and egress such as a slope of at least 2:1 to the bottom of the pit, or a secure ladder or steps shall be provided.

Prior to entering any confined space, including <u>any test pit</u> or any trench that may have the potential for the accumulation of toxic gases or vapors, the field team leader and health and safety officer must prepare a task-specific confined space entry workplan. At a minimum, the atmosphere within the space shall be tested for radioactivity, oxygen deficiency, hydrogen sulfide (H_2S), combustible gases, and organic vapors, in that order. If the excavation is located in an area known or suspected to contain cyanide wastes, the atmosphere shall also be tested for hydrogen cyanide. Depending on the situation, the space may require ventilation and retesting prior to entry.

No employee shall enter any confined or partially confined space unless equipped with a level of respiratory protection consistent with the action levels for airborne contaminants determined according to the air monitoring procedures established in Section 4.8 (also see Warnings and Action Levels in PJSP). Confined space entry will be addressed in site specific PJSPs.

No employee shall enter any confined space requiring the use of Level B (see Section 4.9) protection, unless a back-up person also equipped with a pressure demand SCBA is present. No back-up person shall attempt any emergency rescue unless a second back-up person equipped with an SCBA is present or until the appropriate emergency response authorities have been notified and it has been established that additional help is on the way.

4.7 GENERAL WORK SAFETY PRACTICES

4.7.1 Work Practices

The following work practices must be observed.

- Eating, drinking, smoking, taking medications, chewing gum, etc., is prohibited within the exclusion zone.
- Personnel should avoid direct contact with contaminated materials unless necessary for sample collection or required observation. Remote handling of casing, auger flights, etc., will be practiced whenever practical.
- Do not handle soil, waste samples, or any other potentially contaminated items unless wearing nitrile-butyl rubber (NBR) or neoprene rubber gloves.
- Stand upwind of excavations, boreholes, well casings, drilling spoils, etc., as indicated by an onsite windsock, whenever possible.
- Stand well clear of the trenches during excavation. Always approach an excavation from upwind.
- Be alert to potentially changing exposure conditions as evidenced by perceptible odors, unusual appearance of excavated soils, oily sheen on water, etc.
- Do not enter any test pit or trench greater than 4 feet in depth unless in accordance with procedures specified below.
- Do not, under any circumstances, enter or ride in or on any backhoe bucket, materials hoist, or any other similar device not specifically designed for carrying human passengers.
- All drilling team members must make a conscientious effort to remain aware of their own and other's positions in regards to rotating equipment, cat heads, u-joints, etc. and be extremely careful when assembling, lifting, and carrying flights or pipe to avoid pinch joint injuries and collisions.
- Tools and equipment will be kept off the ground whenever possible to avoid tripping hazards and the spread of contamination.
- While operating in the controlled zone, personnel shall use the "buddy system" or be in visual contact with someone outside of the controlled zone at all times.
- The buddy system will be used where appropriate for manual lifting.

- Personnel not involved in operation of the cable tool drill rig or monitoring activities shall remain a safe distance from the rig as indicated by the field team leader.

- Follow all provisions of each site-specific cutting and welding permit.

- Catalytic converters on the underside of vehicles are sufficiently hot to ignite dry prairie grass. Team members should not drive over dry grass that is higher than the ground clearance of the vehicle and should be aware of the potential fire hazard posed by catalytic converters at all times. Never allow a running vehicle to sit in a stationary location over dry grass or other combustible materials.

- WHC radiological safety requirements shall be followed for all work involving radioactive materials or radioactive contamination.

- Team members will attempt to minimize truck tire disturbance of all stabilized sites.

- Work operations on site shall not start before sunrise and shall cease at sunset, unless the entire control zone is adequately illuminated with artificial lighting. A new tour (shift) will man the drilling rig after completion of each shift.

- All team personnel are required to attend a pre-job safety meeting prior to the start of the campaign and attendance will be documented.

- A mandatory "tail-gate" meeting will be conducted on a daily basis prior to each field operation.

4.7.2 Personal Protective Equipment

Personal protective equipment must be used in certain situations.

- Hard hats, safety glasses, and steel-toed boots will be worn when inside the exclusion zone.

- Personnel shall maintain a high level of awareness of the limitations in mobility, dexterity, and visual impairment inherent in the use of Level B and Level C PPE.

- Be alert to the symptoms of fatigue and heat stress, and their effect on the normal caution and judgment of personnel.

- Always use an appropriate level of personal protection. Lesser levels of protection can result in otherwise preventable exposure; excessive levels of safety equipment can impair efficiency and increase the potential for accidents to occur.

- Noise may pose a health and safety hazard, particularly during drilling and construction activities. A good rule of thumb is that if you have to raise your voice to communicate at a distance of 3 feet in steady state (continuous) noise, you should be wearing hearing protection (disposable ear plugs). Likewise, any impact noise from activities such as driving casing on a drilling operation that is loud enough to cause wincing or discomfort, would also indicate the need to use hearing protection. Hearing protection is available and should be included in your standard field kit along with hard hat, safety glasses, etc.

4.7.3 Decontamination

The following decontamination procedures must be observed.

- Thoroughly wash hands and face before eating or putting anything in your mouth (i.e., avoid hand-to-mouth contamination).

- At end of each work day, or each job, disposable clothing shall be removed and placed in drums (chemical contamination) or plastic-lined radiation boxes, as appropriate. Clothing that can be cleaned shall be sent to the Hanford laundry.

- Individuals are expected to thoroughly shower at home, or as soon as possible after leaving the job site if directed to do so by the RPT, site Safety Officer, or field team leader.

4.7.4 Emergency Preparation

The following emergency preparations should be arranged.

- A multi-purpose dry chemical fire extinguisher, a complete field first-aid kit, and a portable deluge shower shall be available at every drill site.

- Establish prearranged hand signals or other means of emergency communication when wearing respiratory equipment, since this equipment seriously impairs speech communications.

4.8 ENVIRONMENTAL AND PERSONAL MONITORING

The site safety officer shall be present at all times during work activities. The use of direct-reading air-monitoring instruments has been established to provide adequate warning and facilitate appropriate preventive action prior to potentially excessive exposure to contaminants in the work environment. The air monitoring program will consist of the use of direct-reading instruments to estimate concentrations of organic vapors and radioactive contaminants in the vicinity of boreholes and in employee breathing zones.

At a minimum, periodic monitoring shall be conducted whenever there is any indication that exposure levels may have risen since prior monitoring. Situations where it shall be assumed that the possibility exists that exposures have risen are as follows: (a) when work begins on a different portion of the site, (b) when contaminants other than those previously identified are being handled, (c) when a different type of operation is initiated (e.g., drum opening as opposed to exploratory well drilling), and (d) when employees are handling leaking drums or containers or working in areas with obvious liquid contamination (e.g., a spill or lagoon).

An RPT must be on site at all times and will observe the action levels and procedures specified in the radiation work permit (RWP) and appropriate ALARA plans. Core samples will also be monitored to determine levels of radioactivity and occupational risks prior to actual sample collection. As indicated previously, the decision to modify the level of protection will be made by the Site Safety Officer, RPT, and the field team leader based on, but not limited to, the following:

- Interpretation of organic vapor and radiation detection instrument readings by Health and Safety personnel and RPTs

- Any perceptible solvent-like odors or any organic vapor readings in the breathing zone that are discernibly above background shall be the action level for donning air-purifying respirators

- Any "break through" of odors, any continuous readings in breathing zone greater than 5 ppm averaged over a 5-minute period, or any peak readings greater than 25 ppm shall be the action level for upgrading the level of respiratory protection to pressure-demand supplied air. These guidelines may be modified in PJSP on a task-specific basis if contaminants are well characterized or if deemed appropriate by project health and safety personnel

- Visual observation such as wind-blown dust, discolored soil, etc.

- Results of monitoring with other sampling devices such as O_2 and combustible gas level meters

- Information specific to the individual sites (i.e., known or suspected chemical contaminants and levels of each)

- Physical characteristics of the work environment, such as temperature and pH.

Air sampling may be required downwind of the referenced waste sites to monitor particulates and vapors prior to job start up. Siting of such sampling devices will be determined by Operational Health Physics, GEU Site Safety Officer, and Hanford Environmental Health Facility (HEHF) (if appropriate). Discrete sampling of ambient air within the work zone and breathing zones will be conducted using the HNU or organic vapor analyzer (OVA), radiation detectors, and other methods as deemed appropriate (e.g., pumps with tubes, O_2 meters, etc.). The following standards will be used in determining critical levels:

- Radionuclide concentrations in air, DOE derived allowable concentrations (DAC), and Westinghouse Hanford Company Radiation Protection Standard Procedures

- Threshold limit values (TLV) (American Conference of Governmental Industrial Hygienists)

- Occupational Safety and Health Standards, 29 CFR 1910.1000

- NIOSH recommended exposure limits (REL)

4.9 PERSONAL PROTECTIVE EQUIPMENT AND RESPIRATORY PROTECTION

The following scheme will be used to designate the required level(s) of personal protective equipment and respiratory protection: The alphabetical designations "B," "C," and "D," typically associated with U.S. Environmental Protection Agency's (EPA) widely accepted Levels of Protection, shall refer specifically to levels of <u>respiratory</u> protection, namely pressure-demand air-supplying respirators with escape provisions (B), air-purifying respirators (C), and no respiratory protection (D), respectively. Since various levels of personal protective <u>clothing</u> may be indicated apart from an appropriate level of respiratory protection, the numerical designations "1," "2," and "3" will be used to specify the level of protective <u>clothing</u> that is to be employed in addition to the specified level of respiratory protection as described below (i.e., the level of protective equipment can be completely defined by a designation of "C-2," "B-1," etc).

LEVEL 3 PROTECTIVE CLOTHING

1. Cloth coveralls (i.e white cotton overalls for work in radiation area SWPs) when working in designated surface radiation areas or when performing any invasive procedure.

2. Steel-toed rubber boots

3. Safety glasses or safety goggles

4. Hard hat

5. NBR (nitrile-butyl rubber) or neoprene rubber outer gloves where appropriate

6. Leather work gloves where appropriate

7. Inner gloves of polyvinyl chloride (PVC) or latex rubber.

LEVEL 2 PROTECTIVE CLOTHING

1. Cloth coveralls (SWPs)

2. One-piece Tyvek suit or waterproof Saranex or Chemrel suit, as appropriate

3. Steel-toed rubber boots or steel-toed leather boots, as appropriate

4. Outer boot covers (booties)

5. Safety glasses or safety goggles if splash hazard exists

6. Hard hat

7. NBR (nitrile-butyl rubber) or neoprene rubber outer gloves

8. Inner gloves of PVC or latex rubber.

LEVEL 1 PROTECTIVE CLOTHING

1. Hard hat

2. Cotton coveralls (SWPs) or inner Tyvek suit

3. Inner gloves of PVC or latex taped to inner Tyvek

4. Hooded one-piece waterproof outer suit (Saranex, Chemrel, or PVC)

5. Outer NBR gloves taped to outer suit

6. Solvent-resistant, steel-toed rubber boots taped to inner suit

7. Outer boot covers (booties) taped to outer suit.

A minimum of Level D-3 PPE will be required within the operable unit at all times. Task-specific levels of protection are discussed in Section 5.0.

If employees find that there is a likelihood of being splashed with mud or groundwater, or if radiological contamination is detected at levels greater than background, the level of protective clothing shall be upgraded to Level

D-2 and shall include a one- or two-piece Saranex or Chemrel suit. Appropriate gloves shall be worn whenever it is necessary to contact or handle wet soil, groundwater, or any other potentially contaminated implements or materials. The level of protective clothing shall be upgraded to Level 1 as described above if there is the likelihood of dermal exposure to unknown contaminants or to substances known to be toxic by the dermal exposure route.

Level D respiratory protection shall be immediately upgraded to Level C or Level B as appropriate, if indicated by real-time conditions as determined by site monitoring and the action levels specified in Section 4.8. No changes to the specified levels shall be made without the approval of the Site Safety Officer, the RPT, and the field team leader.

4.10 HEAT STRESS

Working in protective clothing can greatly increase the likelihood of heat fatigue, heat exhaustion, and heat stroke, the latter being a life-threatening condition. If temperatures at the site are above 65 °F, the wet bulb globe temperature (WBGT) shall be monitored to assess the potential for heat stress. Work/rest periods will be adjusted according to the standards stated in current TLVs (American Conference of Governmental Industrial Hygienists). Sufficient cool water and disposable drinking cups will be provided in the rest area which should, if possible, be located in an area cooler than the work station. Engineering controls such as solar shielding, etc., will also be applied when and where appropriate.

If employees are required to wear impermeable chemical protective clothing in temperatures exceeding 70 °F, employees shall use the "buddy system" to monitor each other's pulse rate at the start of each rest period. If the pulse rate exceeds 110 beats per minute, the employee shall take his or her oral temperature with a clean disposable calorimetric oral thermometer. If the oral temperature exceeds 99.6 °F, the next work period shall be shortened by one-third without shortening the rest period. The pulse rate and oral temperature shall be monitored again at the beginning of the next rest period; and if the oral temperature exceeds 99.6 °F, the work period shall again be shortened by one-third, etc., until the oral temperature is below 99.6 °F. No employee shall be permitted to continue working in PPE if his or her oral temperature exceeds 100.6°F.

All employees are to be alert to the possibility and symptoms of heat stress. Should any of the following symptoms occur--extreme fatigue, cramps, dizziness, headache, nausea, profuse sweating, pale clammy skin--the employee is to immediately leave the work area, rest, cool off, and drink plenty of cool water. If the symptoms do not subside after a reasonable rest period, the employee shall notify the project supervisor or Site Safety Officer and seek medical assistance.

4.11 COLD STRESS

The primary hazards associated with working in the cold are hypothermia (decrease in body temperature) and frostbite.

Hypothermia is the most frequent cause of accidental death in outdoor activities (i.e., individuals lost, stranded or otherwise unprepared for extended periods of exposure) but it is rarely a serious occupational hazard. Nevertheless, workers should be aware of the symptoms of hypothermia: an involuntary increase in muscle tension (goose bumps) and mild shivering occur in response to a lowered body temperature and result in a metabolic heat production 1.5 to 2 times resting levels. If the core temperature drops below 95°F, violent whole body shivering will occur resulting in greatly increased heat production, which may also temporarily render the individual totally helpless. At this point, under controlled working conditions, most individuals would seek shelter and warmth. Further cooling (i.e., the lost or stranded individuals mentioned above) would result in loss of muscle coordination, irritational behavior, unconsciousness, and eventually death (core temperature below 80°F).

Employees who must work under cold conditions should:

- Eat a proper diet and avoid alcohol.
- Always wear a hat, cover the neck, and use a layered system of clothing. Ideally, the innermost layer should be polypropylene or a similar material which will "wick" moisture away from the skin.
- Wear proper boots (rubber boots that tap moisture are not recommended unless absolutely necessary) and an appropriate number of pairs of socks (too many can be as bad as too few). Never wear steel toed boots in conditions of extreme cold. Without steel-toed boots, foot injuries are a possibility. With steel-toed boots under conditions of extreme cold, foot injuries are a certainty.
- Wear a windproof outer layer of clothing.
- Workers who must travel during periods of extreme cold should have appropriate clothing and equipment to deal with the environment in the event of a breakdown or other emergency.

When working in multiple layers of PPE, overheating and sweating inside of the suit(s), and the resultant potential for cold stress are likely to become the most serious problems. When working in multilayered or impermeable layers of PPE, employees should initially wear less warm clothing than the would normally wear without the PPE, and should of course remain alert to the symptoms of hypothermia.

Frostbite is much more likely to occur than hypothermia. As the body attempts to keep vital internal organs warm, it increases blood flow to the "core" at the expense of the extremities (hands and feet), which are also likely to be the most exposed parts of the body.

Frostbite does not become a factor until temperatures drop below 15°F, and is typically not a serious concern for a properly clothed individual until temperatures drop below minus 20°F in calm winds (i.e. the "windchill index" is -20°F). That same -20°F, however, in a 25 mile per hour wind yields a windchill factor of -74°F and represents a serious frostbite hazard.

Frostbite is most likely to occur in extremities, especially the fingers and toes, and in the cheeks and ears. In very early stages of frostbite, the affected body part may feel numb and appear white. As frostbite progresses, the individual may experience pain and a loss of flexibility in the affected body part and the affected skin may appear waxy or translucent. Mild frostbite can be treated by immersing the affected part in warm water. Frost bitten tissue should not be rubbed. Deep frostbite is a very serious condition that requires immediate medical treatment.

Preventative measures for frostbite:

- Wear proper boots and socks. Do not wear steel-toed boots.
- Wear mittens rather than gloves if possible.
- Avoid the use of tobacco, which is a vascoconstrictor.
- Always wear a hat and/or a hood that covers the ears.
- In extreme conditions, wear a mask or skin cap that covers the entire face except the nose and mouth.
- Be aware of the conditions that are likely to cause frostbite, be aware of the symptoms, and be prepared.

4.12 SITE CONTROL

The field team leader, Site Safety Officer, and radiation protection technologist are designated to coordinate access control and security on the site. A temporary exclusion zone will be established (a minimum of a 25-foot radius) at each digging or drilling location. The exclusion zone will be clearly marked with radiation zone rope or tape and Radiation Area signs. All drilling operations within the operable unit will require a clearly designated "control" or "exclusion" zone to be established around the operation. No unauthorized person shall be allowed within the exclusion zone and no authorized person shall be allowed in the exclusion zone unless they are properly equipped with the required level of personal protective clothing and respiratory protection. The size and shape of the exclusion zone will be dictated by the types of hazards expected, the climatic conditions, and specific drilling and sampling operations required.

The ground surface of the area immediately around the drill hole, the corridors to the command post and the decontamination area, and the escape route will be covered with appropriate material to reduce contamination of personnel and equipment. Exclusion zone boundaries will be increased or decreased based on results of field monitoring, environmental changes, work technique changes, or site RWP designations. All team members must be surveyed for radioactive contamination on leaving the exclusion zone.

The onsite command post and staging area will be established near the exclusion zone on the upwind side if physically possible. Exact location for the command post is to be determined just prior to start of work. Vehicle access, availability of utilities (power and telephone), wind direction, and proximity to sample locations should be considered in establishing command post location.

4.13 DECONTAMINATION PROCEDURES

RCRA facility investigation activities will require intrusion into areas of known chemical and radiological contamination. Consequently it is likely that personnel and equipment will be contaminated with hazardous chemical and radiological substances.

During drilling and sampling activities at the site, field workers may become contaminated in various ways, many of which are not readily apparent to the individual. Potential sources of contamination include, but are not limited to, airborne vapors, gases, dust, mists, and aerosols; splashes and spills; walking through contaminated areas; and handling contaminated equipment. All personnel who enter the exclusion zone will be required to go through decontamination procedures on leaving the zone. The procedures discussed below are intended to be compatible with procedures for decontamination specified in the Environmental Investigations and Instructions (EII) manuals (WHC 1989).

Unless otherwise specified in Section 5.0, it is assumed that decontamination procedures for potential radiological contamination will also provide adequate decontamination for chemical contamination. Radiological decontamination procedures shall consist of sequential removal of protective clothing as described in Section 4.12.1. The routine use of water or other liquid rinses is not recommended.

In those instances where potential chemical contamination is judged to pose a greater risk than radiological contamination, decontamination procedures will include progressive wash/scrub/rinse and doffing of outermost to innermost layers of protective clothing as described in the "Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities," DHHS (NOISH) Publication No. 85-115.

Decontamination stations will require the following routine and emergency equipment:

- Decontamination garbage/dirty equipment bags

- Decontamination pad/corridor cover (Kraft paper)
- Emergency response pressurized water tank with wand and adjustable spray nozzle
- Bagging and taping material
- Emergency water deluge/detergent, brush, and bucket
- Barrels
- Step-out pads
- Sponges, wipes, and rags
- Tables and stands.

Operational Health Physics (OHP) shall review each task and establish contamination action levels" and upper limits" on a facility or area case-by-case basis when appropriate. Contamination levels above the designated action level indicate an abnormal condition requiring attention and corrective action such as determination of the source, and more rigorous decontamination. Values in excess of the upper limit indicate that continued operation poses an unacceptable risk. Operations shall be discontinued until effective control measures are established and implemented.

If contamination is detected on skin or clothing by any means, an RPT must be contacted and approved decontamination measures performed under the RPT's direction. [Skin decontamination procedures are approved by the Hanford Environmental Health Facility (HEHF).]

Every reasonable effort shall be made to reduce contamination to less than detectable levels. If contamination on skin or clothing cannot be reduced to less than detectable levels, then the employee may be permitted to leave the controlled area at the OHP supervisor's discretion taking into consideration the nature and extent of contamination and after consulting with OHP Dosimetry and HEHF.

In the event that contamination on the skin cannot be reduced to less than 50,000 dpm (beta-gamma) per hand-held probe area, OHP Dosimetry must be notified as soon as possible.

Appropriate measures shall be specified in the RWP by OHP, and must be followed by personnel who are permitted to leave the controlled area with detectable contamination still present.

4.13.1 Personnel Decontamination

All personnel who access the exclusion and contamination reduction zones of the project will process through decontamination at the end of any given work shift. A decontamination corridor will be established within the exclusion zone for each task of the campaign. Clothing that is disposable will be removed so that outer layers are removed first and placed in sealed containers. Nondisposable clothing, such as SWPs, that can be cleaned will be removed, bagged, and sent to the laundry. After removing outer protective clothing, each team member must be surveyed by qualified and authorized personnel prior to proceeding to an uncontrolled area. The nearest toilet facilities will be available for site personnel use.

4.13.2 Equipment Decontamination

Equipment decontamination methods will generally consist of washing or steam cleaning with a detergent/water or other decontamination solution. Rinsing with a dilute nitric acid solution may be necessary to remove metal oxides and hydroxides. Where applicable, field contamination of drilling equipment shall be performed within impoundments in the decontamination zone to ensure that all wash liquids are captured.

Downhole drilling equipment shall be decontaminated prior to use on another borehole and/or as required to ensure the safety of personnel and prevent cross-contamination of samples.

Equipment that is radiologically contaminated beyond the limits specified in the RWP shall not be decontaminated in the field. Such equipment shall be transported to the 2705-T Building for decontamination prior to reuse.

4.13.3 Sampling and Monitoring Equipment

All possible measures should be taken by personnel to prevent or limit the contamination of any sampling and monitoring equipment used. Sampling devices will become contaminated. In general, air monitoring instruments will not be contaminated by chemicals unless splashed or set down on contaminated areas. Any delicate instrument that cannot be easily decontaminated should be protected while it is being used by placing it in a bag and using tape to secure it around the instrument. Openings in the bag can be made for sample intake, exhaust, electrical connections, etc. Personnel performing field maintenance procedures on air monitoring instruments should be aware of the fact that instruments may become contaminated internally if air containing high concentrations of radioactive particulate is drawn through the instrument. Foreign material that collects within the probe tip and on the face of the lamp on the HNU photo-ionization detector may be chemically or radioactively contaminated and should be handled appropriately when disassembling the probe or cleaning the lamp. Whenever possible, a pre-filter should be placed in the sampling line. A similar situation exists with the read-out probe and sintered metal filters in the sampling line of the OVA. All instruments and equipment must be surveyed for radiological contamination control prior to removal from the exclusion zone. Items with detectable levels of contamination must be controlled as radioactive material or controlled or regulated equipment.

Sampling devices require special cleaning and decontamination (see Sampling and Analysis Plan). When appropriate, disposable sampling equipment will be used to eliminate the need for decontamination liquids.

4.13.4 Respiratory Protection Equipment

Respiratory protection will be used based on the level of protection required for each job. There is a high potential for hoses to become contaminated; therefore, where possible and necessary, hoses should be covered with plastic. If grossly contaminated, they may have to be discarded. Cleaning and decontamination of face pieces will be performed by the mask cleaning station (i.e., laundry). Maintenance of special respiratory protection equipment (i.e., SKA PAK) is performed by the Personal Protective Equipment Unit in MO-412, 200 West Area.

4.13.5 Heavy Equipment

All possible measures will be taken to prevent or limit the contamination of heavy equipment. Those parts of drilling equipment that become contaminated, such as auger flights, will be double-bagged and taken to the 2705-T Building for decontamination before reuse to minimize personnel contamination potential and cross-contamination of samples between boreholes.

5.0 TASK-SPECIFIC HAZARDS AND PROCEDURES

5.1 TASK 1C--ELECTROMAGNETIC INDUCTION/MAGNETOMETER SURVEY

Electromagnetic induction (EMI) and magnetometer (MAG) surveys will be conducted over the entire area of the following facilities:

- Septic tanks 1607-D2, 1607-D4, and 1607-D5, and septic tank located at N93050, W52850, and associated tile fields
- 116-D-2 pluto crib
- Waste acid reservoir
- Underground fuel oil tank west of the 184-DA steam generating facility
- Salt dissolving pit
- 126-D-2 solid waste landfill
- Buried fuel oil pipeline associated with the 166-D aboveground fuel oil tank
- Burial grounds 4A, 4B, and 18
- Buried process effluent pipelines
- Buried discharge pipelines to the Columbia River.

Magnetometer (MAG) surveys detect ferro-nickel metallic objects buried beneath the surface. MAG surveys are used in conjunction with EMI to further define buried objects. Electromagnetic induction (EMI) surveys measure the electrical resistivity of subsurface materials. Variations in resistivity may be caused by changes in soil moisture content, presence of ionic species, or the presence of metallic objects. The EMI survey will be used to screen large areas for possible contamination and to precisely locate buried facilities. Areas identified as having potential for being contaminated will be marked for further investigation in the Task 3 soil investigation.

The locations of anomalies found during Task 1c-1 will be geodetically surveyed for north-south east-west (N-S/E-W) coordinates in an approved coordinate system. This information will be incorporated into the preparation of the 100-DR-1 topographic base map (Task 1b).

5.2 TASK 1D--GROUND PENETRATING RADAR (GPR) SURVEY

A grid will be established by geodetic survey tied into an approved coordinate system over the surface of areas to be surveyed by GPR. A GPR survey will then be conducted along the transects established.

The GPR survey is an effective tool for detecting subsurface irregularities such as buried objects. The results of the survey will be used to determine the location of the following facilities:

- Septic tanks and tile fields
- The 116-D-2 pluto crib
- Waste acid reservoir
- Boundaries and depth of the 126-D-2 solid waste landfill
- The 116-DR-5 outfall structure.

This information will be used to identify locations for additional investigations described in Task 1g - sampling and analysis and Task 3 - soil investigation.

The EMI/MAG survey (Task 1c) and the GPR survey (Task 1d) will be non-invasive procedures but may involve entry into surface radiation zones. The initial level of protective clothing required will be D-3. Entry into radiation zones will require a radiation work permit (RWP). All employees entering a surface radiation zone will be required to wear white SWPs. On leaving a radiation zone, and on leaving the operable unit on completion of the tasks, all personnel must be surveyed and determined to be free from detectable radiological contamination by an RPT prior to release.

If contamination is detected, decontamination procedures are to be implemented as discussed in Section 4.12.1.

5.3 TASK 1E--SOIL GAS SURVEY

A soil gas survey will be conducted in areas where petroleum products or solvents were stored or used. The survey will include a combination of testing for the presence of carbon dioxide and for volatile organic compounds. The soil gas survey will include the following areas:

- The 103-D fuel element storage building
- Sewer lines, septic tanks, and tile fields
- The 1713-D instrument and electrical development laboratory
- The 1714-D solvent storage building
- The 1715-D oil and paint storage
- The 1716-D gas station
- The 1722-D equipment development laboratory
- The underground fuel oil tank west of the 184-DA Building
- The 116-D fuel oil tank
- The 126-D-2 solid waste landfill
- Burial grounds 4A, 4B, and 18
- Paint shop (west of 182-D reservoir).

The area of coverage for the soil gas survey will include any associated underground pipelines. Probes will be installed from 1-m to 2-m (3-ft to 6 ft) deep in backfill around the buried tanks and pipelines, and other relatively small facilities on 15-m (50-ft) centers. Probes will be installed around the perimeter of existing structures on 7.6-m (25-ft) centers. The areal extent of contamination will be determined by installing additional probes until no detectable contamination is found in two adjacent probes bounding the area.

This task will involve driving probes one to two meters below the surface into areas of potential chemical and/or radiological contamination. Consequently, it is possible that the probes themselves will become contaminated.

All personnel actively engaged in soil gas probe placement, handling, etc. must be in Level D-2 PPE. This will include white Tyvek in non-radiation zones, and SWPs if sampling should involve entry into a surface radiation zone.

Installation of probes in areas where conditions (as described in Section 4.8) suggest the possibility of exposure to organic vapors shall include air monitoring in employee breathing zones. Action levels specified in Section 4.8 shall apply.

On removal from the ground, probes must be surveyed for chemical and radiological contamination using direct-reading instruments. On leaving a radiation zone and prior to leaving the operable unit on completion of the tasks, all personnel must be surveyed and determined to be free from detectable radiological contamination by an RPT prior to release from the controlled zone or operable unit.

If contamination is detected on equipment or personnel, decontamination procedures are to be implemented as discussed in Section 4.12.

5.4 TASK 1F--PROCESS EFFLUENT AND DISCHARGE PIPELINES INTEGRITY ASSESSMENT

Process effluent pipelines emanate from the 118-D-6 and 118-DR-2 (105-DR) reactor buildings to various process effluent disposal and treatment facilities. Discharge pipelines run from the 116-D-7 (107-D) and 116-DR-9 (107-DR) retention basins to the Columbia River. Wastes transferred by the pipelines are assumed to have been the same as wastes generated in the facilities served by the pipelines. It is further assumed that the pipelines contain significant accumulations of long-lived radionuclides. Some of the pipelines are known to have developed leaks during their operational periods.

The entire interior circumference of the process effluent pipeline will be inspected using a remote camera system. This task will identify the location and severity of the cracks in the process effluent pipelines and the discharge pipelines. The visual image of the pipe interior will be monitored during the inspection and will be recorded on videotape. The position of all cracks or other faults in the process effluent pipelines will be noted and identified in the field by staking and flagging.

The methods ultimately selected to access and move the camera through the pipeline will determine the requisite level of protective clothing and respiratory protection. It is anticipated that access to the pipelines will require a minimum of Level C-2 protection as defined previously and could require a level as high as B-1 depending on the extent of potential for contacting waste materials during camera placement and conveyance. At no time shall any employee enter the pipeline unless all aspects of confined space entry have been considered and addressed.

All work shall be performed within the allowable action levels and upper limits for surface contamination established by Operational Health Physics (OHP). All equipment and all personnel must pass through decontamination on leaving the work zone and must be surveyed and released by an RPT prior to leaving the controlled zone or the operable unit on completion of the task.

5.5 TASK 1G--SAMPLING AND ANALYSIS

This task involves collecting samples from potential waste sources for which soil borings are not currently planned. This includes the following facilities:

- Process effluent pipelines
- Discharge pipelines to the Columbia River
- The 103-D fuel element storage building
- Septic tanks 1607-D2, 1607-D4, and 1607-D5, and septic tank at N93050 and W52850
- The (120-D-1) 100-D ponds
- Electrical facilities (i.e., transformers, capacitors, etc.)
- The 132-D-4 stack
- The 1724-DA underwater test facility.

Employees are directed to the discussion of confined space entry in Section 4.6. Employees are again reminded that under no circumstances shall any employee enter any confined or partially confined space for the purpose of collecting any sample or in the course of any investigation unless it is in keeping with the requirements and procedures specified in Section 4.6.

Similarly, employees are referred to Section 4.9 for general selection criteria for levels of protective clothing, and Section 4.12 for general decontamination procedures. Eye protection is required at all times during sampling activities. Sampling procedures and the potential health and safety concerns are discussed in greater detail in the following sections.

5.5.1 Process Effluent Pipelines

This subtask will sample the sludge that has been deposited from the process effluent stream in each of the process effluent pipelines. Radionuclides may be present in these pipelines. The Task 1f integrity assessment should indicate the extent of accumulation of sludge and will serve to identify sampling locations and frequencies. Acceptable methods for accessing and sampling the pipelines have yet to be established.

The primary health and safety concerns will be radiological contamination of equipment and personnel, and entry or partial entry into confined spaces containing potentially oxygen-deficient or toxic atmospheres. A PJSP will be prepared once exact sampling procedures are specified.

5.5.2 Discharge Pipelines to the Columbia River

Sludge samples will be taken from the discharge pipelines at locations determined after Task 1f has been completed. The majority of these pipelines are underwater and there is no available information regarding the absence or presence of sludge. Since the discharge lines were used to discharge process effluents from the 116-D-7 and 116-DR-9 retention basins, contamination would be a result of the substances determined to be present in the process wastewater from the D and DR Reactors. Acceptable methods for accessing and sampling the pipelines have yet to be established.

The primary health and safety concerns will be radiological contamination of equipment and personnel, and entry or partial entry into confined spaces containing potentially oxygen-deficient or toxic atmospheres. A PJSP will be prepared once exact sampling procedures are specified.

5.5.3 The 103-D Fuel Element Storage Building

Signs posted on this building indicate it has been used to store solvents and herbicides. Initially an inspection will be conducted of the building for physical or visual evidence of any spills or leaks. An organic vapor analyzer will be used to monitor for the presence of volatile organic compounds. Wipe samples will be obtained from four random locations on the concrete floor of the building and at all locations with visible contamination. Core samples will be obtained of the concrete floor, and the soil immediately underneath the floor will be sampled if the wipe samples indicate the presence of hazardous substances.

The task poses a potential inhalation hazard due to the presence of toxic vapors, toxic particulate, or oxygen-deficient conditions. The initial level of protection required will be D-2. Employees shall implement the air monitoring procedures and observe the action levels specified in Section 4.8.

5.5.4 Septic Tanks 1607-D2, 1607-D4, and 1607-D5, and Septic Tank at N93050 and W52850

The 1607-D2 Sanitary Septic System. This tank served the 182-D, 183-D, 190-D, and several 1700-D office and maintenance service buildings. It also served the 118-D-6 reactor building. The septic tank is located in the 116-D-7 and 116-DR-9 retention basin area in the northeast corner of the 100-DR-1 operational unit. The associated tile field was constructed in the location of 116-DR-9 but was relocated in 1950 when 116-DR-9 was constructed. A field visit in March 1989 revealed a small quantity of flow along the pipeline.

The 1607-D4 Sanitary Septic System. This septic tank received sanitary sewage from the 115-D gas recirculation building. It is located in the southeast corner of 100-DR-1 near the 118-D-6 reactor building and related facilities.

The 1607-D5 Sanitary Septic System. This tank received sanitary sewage from the 181-D river pumphouse.

Septic Tank at N93050 and W52850 (existence questionable). There is no information as to the waste received at this location or whether a septic tank in this location even existed. According to sewer drawings, this is a drop manhole structure.

Sanitary Sewer Pipelines. Sanitary sewage was collected from the various buildings within the 100-D/DR Area and transported to at least three different septic systems. No details as to the construction of these pipelines are available, but such pipelines in the 300 Area were constructed of vitreous tile pipe. These pipelines are presumably still in existence.

This subtask will sample the sludge found in the bottom of the septic tanks to determine whether there were any hazardous or radioactive contaminants discharged into the drains that connect to the septic system. Access to the sludge in the septic tanks will be conducted through the clean-out ports. One sample from each septic tank will be collected and sent for laboratory analysis. All sample locations and elevations will be surveyed on completion of the sampling activity.

Under no circumstances will task personnel enter or allow any portion of their bodies to enter the septic tanks without assessment of appropriate confined space entry requirements.

The initial level of protective equipment during sampling procedures will be C-2 with outer tyvek suits, neoprene or nitrile-butyl rubber gloves, and full-face air-purifying respirators equipped with organic vapor, acid gas cartridges. Task personnel will monitor the access area prior to opening any clean-out port for sufficient oxygen, explosive gases, and organic vapors, using a combustible gas indicator and photo-ionization detector (PID).

Any readings greater than 5 ppm on the PID of the employee's breathing zone other than a momentary peak, shall be the action level for upgrading the level of respiratory protection to pressure-demand self-contained breathing apparatus.

If greater than background combustible gas readings are encountered, task personnel must use extreme caution when opening the clean-out port(s). If levels greater than 25% LEL are encountered at any time, task personnel shall cease operations and consult the Health and Safety Officer.

If oxygen levels less than 19.5% are detected in any potential workspace, the area must be thoroughly ventilated and retested, or the level of respiratory protection upgraded to pressure-demand supplied air.

On completion of the task, personnel must implement the decontamination procedures set forth in Section 4.11 and be surveyed for radiological contamination by an RPT prior to leaving the task exclusion zone.

5.5.5 120-D-1 (100-D) Ponds

The 100-DR-1 operable unit contains one waste storage and treatment facility subject to permitting and/or closure under the Resource Conservation and Recovery Act (RCRA), the 120-D-1 ponds. These ponds are located in the 188-D ash disposal basin just north of the 184-D powerhouse. In 1977 the original ash pit was excavated to a depth of 9 m (30 ft) below grade and 0.8 ha (2 ac) in area. The ponds occupy approximately half of the area of the original ash pit. This pond received backwash water from the 183-D filter plant, and discharge water from the 189-D thermal hydraulics test and fuel discharge trampoline facilities. The waste stream also consisted of demineralizer fluids, which contained hydrochloric acid. This constituent was the reason for the pond's listing as a RCRA site. In 1979, a dike was constructed to form a settling pond and a percolation pond. Since this modification, very little water has been received.

This waste was transported in a 2.06 m (6 ft 9 in) in width and 2.06 m (6 ft 9 in) in height concrete box that was connected to the pipeline that sluiced ash from the 184-D powerhouse building to the 188-D ash pit. Prior to this water being transported to the ponds, it was discharged directly to the Columbia River by means of the 116-D-5 outfall.

The 120-D-1 (100-D) Ponds will be evaluated to yield information about the inventory of hazardous waste that is in the soil and sediments and to determine groundwater quality of the uppermost aquifer underlying the ponds. Data generated by that effort will be used in decisions regarding future sampling efforts and selection of options for closure of the facility. A separate closure plan will be prepared for the 120-D-1 ponds, which will be integrated with the corrective measures developed for the rest of the operable unit.

The north 120-D-1 pond will be sampled initially with a hand auger for analysis. The south pond will be sampled with a coring sampler if water is still in the pond. Samples will be obtained at four locations at the surface and at 1-m (3-ft) in each of the ponds. One sample location in each pond will be at the influent end where insoluble or quickly precipitated compounds would be expected in highest concentrations. The other three sample locations in each pond will be selected randomly.

Specific health and safety procedures and levels of protection will be established in a PJSP once exact sampling procedures are identified.

5.5.6 Electric Facilities

These facilities include the transformers, capacitors, switches and other miscellaneous electrical facilities within the 100-DR-1 operable unit. The main substation for the 100 D/DR area was located within the 100-DR-2 operable unit, however, many substations are located throughout the 100-DR-1 operable unit. Leaks of PCB oil appear to have occurred at the transformers located on the east side of the 190-D Building. A site visit in March 1989 revealed large stains. The extent and locations of all such waste are unknown at this time.

Surface soils around the areas where transformers and capacitors have been stored will be visually examined for evidence of leaks. Soil samples will be obtained of any visibly stained soils for analysis of PCBs.

The primary hazard will be potential contamination by and dermal contact with PCBs. The initial level of protection will be D-2, or C-2 with particulate filter cartridges in the presence of wind-blown fugitive dust.

5.5.7 The 1724-DA Underwater Test Facility

Samples will be taken of both the sediment and liquid surfactant presently in this facility. Non-hazardous and non-radioactive substances were used in conjunction with this facility. However, if contamination is found, soil beneath the structure would be sampled as part of Task 3c-2 soil sampling.

Specific health and safety procedures and levels of protection will be established in a PJSP once exact sampling procedures have been identified.

5.5.8 The 132-D-4 Reactor Exhaust Stack

A radiation survey for alpha, beta, and gamma radiation will be conducted in the interior of the stack, using a portable, laboratory-quality alpha detector and sodium iodide beta/gamma detector that reads in counts per minute. At least five randomly located wipe samples within the interior of the stack will be collected for laboratory analysis.

This procedure will constitute a confined space entry. A prejob safety plan which incorporates a task-specific confined space entry permit, with subsequent review by Health Physics and Industrial Safety and Fire Protection, will be prepared pending more detailed characterization of the nature and extent of the hazards associated with this task.

5.6 TASK 2B--SURFACE GEOLOGIC MAPPING

Surface geologic mapping will be performed over the entire operable unit to identify the types and areal extent of surficial deposits.

Surface geologic mapping will be a non-invasive procedure, but may involve entry in designated surface radiation areas. The initial level of personal protective equipment used will be D-3. Entry into radiation zones will require a radiation work permit (RWP). All employees entering a radiation zone must wear white SWPs. On leaving a radiation zone, and on leaving the operable unit, all personnel must be surveyed and determined to be free from detectable radiological contamination by an RPT prior to release.

If contamination is detected, decontamination procedures are to be implemented as discussed in Section 4.12.1.

5.7 TASK 3A--SURFACE RADIATION SURVEY

A surface radiation survey will be conducted over a grid covering the entire operable unit using a portable alpha detector and a beta/gamma detector.

The surface radiation survey will be a non-invasive procedure, but may involve entry in designated surface radiation areas. The initial level of personal protective equipment used will be D-3. Entry into radiation zones will require a radiation work permit (RWP). All employees entering a radiation zone must wear white SWPs. On leaving a radiation zone, and on leaving the operable unit, all personnel must be surveyed and be determined to be free from detectable radiological contamination by an RPT prior to release.

If contamination is detected, decontamination procedures are to be implemented as discussed in Section 4.12.1.

5.8 TASKS 3C AND 3D--SOIL SAMPLING

Test pits will be excavated at some facilities. Samples will be collected and analyzed for the appropriate analytes. If contamination is present, additional samples may be required.

Borehole soil sampling will be performed at each waste facility of concern as well as in those areas identified in the course of the survey and sampling procedures discussed previously. The sampling will determine the physical characteristics of subsurface soils, and assess the nature of vertical and horizontal extent of contamination.

At a minimum, all personnel involved in onsite drilling and/or sampling operations must meet the medical surveillance, training, dosimetry, and respiratory protection requirements discussed in Sections 4.2, 4.3, 4.4 and 4.5.

All drilling operations must incorporate the minimum monitoring procedures discussed in Section 4.8, and must be conducted in keeping with the site control and decontamination procedures discussed in Sections 4.11 and 4.12.

Drilling and sampling in cribs, disposal trenches, and other areas where highly radioactive contamination may be reasonably anticipated will be performed using a dual-wall core-barrel technique. The inner tubes that contain the presumably contaminated samples will be transported to a separate sample extraction facility for sample removal. Drive tube samplers will be used to obtain samples in all other areas.

The hazards of greatest concern associated with this task, although unlikely, are personal contamination and inhalation of alpha-contaminated airborne particulate as a result of drilling into unanticipated transuranic wastes. A minimum level of D-3 for PPE, including white SWPs and rubber gloves, will be used by all team members within the exclusion zone during drilling or sampling operations.

An RPT must be present and an RWP must be secured for all trenching and drilling activities within the 100-DR-1 operable unit. Whenever any drilling tool, bailer, drive tube sampler, etc. is withdrawn from the hole, it must be screened for alpha contamination and beta/gamma emissions. Any detectable alpha contamination will require that the Westinghouse Health Physics group be notified and that drilling/sampling operations be temporarily discontinued, and/or the level of protection be upgraded to B-2, until the exact nature of the contaminant(s) is identified.

Team members must be especially cautious to avoid cuts or puncture wounds while working within the exclusion zone and must immediately bring any such injuries to the attention of the RPT.

Similar hazards are associated with the presence of beta/gamma emitters but are more readily detectable. The Health Physics group shall likewise identify a radiation exposure (beta/gamma) action level for upgrading the level of PPE to C-2 with high-efficiency particulate (HEPA) cartridges, B-2, and evacuation, and shall clearly state same in the RWP for each drilling operation. The initial level of PPE for team members within the exclusion zone, if different than Level D-3, will also be specified in the RWP.

Table 1 lists each facility that is tentatively included in this task and the proposed number and location of boreholes. A brief description of each facility follows.

Table 1. Soil Boring Sampling Activity by Facility in 100-DR-1 Operable Unit. (Sheet 1 of 9)

Facility	Figure in text showing Phase 1 borehole locations	Number of Phase 1 boreholes	Phase 1 rationale	Phase 1 parameters for analysis	Phase 2 program if contaminants identified in Phase 1	Phase 3 program if contamination identified at depth	Preferred sampling method[a]
Facilities used to dispose of waste into the soil column							
116-D-1A fuel storage basin trench No. 1	16	1 boring at center of small facilities; at larger facilities, one boring where the full range of contamination can adequately be determined; sample at 5-ft intervals to depth of 10 ft below fill	One borehole at each facility will be adequate to determine the nature of contamination to 10 ft below facility	Radionuclides, TCL (organics), TAL (inorganics) from each sample interval; one physical sample and one archive sample per geologic unit	Deepen Phase 1 boring to sample at 5-ft intervals to 10 ft above water table; one additional deep boring at 116-D-1A, 116-D-1B, 116-DR-1, and 116-D-2; sample for contaminants identified in Phase 1	At least 2 borings, either randomly located or where seepage likely to have occurred, away from margins of facility (distance from facility boundary to be determined) to determine horizontal distribution of contamination; sample for contaminants identified in Phases 1 and 2 at 5-ft intervals to 10 ft above water table	dual-wall core or drive tube
116-D-1B fuel storage basin trench No. 2	16						
116-D-2 pluto crib	16						
116-D-6 cushion corridor French drain	16						
116-DR-1 liquid waste disposal trench No. 1	17						
116-DR-2 liquid waste disposal trench No. 2	17						
116-D-3 crib No. 1	16						
116-D-4 crib No. 2	16						
116-D-9 reactor confinement seal drainage pit	16						
Sanitary sewage transfer, treatment, and disposal facilities							
1607-D2 septic tank	17	If Task 3c test pit sampling indicates contaminants, 1 boring through center or next to tank; sample at 5-ft intervals to depth of 10 ft above water table	These facilities are small; one boring will be adequate to determine the depth of contamination	Contaminants identified during Task 3c from each sample interval; one physical sample and one archive sample per geologic unit	At least 2 borings, either randomly located or where seepage likely to have occurred, away from margins of tank (distance from tank boundary to be determined) to determine horizontal distribution of contamination; sample for contaminants identified in Phase 1, at same sample intervals	Horizontal extent of contamination will be determined in Phase 2	drive tube
1607-D4 septic tank	16						
1607-D5 septic tank	21						
Septic tank at N93050/W52850	18						

Table 1. Soil Boring Sampling Activity by Facility in 100-DR-1 Operable Unit. (Sheet 2 of 9)

Facility	Figure in text showing Phase 1 borehole locations	Number of Phase 1 boreholes	Phase 1 rationale	Phase 1 parameters for analysis	Phase 2 program if contaminants identified in Phase 1	Phase 3 program if contamination identified at depth	Preferred sampling method[a]
Sanitary sewage transfer, treatment, and disposal facilities (Continued)							
Tile field associated with above septic tanks	17	1 boring at beginning of distribution system; sample at 5-ft intervals to 10 ft below facility	One boring at the beginning of the distribution system will permit determination of the nature of contamination within this rectangular facility	Radionuclides, TCL (organics), TAL (inorganics) from each sample interval; archive one physical sample and one archive sample per geologic unit	Deepen Phase 1 boring to sample at 5-ft intervals to 10 ft above water table; 4 additional deep borings at center, east, west, and north end of system; sample for contaminants identified in Phase 1	Borings randomly located at margins of field (distance from tile field boundary to be determined) to determine horizontal distribution of contamination; sample for contaminants identified in Phases 1 and 2 at 5-ft intervals to 10 ft above water table	dual-well core or drive tube
Sanitary sewer pipelines associated with septic tanks	not shown	If Task 3c test pit sampling indicates contaminants, borings sampled at 5-ft intervals to 10 ft above water table	The actual number of borings will be determined by the number and location of contaminated areas identified in Task 3c	Contaminants identified during Task 3c test pit sampling from each sample interval; one physical sample and one archive sample per geologic unit	1 boring on each side of pipe, at each initial boring location (distance from pipe boundary to be determined) to determine horizontal distribution of contamination; sample for contaminants identified in Phase 1, at same sample intervals	Horizontal extent of contamination will be determined in Phase 2	drive tube
Facilities used to transport liquid waste							
116-D-7 and 116-DR-9 Process effluent pipelines Discharge pipelines to river (land portions only)	not shown not shown	If pipeline breaches are identified from the Task 1f pipeline integrity assessment and contaminants are identified by the Task 1g sludge sampling, borings along affected areas of pipeline; sample at 5-ft intervals to 10 ft above water table	The actual number of borings will be determined by the number of contaminated areas identified in Task 1	Contaminants identified during Task 1g from each sample interval; one physical sample and one archive sample per geologic unit	1 boring on each side of pipe, at each initial boring location (distance from pipe boundary to be determined) to determine horizontal distribution of contamination; sample for contaminants identified in Phase 1, at same sample interval	Horizontal extent of contamination will be determined in Phase 2	dual-wall core or drive tube

Table 1. Soil Boring Sampling Activity by Facility in 100-DR-1 Operable Unit. (Sheet 3 of 9)

Facility	Figure in text showing Phase 1 borehole locations	Number of Phase 1 boreholes	Phase 1 rationale	Phase 1 parameters for analysis	Phase 2 program if contaminants identified in Phase 1	Phase 3 program if contamination identified at depth	Preferred sampling method[a]
Facilities used to transport liquid waste (Continued)							
116-D-5 outfall structure 116-DR-5 outfall structure	17 17	One at center of each outfall structure; sample at 5-ft intervals to 10 ft below facility	One borehole at the center of each outfall will be adequate to determine the nature of contamination	Radionuclides, TCL (organics), TAL (inorganics) from each sample interval; archive one physical sample and one archive sample per geologic unit	Deepen Phase 1 borings to sample at 5-ft intervals to 10 ft above water table; sample for contaminants identified in Phase 1	Borings randomly located at margins of structure (distance from boundary to be determined) to determine horizontal distribution of contamination; sample for contaminants identified in Phases 1 and 2 at 5-ft intervals to 10 ft above water table	dual-wall core or drive tube
Facilities used to retain process effluents							
116-D-7 process effluent retention basin 116-DR-9 process effluent retention basin Area around retention basins	17 17 not shown	1 boring at influent end of each of the basins' two cells; sample at 5-ft intervals to depth of 10 ft below fill	Borings at the beginning of the distribution system will permit determination of the nature contamination of these facilities to 10 ft below facility; if rubble prevents sampling, borings placed along outer margins of basins	Radionuclides, TCL (organics), TAL (inorganics) from each sample interval; archive one physical sample and one archive sample per geologic unit	Deepen Phase 1 borings to sample at 5-ft intervals to 10 ft above water table; one additional deep boring at effluent end and 2 along centerline of each of the basins' two cells; sample for contaminants identified in Phase 1	Borings either at random locations or where seepage likely to have occurred away from margins of basin (distance from basin boundary to be determined) to determine horizontal distribution of contamination; additional borings as required in area around basins; sample for contaminants identified in Phases 1 and 2 at 5-ft intervals to 10 ft above water table	dual-wall core or drive tube

Table 1. Soil Boring Sampling Activity by Facility in 100-DR-1 Operable Unit. (Sheet 4 of 9)

Facility	Figure in text showing Phase 1 borehole locations	Number of Phase 1 boreholes	Phase 1 rationale	Phase 1 parameters for analysis	Phase 2 program if contaminants identified in Phase 1	Phase 3 program if contamination identified at depth	Preferred sampling method[a]
Tanks							
Fuel oil tank (west of 184-DA building)	19	If contaminants identified during Task 3c test pit sampling, 1 boring through center of each facility; sample at 5-ft intervals to 10 ft above water table	These facilities are small; one boring will be adequate to determine the depth of contamination	Contaminants identified during Task 3c test pit sampling for each sample interval; one physical sample and one archive sample per geologic unit	2 borings, either randomly located or where seepage likely to have occurred, away from margins of tank (distance from tank boundary to be determined) to determine horizontal distribution of contamination; sample for contaminants identified in Phase 1, at same sample intervals	Horizontal extent of contamination will be determined in Phase 2	drive tube
166-D above-ground fuel oil tank location	18						
166-D fuel oil tank pipeline	not shown	If contaminants identified during Task 3c test pit sampling, borings along affected areas of pipeline; sample at 5-ft intervals to 10 ft above water table	The actual number of borings will be determined by the number of contaminated areas identified in Task 3c	Contaminants identified during Task 3c test pit sampling for each sample interval; one physical sample and one archive sample per geologic unit	1 boring on each side of pipe, at each initial boring location (distance from pipe boundary to be determined) to determine horizontal distribution of contamination; sample for contaminants identified in Phase 1, at same sample intervals	Horizontal extent of contamination will be determined in Phase 2	drive tube
130-D-1 gasoline storage tank	19	1 boring at location where contamination identified in July 1989 tank removal program; sample at 5-ft intervals to 10 ft above water table	Soil contamination has been identified as a result of July 1989 tank removal and sampling program; one deep boring will be adequate to determine the vertical extent of contamination	Contaminants identified during July 1989 tank removal program	2 borings, either randomly located or where seepage likely to have occurred, away from margins of tanks (distance from tank to be determined) to determine horizontal distribution of contamination; sample for contaminants identified in Phase 1, at same sample intervals	Horizontal extent of contamination will be determined in Phase 2	drive tube

Table 1. Soil Boring Sampling Activity by Facility in 100-DR-1 Operable Unit. (Sheet 5 of 9)

Facility	Figure in text showing Phase 1 borehole locations	Number of Phase 1 boreholes	Phase 1 rationale	Phase 1 parameters for analysis	Phase 2 program if contaminants identified in Phase 1	Phase 3 program if contamination identified at depth	Preferred sampling method[a]
Tanks (Continued)							
Sodium dichromate tanks	locations currently unknown	One at center of former tank location, as necessary	Tank locations unknown. Site survey to find present and former tank sites; soil sampling if appropriate	TBD[b]	TBD[b]	TBD[b]	TBD[b]
Sludge disposal trenches							
Five sludge disposal trenches	17	1 boring at random location in one randomly selected trench; sample at 5-ft intervals to depth of 10 ft below fill; if contaminants identified in first trench, one boring in center of other 4 trenches at same intervals and depth	If the results of sampling of one trench shows the same levels of contamination as adjacent areas, no further sampling will be done specifically for the sludge disposal trenches	Radionuclides, TCL (organics), TAL (inorganics), and chlorine from each sample interval; archive one physical sample and one archive sample per geologic unit	Deepen Phase 1 boring to sample at 5-ft intervals to 10 ft above water table; if the borehole sampling results vary from adjacent areas, the remainder of the trenches will be sampled by one deep borehole at each trench; sample for contaminants identified in Phase 1	2 borings, either randomly located or where seepage likely to have occurred, away from margins of trench (distance from trench boundary to be determined) to determine horizontal distribution of contamination; sample for contaminants identified in Phases 1 and 2 at 5-ft intervals to 10 ft above water table	dual-wall core or drive tube
Waste acid reservoir							
Waste Acid Reservoir	19	1 boring at a location where the full range of contamination can adequately be determined; sample at 5-ft intervals to depth of 10 ft below base	One borehole will be adequate to determine the nature of contamination to a depth of 10 ft below facility	Radionuclides, TCL (organics), TAL (inorganics) from each sample interval; archive one physical sample and one archive sample per geologic unit	Deepen Phase 1 boring to sample at 5-ft intervals to 10 ft above water table; sample for contaminants identified in Phase 1	2 borings, either randomly located or where seepage likely to have occurred, away from margins of reservoir (distance from reservoir boundary to be determined) to determine horizontal distribution of contamination; sample for contaminants identified in Phases 1 and 2 at 5-ft intervals to 10 ft above water table	dual-wall core or drive tube

Table 1. Soil Boring Sampling Activity by Facility in 100-DR-1 Operable Unit. (Sheet 6 of 9)

Facility	Figure in text showing Phase 1 borehole locations	Number of Phase 1 boreholes	Phase 1 rationale	Phase 1 parameters for analysis	Phase 2 program if contaminants identified in Phase 1	Phase 3 program if contamination identified at depth	Preferred sampling method[a]
120-D-1 (100-D) Ponds							
120-D-1 settling and percolation ponds	20	If contaminants identified during Task 1g source investigation, 1 boring at each pond where the full range of contamination can adequately be determined; sample at 5-ft intervals to 10 ft above water table	These ponds are relatively small; one borehole at each pond will be adequate to determine the nature and vertical extent of contamination	Contaminants identified during Task 1g from each sample interval; one physical sample and one archive sample per geologic unit	2 randomly located borings at margins of pond (distance from pond boundary to be determined) to determine horizontal distribution of contamination; sample for contaminants identified in Phase 1, at same sample intervals	Horizontal extent of contamination will be determined in Phase 2	drive tube
Support facilities							
Includes, but not limited to: - 1713-D instrument and electrical development laboratory - 1714-D solvent storage bldg - 1715-D oil and paint storage - 1716-D gas station/bus maintenance shop - 1722-D equipment development lab - Paint shop west of 182-D reservoir - Salt dissolving pit	 not shown 18 18 19 18 21 18	If Task 3c test pit sampling indicates contaminants, 1 boring through center of affected area; sample at 5-ft intervals to 10 ft above water table	These facilities are relatively small; one borehole at the center of each facility will be adequate to determine the vertical extent of contamination	Contaminants identified during Task 3c test pit sampling from each sample interval; one physical sample and one archive sample per geologic unit	2 randomly located borings at margins of affected area (distance from area boundary to be determined) to determine horizontal distribution of contamination; sample for contaminants identified in Phase 1, at same sample intervals	Horizontal extent of contamination will be determined in Phase 2	drive tube
1734-D cylinder storage	not shown	TBD[b]	Additional information required from Task 1 source data compilation	TBD[b]	TBD[b]	TBD[b]	

Table 1. Soil Boring Sampling Activity by Facility in 100-DR-1 Operable Unit. (Sheet 7 of 9)

Facility	Figure in text showing Phase 1 borehole locations	Number of Phase 1 boreholes	Phase 1 rationale	Phase 1 parameters for analysis	Phase 2 program if contaminants identified in Phase 1	Phase 3 program if contamination identified at depth	Preferred sampling method[a]
Demolished contaminated ancillary facilities							
Site of former 108-D equipment decontamination station Site of former 132-D-3 effluent pumping station Site of former 115-D gas recirculation building Site of former 117-D exhaust air filter bldg	not shown not shown not shown not shown	1 boring at 132-D-3 and 117-D facilities and at least 2 borings at 108-D and 115-D facilities; sample at 5-ft intervals to depth of 10 ft below base of facility	One boring at small facilities will be sufficient to determine the nature of contamination to 10 ft below facility; larger facilities will require additional borings; borehole locations will be based on Task 1a source data compilation and Task 3a surface radiation anomalies; if no anomalies identified, borings at random locations within facility boundaries	Radionuclides, TCL (organics), TAL (inorganics) from each sample interval; archive one physical sample and one archive sample per geologic unit	Deepen Phase 1 borings to sample at 5-ft intervals to 10 ft above water table; additional borings will be required at larger facilities; sample for contaminants identified in Phase 1	At least 2 randomly located borings at margins of affected area (distance from area to be determined) to identify horizontal distribution of contamination; sample for contaminants identified in Phases 1 and 2 at 5-ft intervals to 10 ft above water table	dual-wall core or drive tube
Existing contaminated ancillary and support facilities							
103-D fuel element storage building 1724-DA underwater test facility	not shown not shown	If contaminants identified during Task 1g sampling, one boring at outer margin of building where contaminants identified; sample at 5-ft intervals to 10 ft above water table	Borings will be placed on outer margins of buildings because boring through existing buildings is not feasible	Contaminants identified during Task 1g source investigation from each sample interval; one physical sample and one archive sample per geologic unit	At least 2 randomly located borings away from margins of affected area (distance of borings from outer margins of building to be determined) to determine horizontal distribution of contamination; sample for contaminants identified in Phase 1, at same sample intervals	Horizontal extent of contamination will be determined in Phase 2	drive tube

Table 1. Soil Boring Sampling Activity by Facility in 100-DR-1 Operable Unit. (Sheet 8 of 9)

Facility	Figure in text showing Phase 1 borehole locations	Number of Phase 1 boreholes	Phase 1 rationale	Phase 1 parameters for analysis	Phase 2 program if contaminants identified in Phase 1	Phase 3 program if contamination identified at depth	Preferred sampling method[a]
Solid waste facilities							
126-D-2 Solid Waste Landfill	not shown	If Task 3c test pit sampling indicates contaminants, one boring at each test pit location; sample at 5-ft intervals to 10 ft above water table	Number and locations of borings will depend on the number of contaminated test pits identified in Task 3c	Contaminants identified during Task 3c test pit sampling from each sample interval; one physical sample and one archive sample per geologic unit	2 randomly located borings away from source (distance from margins of source to be determined) to determine horizontal distribution of contamination; sample for contaminants identified in Phase 1, at same sample intervals	Horizontal extent of contamination will be determined in Phase 2	drive tube
Burial grounds 4A, 4B, and 18	not shown	If "hot spots" identified during Task 1e soil gas survey or Task 3a surface radiation survey, boring(s) at identified anomalies; if no anomalies identified, boring(s) at random location(s) within burial ground boundaries; sample at 5-ft intervals to 10 ft below fill	Number and location of borings will depend upon the number of anomalies identified in Tasks 1e and 3a; if no anomalies identified, one or more borings, depending on size of burial ground, drilled at random locations will be adequate to the nature of contamination	Radionuclides, TCL (organics), TAL (inorganics) from each sample interval; archive one physical sample and one archive sample per geologic unit	Deepen Phase 1 borings and sample at 5-ft intervals to 10 ft above water table; sample for contaminants identified in Phase 1	1 boring on each side of contaminant source (distance from margins of source to be determined) to determine horizontal distribution of contamination; sample for contaminants identified in Phase 1 at same sample intervals	dual-wall core or drive tube

Table 1. Soil Boring Sampling Activity by Facility in 100-DR-1 Operable Unit. (Sheet 9 of 9)

Facility	Figure in text showing Phase 1 borehole locations	Number of Phase 1 boreholes	Phase 1 rationale	Phase 1 parameters for analysis	Phase 2 program if contaminants identified in Phase 1	Phase 3 program if contamination identified at depth	Preferred sampling method[a]
Solid waste facilities (Continued							
Electrical facilities	not shown	If Task 3c test pit sampling indicates contaminants, one boring at each test pit location; sample at 5-ft intervals to 10 ft above water table	Number and locations of borings will depend on the number of contaminated test pits identified in Task 3c	Contaminants identified during Task 3c test pit sampling from each sampling interval; one physical sample and one archive sample per geologic unit	2 randomly located borings away from source; (distance from margins of source to be determined) to determine horizontal distribution of contamination; sample for contaminants identified in Phase 1, at same sample intervals	Horizontal extent of contamination will be determined in Phase 2	drive tube

[a]The type of drilling/sampling method will depend on the nature of the sediments encountered at the site. The methods listed are the current preferred methods, but the actual site conditions may require modification of the drilling program.

[b]TBD - To be determined.

The 116-D-1A and 116-D-1B (105-D) Fuel Storage Basin Trenches. These trenches received contaminated water and sludge from the 105-D fuel storage basin where irradiated fuel elements were discharged from the 118-D-6 (105-D) reactor. The 116-D-1A trench was 40 m (130 ft) in length, 3 m (10 ft) in width, and 1.8 m (6 ft) in depth. It was covered with clean soil in 1955. The 116-D-1B trench was 30 m (100 ft) in length, 3 m (10 ft) in width, and 4.6 m (15 ft) in depth. It was covered with clean soil in 1967.

The 116-D-2 (105-D) Pluto Crib. The 116-D-2 crib, also known as the plutonium or "pluto" crib, was located southeast of the 132-D-3 (1608-D) pumping station. It is situated within the security fence that surrounds the reactor building. This facility, which was specifically included in the NPL proposal, was constructed in 1950 to receive process effluents contaminated by fuel element ruptures.

The crib was small, 3.0 m (10 ft) long and wide, and 3.0 m (10 ft) deep and probably only received the small amounts of process effluent resided within process tubes containing ruptured fuel. This crib operated only until 1956, at which time it was covered to grade with clean soil.

The 116-D-6 (105-D) Cushion Corridor Decontamination French Drain. This drain is located within the 118-D-6 (105-D) reactor building security perimeter directly northeast of the building. The drain is 0.9 m (3 ft) in diameter, 0.9 m (3 ft) deep, and is made of vitreous tile conduit. THe drain received domestic water from the changing room and very low-level radioactive contaminants from the personnel mask decontamination station.

The 116-DR-1 and 116-DR-2 Process Effluent Disposal Trenches. The 116-DR-1 and 116-DR-2 trenches were located directly east of the 116-DR-9 (107-DR) retention basin in the northeast corner of the operable unit. The 116-DR-1 trench was about 91 m (300 ft) in length, 4.6 m (15 ft) in width, and 6.1 m (20 ft) deep; and the 116-DR-2 trench was 46 m (150 ft) in long, 3.0 m (10 ft) wide, and 6.1 m (20 ft) deep. These facilities served as emergency disposal cribs for process effluents contaminated by fuel element ruptures. When such ruptures occurred, process effluents were diverted from the 116-D-7 and 116-DR-9 basins to these facilities to prevent direct discharge of the highly contaminated waste stream into the Columbia River.

The 116-D-3 and 116-D-4 (108-D) Cribs #1 and #2. These cribs operated as french drains and were 9 m (30 ft) in diameter and 1.5 m (5 ft) deep. They received low-level wastes from the 108-D equipment decontamination building. Effluents from the cask decontamination pad in the 108-D building were disposed of in the 116-D-3 crib. Both cribs are now covered with soil.

The 116-D-9 (117-D) Reactor Confinement Seal Pit Drainage Crib. This small 3 m by 3 m (10 ft by 10 ft) disposal crib is directly east of the 118-D-6 reactor building outside of the fence that encompasses the reactor building. Water from seal pits in the 117-D exhaust filter building was transferred to this crib for disposal. Air emitted from reactor spaces was filtered in the confinement system prior to discharge through the 132-D-4 (116-D) reactor exhaust stack. This facility was constructed in 1960, when reactor emission controls were first installed. The crib was last sampled in 1978.

Sanitary Sewage Transfer, Treatment, and Disposal Facilities. Sanitary sewage generated at the 100-D/DR Area was treated in underground septic tanks and subsequently discharged to associated tile fields. There is no record or documentation of hazardous wastes being disposed of in any of these facilities, and none of these facilities were specifically referenced in the NPL nomination. However, because of the diversity of the support functions conducted in the 100-D/DR Area (e.g., the laboratory and the maintenance shops, which included a paint shop and an automotive repair shop), it is conceivable that some chemical or radiological wastes could have been disposed of in these facilities, which include the 1607-D2, 1607-D4, and 1607-D5 septic systems, the septic tank at N93050 and W52850, and the associated pipelines. Refer to Section 5.5.5 for further discussion.

Process Effluent Pipelines. Process effluent pipelines emanate from the 118-D-6 (105-D) and 118-DR-2 (105-DR) buildings (D and DR reactor buildings, respectively) to the various process effluent disposal and treatment facilities. These lines continue out from the 116-D-7 (107-D) and 116-DR-9 (107-DR) basins (described below) to both the Columbia River and disposal trenches. The lines are constructed of carbon steel and/or concrete pipe and are buried below the land surface. They are presumably still in place. Portions of this transfer system lie beneath areas surrounded by security fences.

These pipelines, which transferred all reactor cooling and decontamination wastes, are known to have developed leaks at various times during their periods of operation. Permanent markers have been placed in the vicinity of the pipelines south of the retention basins designating the area as radioactive.

Process Effluent Outfall Structure and Pipelines (116-D-5 and 116-DR-5). The 116-D-5 and 116-DR-5 outfall structures were located directly to the west of the 116-D-7 basin, overlooking the Columbia River. The locations of these structures and pipelines are shown in Figure 2.

These outfall structures received treated process effluents from the 116-D-7 (107-D) and 116-DR-9 (107-DR) retention basins, directing them to the Columbia River. These pipelines are presumably still in place and extend approximately 564 m (1,850 ft) from the bank to the northern side of a small island in the Columbia River. The pipelines are buried beneath the island adjacent to the bank where the outfall structures were located.

The 116-D-7 and 116-DR-9 (107-D and DR) Process Effluent Retention Basins. The 116-D-7 and 116-DR-9 retention basins were located in the north central portion of 100-DR-1 operable unit and received process effluents, primarily cooling water effluent, from the 118-D-6 and 118-DR-2 reactors, respectively. The 116-D-7 basin was 142 m (467 ft) long, 70 m (230 ft) wide, and 6.1 m (20 ft) deep; and the 116-DR-9 basin was 182 m (600 ft) long, 70 m (230 ft) wide, and 6.1 m (20 ft) deep. The 116-DR-9 (107-DR) basin was constructed above the tile field for the 1607-D2 septic tank, but this tile field was subsequently relocated north of the basin.

These facilities were designed to retain cooling water effluent to allow for radioactive decay and thermal cooling. The effluent was then discharged directly to the Columbia River. Decontamination wastes from the 118-D-6 (105-D) reactor building drains were also pumped into the process effluent pipeline by the 132-D-3 (1608-D) pumping station (discussed below).

Reactor effluents were normally routed to one of the two concrete-lined cells of these basins. In the event of a fuel element cladding rupture, cooling water would come in direct contact with the uranium fuel, thereby picking up high-activity fission products. When this occurred, the water from the side of the basin that had received the contaminated effluent would be drained to the 116-DR-1 or 116-DR-2 liquid waste process effluent disposal trenches (discussed above) for soil column disposal. Normal cooling water would then be routed to the empty cell of the basin.

Around 1954, concern surfaced as to the structural integrity of the 116-D-7 and 116-DR-9 basins because process effluents were leaking from the cells containing water into the cells that were empty at the time. In addition, the volume of cooling water being used had increased to the point where there was concern about the potential for overflow. Therefore, a new policy required that the basins be operated in parallel, enabling the basins to be kept full at all times. On implementing this procedure there was essentially no means of segregating the ruptured fuel element effluent. A groundwater study in 1962 indicated that these basins, and/or their associated effluent lines, showed substantial leakage.

Sludge from the 116-D-7 and 116-DR-9 retention basins was removed in 1953. The material was placed in the adjacent 107-D and 107-DR sludge disposal trenches surrounding the basin area.

The concrete walls of the 116-D-7 (107-D) and 116-DR-9 (107-DR) basins have been demolished and pushed into the basins, and the facilities are now covered with clean gravel. A security fence has been placed around the basins and radioactive signs are posted.

Area Around the Basins. The area around the basins includes the area north of the retention basins and immediately adjacent to the basins as well as along the alignment of the outfalls and outfalls structure. The area around the basins discussed above has been included in this section due to the reports of substantial leakage by the basins. Verbal reports of steam rising from the ground north of the basins indicate a potential pathway of contamination. Within this area lie 15.24 cm (6 in) pipelines providing sanitary water for both basins. This also could provide a pathway of contamination if infiltration occurred.

The 130-D-1 (1716-D) Gasoline Storage Tank. The underground gasoline storage tank was located on the east side of the 1716-D gas station. Following deactivation of the 100 D/DR Areas the tank was emptied and filled with water. During a site visit, the tank was located by an aboveground vent pipe. A rock dropped into the tank hit the tank's bottom, indicating that the tank was empty and had leaked. This tank was removed in July 1989.

Waste Acid Reservoir. A large underground brick structure that was used for storing waste acid was located on the west side of the 186-D building. Information is limited as to whether this was ever used for its intended purpose or as to the process that generated the waste product. Photographs verify the existence of the structure. The size is questionable; drawings indicate a size of approximately 27 m (90 ft) x 27 m (90 ft) and verbal accounts indicate a size of approximately 9 m (30 ft) x 9 m (30 ft). A nearby manhole cover may mark the location of a suspected sump for the waste acid reservoir.

Fuel Oil Tank. An underground fuel oil tank was located just west of the 184-DA steam generating building. This facility was constructed and placed in operation following plant shutdown and deactivation. The facility used the fuel to generate electricity for the area. The size of the tank is unknown. It is scheduled for removal in 1990.

The 166-D Fuel Oil Tank. This aboveground 681,300-l (180,000-gallon) storage tank was located at the confluence of the railroads north of the 184-D powerhouse. Diesel fuel was used to feed the boilers during operation of the plant. The tank has a 137-m (450-ft) fuel oil line transporting oil to the boilers.

Sodium Dichromate Tanks. Two large tanks for sodium dichromate storage were originally installed aboveground west of the 108-D office and decontamination building in accordance with the original proposed purpose of the 108-D Building, which was for chemical feeding for water process water treatment. It is thought that these tanks were moved to a location south of the 190-D building.

The 107-D and 107-DR Sludge Disposal Trenches. Five sludge disposal trenches were excavated around the 116-D-7 and 116-DR-9 retention basins to dispose of accumulated sludges from the basin bottoms while the basins were being repaired in 1953. The trenches were covered with clean soil when work was completed. It is possible that materials from these trenches were used as fill in the 116-D-7 (107-D) and 116-DR-9 (107-DR) retention basins when they were undergoing deactivation. It is possible that this sludge included sands and silt from blowing winds because of the physical location of the basins.

The 126-D-2 Solid Waste Landfill. Radioactive solid waste generated within the 100 D/DR Area was disposed of in the 118-D-3 solid waste burial grounds located within the 100-DR-2 operable unit area. However, a 1983 photograph indicated the presence of a landfill in the 100-DR-1 operable unit area. Verbal accounts verified that in 1966 the 184-D coal storage area, located west of the 184-D powerhouse, was no longer used for storing coal and was subsequently used as an open landfill for approximately 20 years. It was covered in 1986. Most of the materials included decommissioning/demolition wastes, concrete, steel, and other building materials. There are no reports of radioactive material at this location. A field visit revealed a possible asbestos-looking material scattered on the surface. The 1983 photograph revealed a drum. No one individual monitored the waste received at this site.

Burial Grounds No. 4A, 4B, and 18. These burial grounds are located in the southeast portion of the 100-DR-1 operable unit. There is a discrepancy in the description and location of the burial grounds. The original intent was to include all of the burial grounds under the 100-DR-2 operable unit along with other trenches in burial ground No. 4. These questions are currently being addressed. There is limited information on burial ground No. 18.

Electrical Transmission Facilities. See Section 5.5.7.

6.0 CONTINGENCY AND EMERGENCY RESPONSE PLANS

The following procedures have been established to address emergency situations that might occur during drilling or sampling operations. As a general rule, when confronted with an unanticipated, potentially hazardous situation as indicated by instrument readings, visible contamination, unusual or excessive odors, etc., team members shall temporarily cease operations and move to a predesignated, safe upwind area.

6.1 COMMUNICATION

A two-way radio will be operational and be manned by the field team leader to maintain contact with the team's base station. Personnel in the exclusion zone will maintain line-of-sight with the field team leader. Any failure of radio communications will require evaluation of whether personnel shall leave the exclusion zone. Communications from rig to rig or site to site will also be provided so that the Site Safety Officer or field team leader can respond accordingly. In addition, a series of three 1-second horn blasts from a truck in the support zone is the emergency signal for all personnel to leave the exclusion zone.

The following standard hand signals will be used in all cases:

Hand Signal	Meaning
Hand gripping throat	Out of air, can't breathe
Grip partner's wrist or both hands around waist	Leave area immediately
Hands on top of head	Need assistance
Thumbs up	OK, affirmative
Thumbs down	No, negative

6.2 RESPONSIBILITIES

The Site Safety Officer is directly responsible for providing safety recommendations on the site to the Site Emergency Coordinator. The Site Emergency Coordinator for the 100-DR-1 drilling operations will be the field team leader. The Site Safety Officer will call the Hanford Fire Department prior to commencing work on each site. Both the Site Health and Safety Officer and Field Team Leader shall be currently certified in first aid and CPR.

The Site Emergency Coordinator will be responsible for the evacuation, emergency treatment, emergency transport of field personnel as necessary, and notification of the appropriate Hanford Facility emergency response units and management staff.

The Hanford Fire Department is responsible for fire fighting services for the Hanford Site. Memoranda of understanding (MOUs) have been established with the local Tri-Cities Fire Departments for support to the Hanford fire department.

Professional medical help is provided by the Hanford Environmental Health Facility (HEHF) for the entire Hanford Site. Doctors and nurses are available for emergency assistance at all times. The medical personnel are trained to work with injured personnel who have been contaminated from a radioactive source and who may have been exposed to hazardous materials. Emergency call lists ensure availability of professional medical care at all times. A nurse is on duty in each of the 100, 200, and 300 Areas at all times. During hours when the nurse is not on duty in the 400 Area, the 300 Area nurse will respond to first aid emergencies. The locations of onsite emergency facilities are shown in Figure 3.

The Emergency Decontamination Facility, adjacent to the Kadlec Medical Center in Richland, Washington, is available with unique equipment for performing surgery and decontamination on severely contaminated injured persons. Hospital service is also available at Kadlec Medical Center. Kennewick General Hospital in Kennewick, Washington, and Our Lady of Lourdes Health Center in Pasco, Washington, serve as backup hospitals for Kadlec Medical Center.

Radiation protection technologists (RPT) from Westinghouse Hanford, with appropriate survey instruments, will accompany any patient with radioactive contamination to the hospital. Personnel from Pacific Northwest Laboratory (PNL) will meet the ambulance at the hospital and provide monitoring for the patient and hospital premises as needed. Additional health physics services backup capability is available as needed through PNL.

Severely contaminated, injured patients will be cared for in the Emergency Decontamination Facility, which provides both isolation and decontamination. The only exception is if the injury is so severe that immediate medical attention can only be provided in a hospital. The Emergency Decontamination Facility is located behind and immediately north of Kadlec Hospital in Richland.

Ambulance service is provided by the Hanford Fire Department, which has qualified emergency medical technicians (EMTs) as attendants. This service is available from each area fire station on a 24-hour basis. Additional ambulances are available when needed from other fire stations and from other local fire departments under the MOUs.

In addition, an MOU has been established with Washington Public Power Supply System (WPPSS) and the City of Richland for providing backup ambulance service.

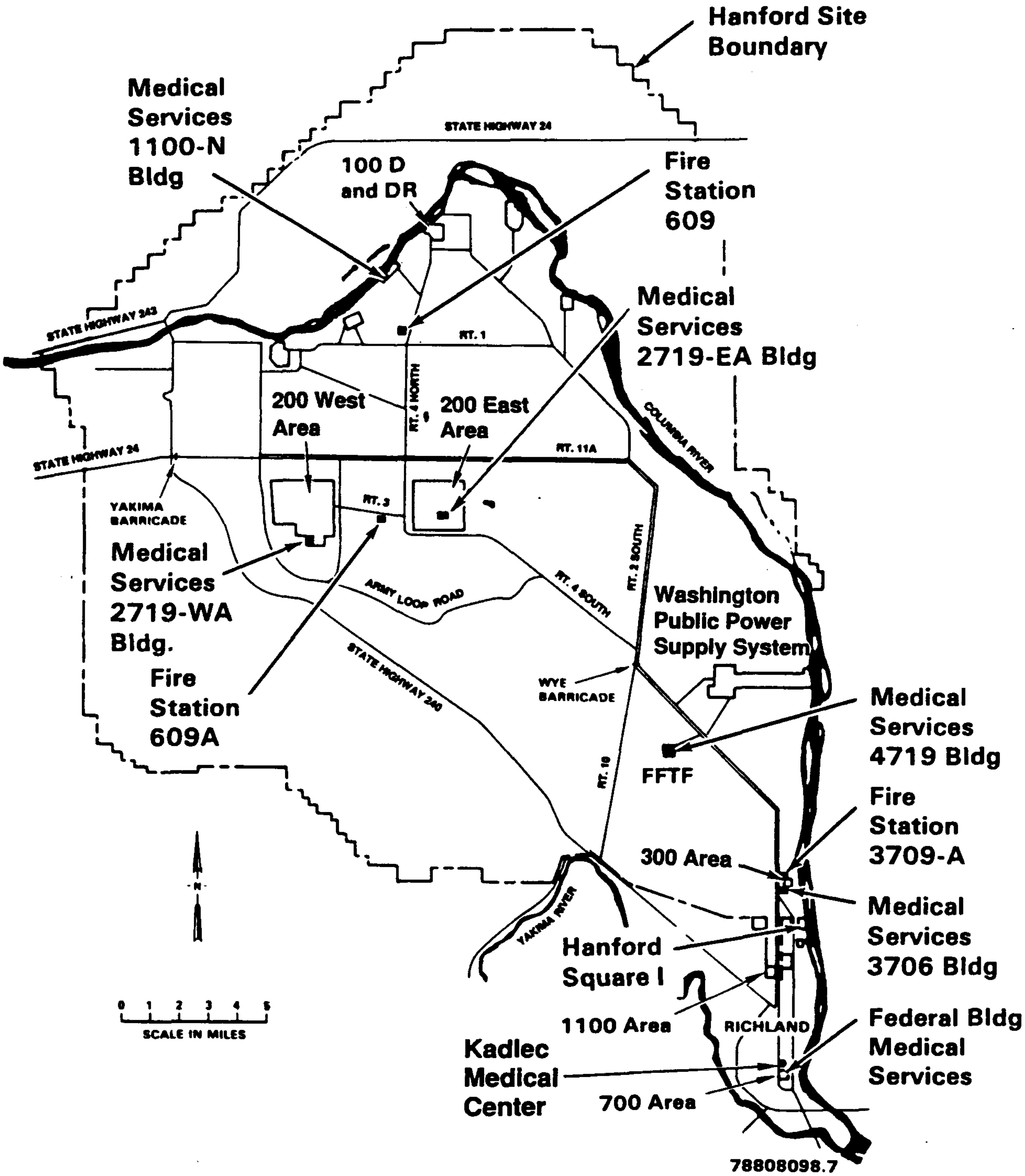


Figure 3. Location of Hanford Emergency Facilities.

Emergency communications will be maintained during all onsite field activities by two-way radio contact. If an emergency occurs such as fire or explosion, all onsite personnel should exit the site in an upwind direction and assemble in a predesignated area. Site-specific emergency response procedures will be covered in the tail gate meeting with the PJSP. If an onsite injury occurs, team members should employ the general procedures detailed in the following sections.

6.3 PROCEDURE FOR PERSONAL INJURY IN THE EXCLUSION ZONE

If able, the injured person should proceed through decontamination to the nearest available source of first aid. If the injured party is extremely muddy, remove outer garments and, if necessary, wash the injured area with soap and water.

On notification of a serious injury in the exclusion zone, the emergency signal of three one-second horn blasts will be sounded. All site personnel will assemble at the decontamination line. The Site Safety Officer and field team leader should evaluate the nature of the injury and the extent of decontamination possible prior to movement of the injured person to the support area. No person should reenter the exclusion zone until the cause of the injury is determined and measures taken to prevent recurrence.

If the victim is unable to walk, but is conscious and there is no evidence of spinal injury, escort or transport the injured person through decontamination procedures to the nearest first aid facility. If the victim cannot be moved without causing further injury, such as in the case of a severe compound fracture, take necessary emergency steps to control bleeding and immediately call for medical assistance as discussed below.

If the victim is unconscious or unable to move, Do Not Move the Injured Person Unless Absolutely Necessary to Save His or Her Life, until the nature of the injury has been determined.

If there is any evidence of spinal injury, do not move the victim unless absolutely necessary to save his or her life. Administer rescue breathing if the victim is not breathing, control severe bleeding, and immediately contact the Hanford Patrol by phone (811) or by radio on Channel 1.

6.4 PROCEDURE FOR PERSONAL INJURY IN THE SUPPORT AREA

On notification of an injury in the support area, the field team leader and the Site Safety Officer will assess the nature of the injury. If the cause of the injury or loss of the injured person does not affect the performance or safety of site personnel, operations may continue, with initiation of first aid and summoning of medical assistance as discussed previously. If the injury increases the risk to others, the emergency signal of three 1-second horn blasts will be sounded and all site personnel shall move to the decontamination area for further instructions. Activities on site will stop until the hazardous condition (if any) is evaluated and reduced to an acceptable level.

6.5 PROCEDURES FOR FIRE AND EXPLOSIONS

The dry chemical fire extinguishers that are required on all field vehicles are effective for fires involving ordinary combustibles such as wood, grass, flammable liquids, and electrical equipment. They are appropriate for small, localized fires such as a drum of burning refuse, a small burning gasoline spill, a vehicle engine fire, etc. No attempt should be made to use the provided extinguishers for well-established fires or large areas or volumes of flammable liquids.

In the case of fire, prevention is the best contingency plan. Smoking in the exclusion zone is strictly prohibited and smoking materials, where permitted, should be extinguished with care.

In the event of a fire or explosion:

1. If the situation can be readily controlled with available resources without jeopardizing the health and safety of yourself or other site personnel, take immediate action to do so. If not, take the actions listed below.

2. Isolate the fire to prevent spreading if possible.

3. Clear the area of all personnel working in the immediate vicinity.

4. Immediately notify site emergency personnel and the local fire department by contacting the Hanford Patrol by phone (811) or by radio on station 1 to relay message.

5. Ensure that on notification of a fire or explosion on site, the emergency signal of three-1-second horn blasts is sounded and all site personnel assemble at the decontamination line. The fire department will be called and all personnel will move to a safe distance from the involved area. Again, based on the individual tail-gate meetings, a decision to send all personnel immediately out of the exclusion area may be an option.

6.6 PROCEDURE FOR PERSONAL PROTECTIVE EQUIPMENT FAILURE

If any site worker experiences a failure or alteration of protective equipment that results in any potential compromise in the level of protection provided by that equipment, that person and his or her buddy shall immediately leave the exclusion zone. Reentry shall not be permitted until the equipment has been repaired or replaced, or the conditions leading to the problem are adequately evaluated and corrected.

6.7 PROCEDURE FOR FAILURE OF OTHER EQUIPMENT

If equipment on site fails to operate properly, the field team leader and Site Safety Officer shall be notified and then determine the effect of the failure on continuing operations. If the failure may jeopardize the safety of personnel or prevents completion of the Work Plan tasks, all personnel shall leave the exclusion zone until the necessary repairs are made.

6.8 EMERGENCY ESCAPE ROUTES

In the event that an emergency situation prevents exiting the exclusion zone by way of the decontamination area, exit the exclusion zone in any direction, preferably upwind, avoiding any barriers.

6.9 RESPONSE ACTION TO PHYSICAL EXPOSURE

If a worker sustains a chemical injury, the following first aid procedures are to be instituted as soon as possible:

- Eye exposure. If contaminated solid or liquid gets into the eyes, immediately wash eyes at the site with an emergency eye wash bottle. Proceed to the emergency eye wash station that will be provided in the field and wash eyes using large amounts of water. Obtain medical attention immediately by calling 811.

- Inhalation exposure. If a person breathes in large amounts of organic vapor, move the exposed person to fresh air at once. If breathing has stopped, perform artificial respiration. If breathing and heart have both stopped, perform cardiopulmonary resuscitation (CPR). Obtain medical attention as soon as possible by calling 811. Keep the person warm and at rest until medical help arrives.

- Skin exposure. If contaminated solid or liquid gets on the skin, promptly use the deluge water unit, then wash contaminated skin using soap or mild detergent and water. If solids or liquid penetrate through the protective clothing, remove the clothing immediately and wash the skin using soap or mild detergent and water. Obtain medical attention immediately, if symptoms warrant, by calling 811.

- Ingestion. If a contaminated solid or liquid has been swallowed, immediately obtain medical attention and call the Poison Control Center. In any of the above situations, if 811 is not notified, the person should be taken to the nearest first aid station.

6.10 EMERGENCY TELEPHONE NUMBERS

Local resources:	Hanford Emergency Response Team	811
Ambulance:	Hanford Fire Department will dispatch the ambulance	811
Hospital:	Kadlec Hospital, Richland	946-4611
Police (Local or State):	Hanford Patrol	811
Fire Department:	Hanford Fire Department	811
Poison Control Center:		800-572-5842

EMERGENCY CONTACTS

Industrial Safety:	Central Area	373-3948 Pager 85-398
Radiological Protection:	Mark E. Hevland	373-4286 373-1996
Field Team Leaders:	Dennis Myers Ted Wood	373-3604 373-5365
Environmental Reporting: (Spill Response)	See Figure 4	
Radio Channels:	Transportation	Station 1

ENVIRONMENTAL RELEASE NOTIFICATION FORM

DATE:	PERSON REPORTING INCIDENT:
TIME:	CONTRACTOR:
RECEIVED BY:	TELEPHONE:

1. WHERE DID THE RELEASE OCCUR?
2. WHAT WAS THE DATE OF THE RELEASE?
3. WHAT WAS THE TIME OF THE RELEASE?
4. WHAT MATERIAL WAS RELEASED?
5. HOW MUCH MATERIAL WAS RELEASED?
6. WHAT IS THE REPORTABLE QUANTITY OF THE MATERIAL?
7. WHAT REGULATIONS REQUIRED THE RELEASE TO BE REPORTED?
8. WHAT WAS THE CAUSE OF THE RELEASE?
9. WHAT IS THE IMPACT OF THE RELEASE?
10. WHAT CLEAN-UP ACTIONS ARE NEEDED?
11. WAS A PRESS RELEASE MADE?
12. WHAT AGENCIES WERE NOTIFIED?

AGENCY	PHONE	PERSON CONTACTED	TIME
NRC	9-1-800-424-8802		
WDOE-HQ (R. Stanley) Central Rgn Office	(206) 438-7020 (509) 575-2490		
HQ EOC	FTS 896-8100		
WA EMERGENCY RESPONSE COMMISSION	9-1-800-262-5990		
BENTON CTY (D. Summer) EMERGENCY MANAGEMENT	586-1451		
TRICOUNTY AIR (P. Cooke) POLLUTION AUTHORITY	946-4489		

RL DISTRIBUTION

AMS AMO AMR MGR COM SED OPD RDD PMO ECB PPB

883-1736/9956

Figure 4 Environmental Release Notification Form

7.0 REFERENCES

WHC, 1989, Environmental Investigations and Site Characterization Manual, WHC-CM-7-7, Westinghouse Hanford Company, Richland, Washington.

PROJECT MANAGEMENT PLAN

This page is left intentionally blank.

CONTENTS

LIST OF FIGURES

This page is left intentionally blank.

1.0 INTRODUCTION

This Project Management Plan (PMP) defines the administrative and institutional tasks necessary to support RCRA facility investigation/ corrective measures study (RFI/CMS) activities in the 100-DR-1 operable unit at the Hanford Site. This plan defines the responsibilities of the various participants, the organizational structure, and the project tracking and reporting procedures.

The U.S. Environmental Protection Agency (EPA), Washington State Department of Ecology (Ecology), and the U.S. Department of Energy (DOE) are entering into an agreement and consent order for remedial action and corrective on the Hanford Site. An action plan, which implements this agreement, defines EPA and Ecology regulatory integration and the methods and processes to be used to implement the agreement. This PMP is in accordance with the provisions of the draft action plan. Revisions to the action plan may result in changed requirements that would supercede the provisions of this plan.

2.0 PROJECT ORGANIZATION AND RESPONSIBILITIES

2.1 INTERFACE OF REGULATORY AUTHORITIES AND THE U.S. DEPARTMENT OF ENERGY

The 100-DR-1 operable unit consists of inactive waste management units to be remedied under RCRA. Ecology has been designated as the lead regulatory agency as defined the agreement. Accordingly, Ecology is responsible for overseeing corrective action activity at this unit and ensuring that the applicable authorities of both EPA and Ecology are applied. The specific responsibilities of Ecology, the EPA, and the DOE are detailed in the action plan.

2.2 PROJECT ORGANIZATION AND RESPONSIBILITIES

The project organization is shown in Figure 1. The following sections describe the responsibilities of the individuals shown in this figure.

Project Managers. The EPA, the DOE, and Ecology each have designated one individual as project manager, who will serve as the primary point of contact for all activities to be carried out under the agreement and action plan. The responsibilities of the project managers are given in Section 4.1 of the action plan.

Unit Managers. The unit manager from Ecology will serve as the lead unit manager. The role of the unit manager is described in Section 4.2 of the action plan.

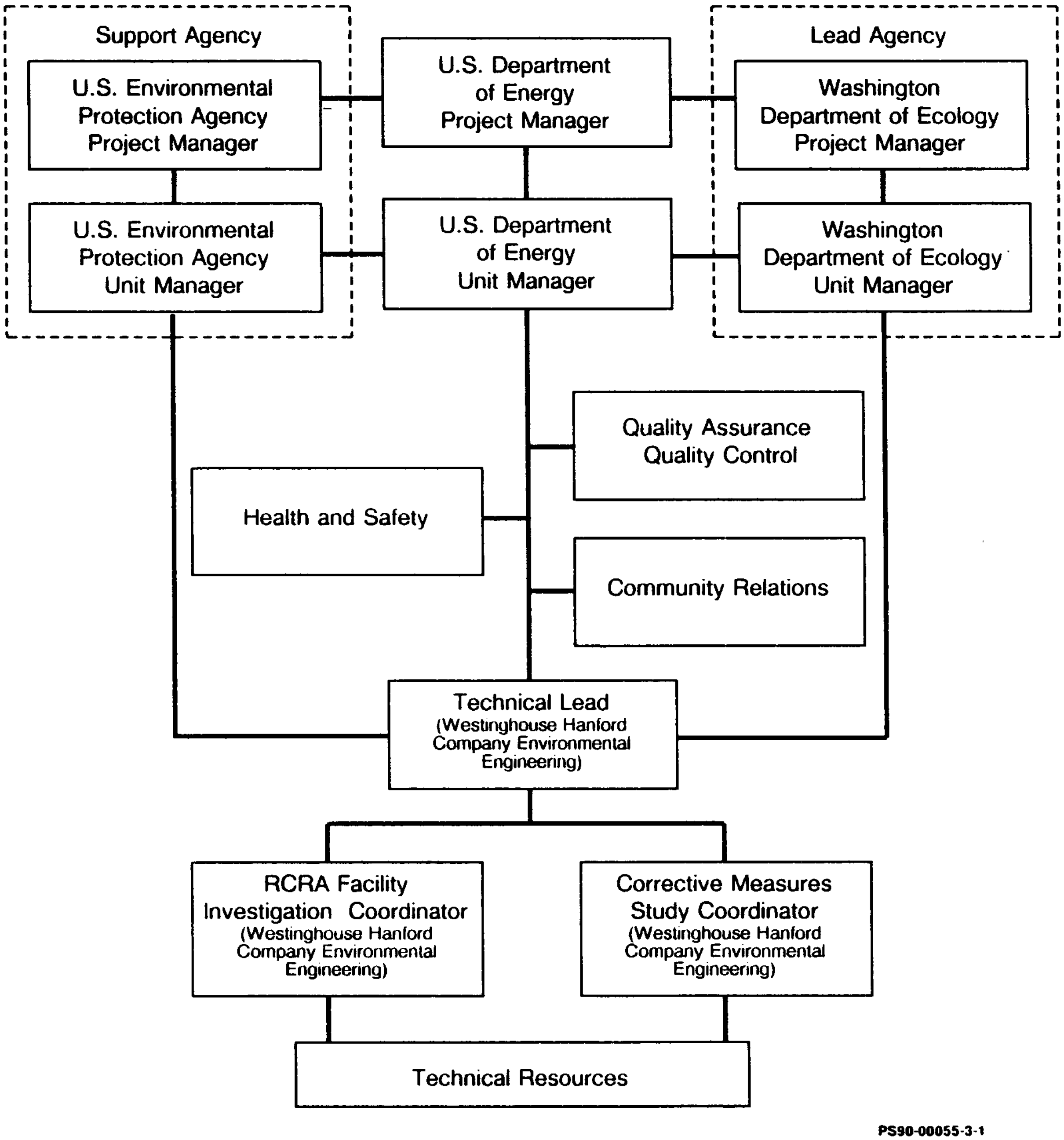


Figure 3-1. Project Organization.

Quality Assurance Officer. The quality assurance officer is responsible for monitoring overall environmental restoration program activities through establishment of site-wide quality assurance auditing program controls that may be appropriately applied to all RFIs, RI/FSs, and other Hanford Site environmental investigations. The quality assurance officer is specifically vested with the organizational independence and authority to identify conditions adverse to quality and to systematically seek effective corrective action.

Quality Coordinator. The quality coordinator is responsible for coordinating and moderating performance to the QAPP requirements by means of internal surveillance techniques and by auditing, as directed by the Quality Assurance Officer. The quality coordinator retains the necessary organizational independence and authority to identify conditions adverse to quality and to inform the technical lead of needed corrective action.

Health and Safety Officer (Environmental Division/Environmental Field Services). The health and safety officer is responsible for determining potential health and safety hazards from radioactive, volatile, and/or toxic compounds during sample handling and sampling decontamination activities and has the responsibility and authority to halt field activities due to unacceptable health and safety hazards.

Technical Lead. The technical lead will be a designated person within the Westinghouse Hanford Environmental Engineering Group. The responsibilities of the technical lead will be to plan, authorize, and control work so that it can be completed on schedule and within budget, and to ensure that all planning and work performance activities are technically sound.

RCRA Facility Investigation Coordinator. The RFI coordinator will be responsible for coordinating all activities related to Phases I and II of the RFI, including data collection, analysis, and reporting. The RFI coordinator will be from the Westinghouse Hanford Environmental Engineering Group, and will be responsible for keeping the technical lead informed as to the RFI work status and any problems that may arise.

Corrective Measures Study Coordinator. The CMS coordinator will be responsible for coordinating all activities related to Phases I, II, and III of the CMS, including data collection, analysis, and reporting. The CMS coordinator will be from the Westinghouse Hanford Environmental Engineering Group, and will be responsible for keeping the technical lead informed as to the CMS work status and any problems that may arise.

RCRA Investigation Technical Resources. The various technical resources responsible for performing the RFI are shown in Figure 2. These resources will be responsible for performing data collection, analysis, and reporting for the technical activities related to the RFI. Figures 3 through 7 show detailed organizational structure for specific RFI tasks.

Technical Resources		
Subject/Activity	RCRA[a] Facility Investigation	Corrective Measures Study
Hydrology and geology	Westinghouse Hanford[b]/Geosciences PNL[c]/Earth and Environmental Sciences Center	Westinghouse Hanford/ Geosciences
Toxicology and risk/ endangerment assessment	Westinghouse Hanford/Environmental Technology PNL/Earth and Environmental Sciences Center PNL/Life Sciences Center	Westinghouse Hanford/ Environmental Technology
Environmental chemistry	Westinghouse Hanford/Geosciences PNL/Earth and Environmental Sciences Center	Westinghouse Hanford/ Geosciences
Geophysics and field testing	Westinghouse Hanford/Geosciences (Planning) Environmental Field Services	N/A
Geotechnical and civil engineering	N/A	Westinghouse Hanford/ Environmental Engineering PNL/Waste Technology Center
Groundwater treatment engineering	N/A	Westinghouse Hanford/ Environmental Engineering PNL/Waste Technology Center
Waste stabilization and treatment	N/A	Westinghouse Hanford/ Environmental Engineering PNL/Waste Technology Center
Surveying	Kaiser Engineers	N/A
Soil and water sampling and analysis	Westinghouse Hanford/Environmental Engineering Environmental Field Services Westinghouse Office of Sample Management PNL/Earth and Environmental Sciences Center PNL/Materials and Chemical Sciences Center U.S. Testing Company, Inc.	N/A
Drilling and well installation	Westinghouse Hanford/Geosciences Environ-mental Field Services Kaiser Engineers	N/A
Radiation monitoring	Westinghouse Hanford/Operational Health Physics	N/A

[a]RCRA = Resource Conservation and Recovery Act.
[a]Westinghouse Hanford = Westinghouse Hanford Company.
[b]PNL = Pacific Northwest Laboratory.

PS90-00055-2

Figure 2. Technical Resources for Conducting RFI/CMS.

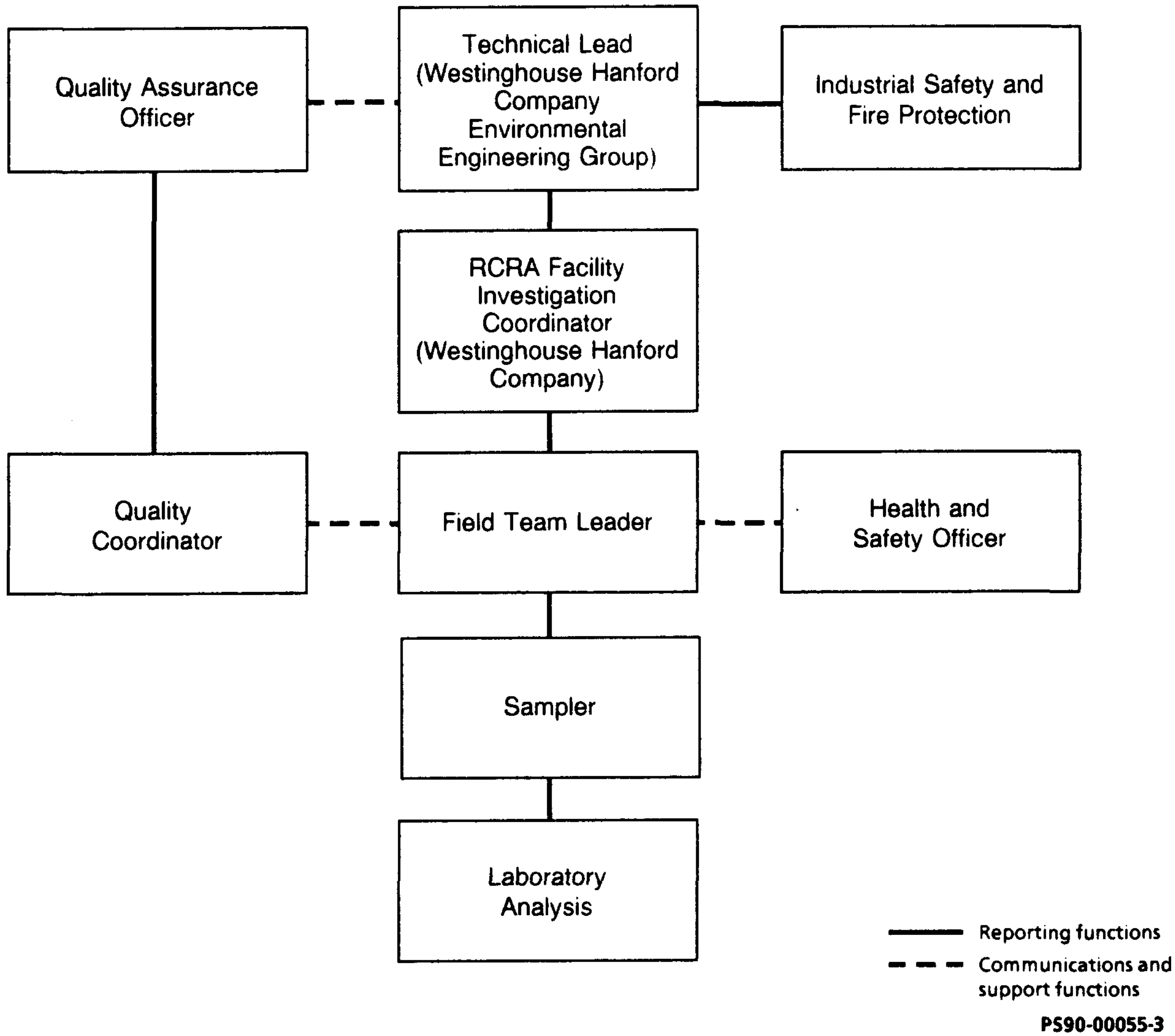


Figure 3. The 100-DR-1 Soil Sampling Team.

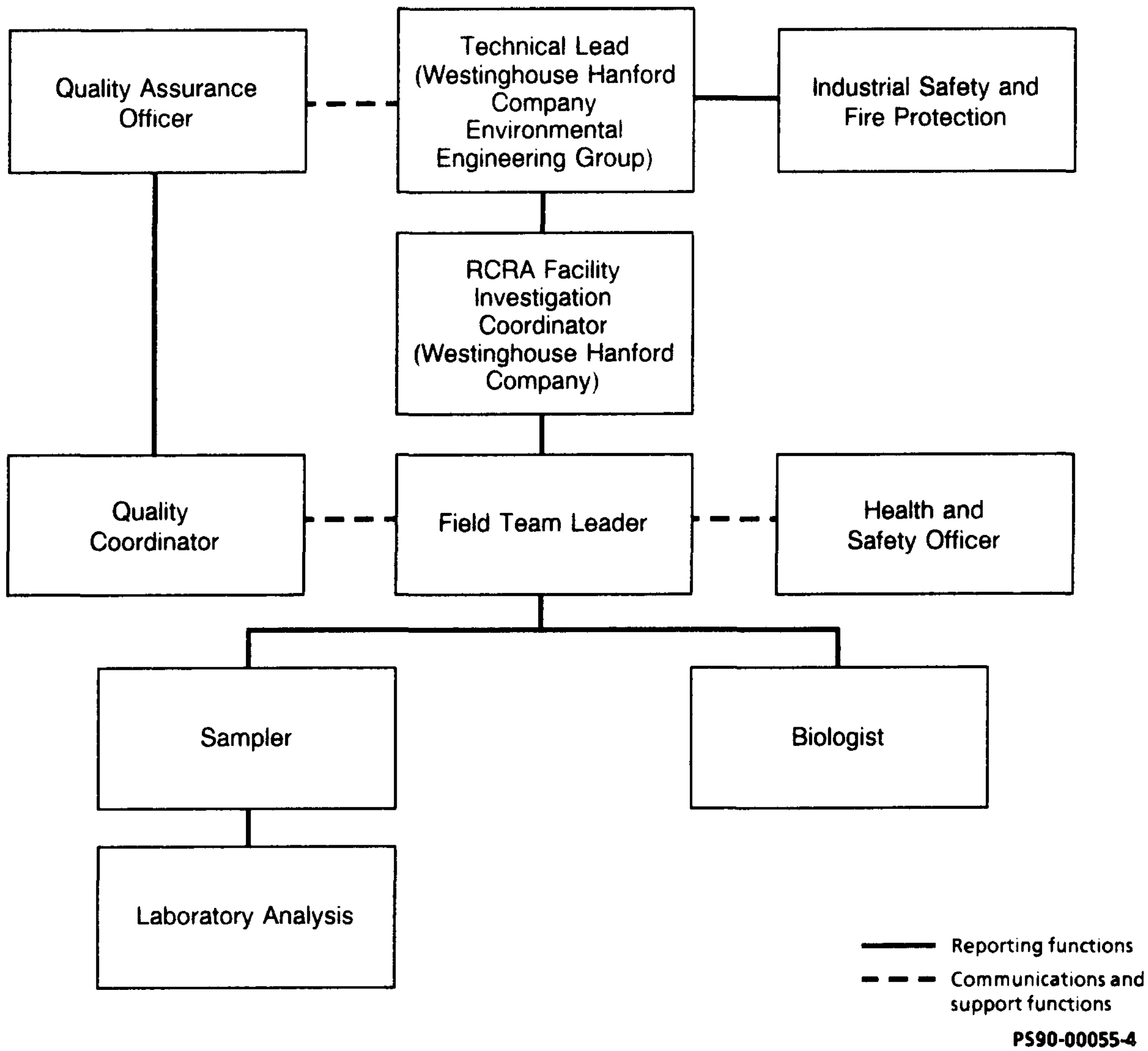


Figure 4. The 100-DR-1 Biological Sampling Team.

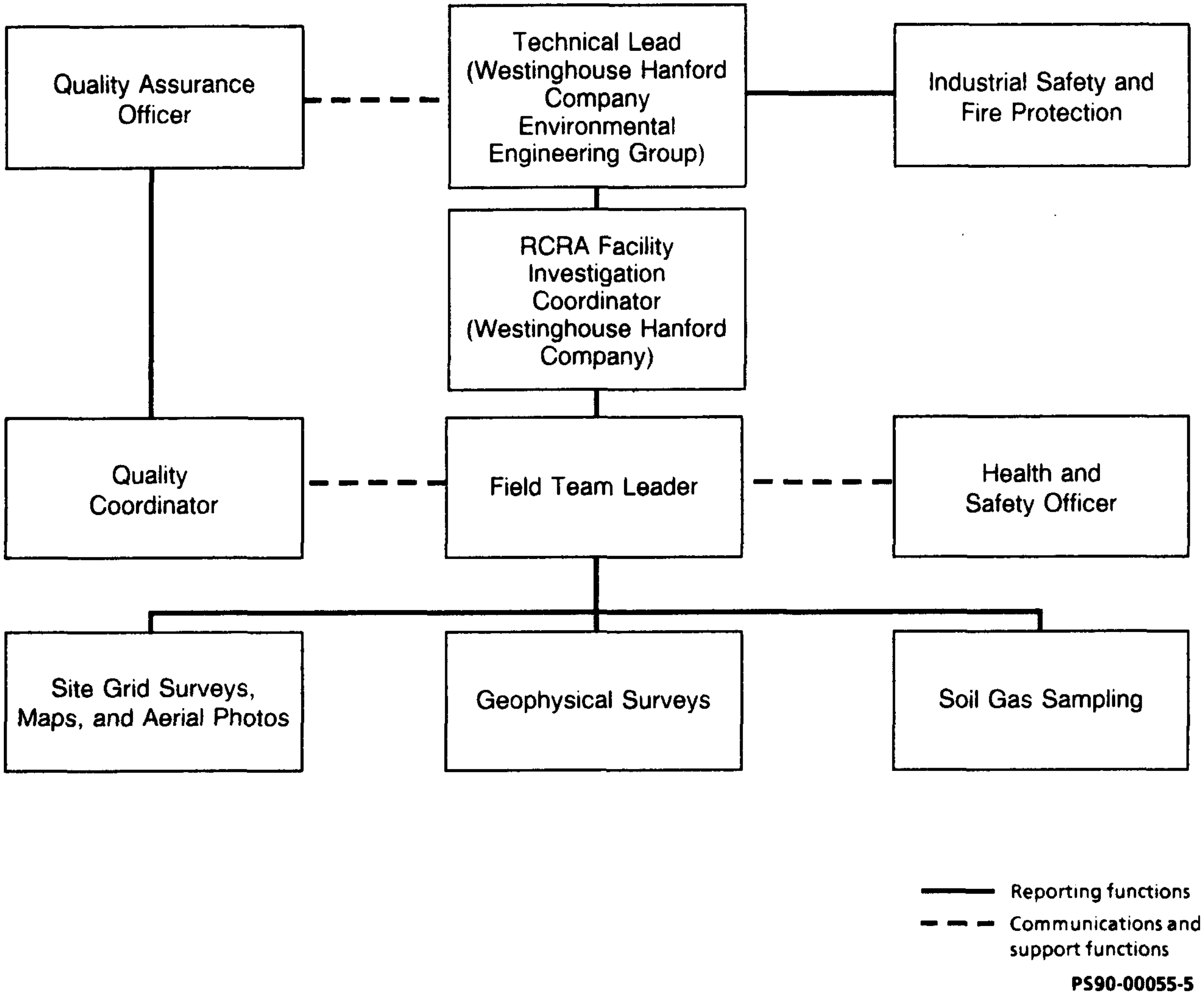


Figure 5. The 100-DR-1 Physical and Geophysical Survey Team.

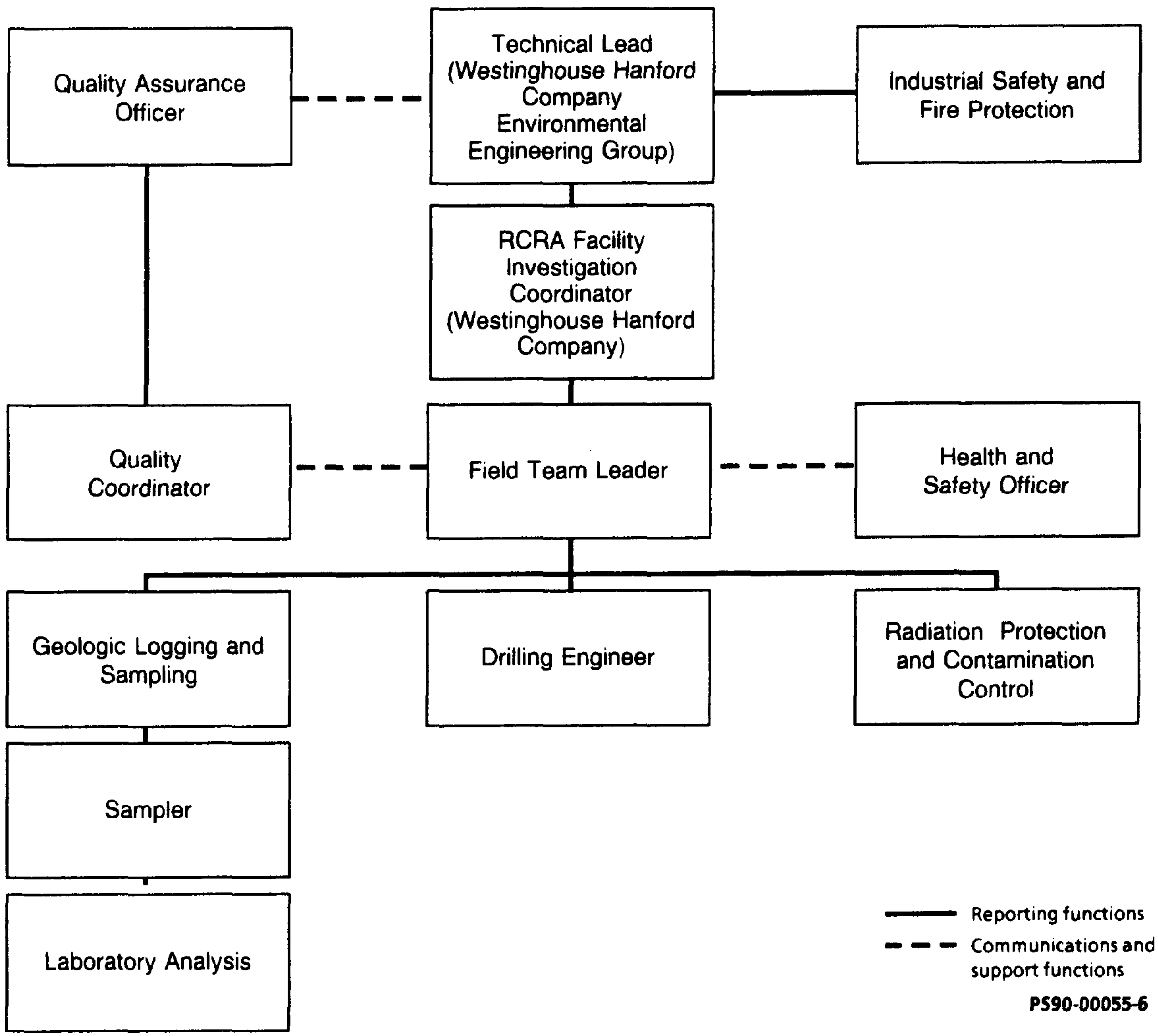


Figure 6. The 100-DR-1 Vadose Zone Drilling and Sampling Team.

Internal and external work orders and subcontractor task orders will be written by the RFI coordinator to use these technical resources, which are under the control of the technical lead. Statements of work will be provided that will include a discussion of authority and responsibility, a schedule with clearly defined milestones, and a task description including specific requirements. Each group will keep the RFI coordinator informed on the RFI work status performed by that group and of any problems that may arise.

Corrective Measures Study Technical Resources. The various technical resources responsible for performing the CMS are also shown in Figure 2. These resources will be responsible for identifying and screening remedial alternatives, and for detailed evaluation of corrective measure alternatives. Work teams reporting to the technical lead for various phases and types of work are shown in Figures 3 through 6.

Internal and external work orders and subcontractor task orders will be written by the CMS coordinator to use these technical resources, which are under the control of the technical lead. Statements of work will be provided that will include a discussion of authority and responsibility, a schedule with clearly defined milestones, and a task description including specific requirements. Each group will keep the CMS coordinator informed as to the CMS work status performed by that group and of any problems that may arise.

3.0 DOCUMENTATION AND RECORDS

ALL RFI/CMS plans and reports will be categorized as either primary or secondary documents as described by Section 9.1 of the action plan. The process for document review and comment is covered by the action plan Section 9.2. Revision, should it become necessary after finalization of any documents, is covered by Section 9.3 of the action plan. Changes in the work schedule, as well as minor field changes can be made without having to process a formal revision. The process for making these changes is covered by the action plan in Section 12. Administrative Records, which must be maintained to support the Hanford Site RCRA permit modification, are described in Section 9.4 of the action plan.

4.0 FINANCIAL AND PROJECT TRACKING REQUIREMENTS

4.1 MANAGEMENT CONTROL

Westinghouse Hanford will be responsible to plan and control activities and to provide effective technical, cost, and schedule baseline management. The Westinghouse Hanford Management Control System (MCS) will be used for effective planning and control practices. The MCS meets the requirements of DOE Order 4700.1, Project Management System (DOE 1987) and DOE Order 2250.1B, (DOE 1985) Cost and Schedule Control Systems Criteria for Contract Performance Measurement. The primary goals of the Westinghouse Hanford MCS are to provide methods for planning, authorizing, and controlling work so that it can be completed on schedule and within budget and to ensure that all planning and work performance activities are technically sound and in conformance with management and quality requirements.

The work plan schedule and major milestones are described in Section 6.0 of the 100-DR-1 operable unit Work Plan. The work plan schedule will be the primary vehicle for the unit and technical leads to track progress. The Work Plan schedule must be consistent with the work schedule contained in the action plan for implementation of the agreement.

The Work Plan schedule will be updated at least annually, with the primary purpose to expand the new current fiscal year and follow-on year. In addition, any approved schedule changes (see Section 12.0 of the action plan for formal change control system) would be incorporated at this time, if not previously incorporated. This update will be performed in the fourth quarter of the previous fiscal year (e.g., July to September) for the upcoming current fiscal year. The work schedule can be revised at any time during the year if the need arises, but would be restricted to major changes that would not be suitable for the change control process.

4.2 MEETINGS AND PROGRESS REPORTS

Both project and unit managers must meet periodically to discuss progress, review plans and address any issues that have arisen. The project managers meeting will take place at least quarterly and is discussed in Section 8.1 of the action plan. The unit managers meeting will take place at least monthly. Details of the unit managers meetings are given in Section 8.2 of the action plan. Project coordinators for each operable unit will meet on a weekly basis to share information and to discuss progress and problems. The DOE shall prepare and issue a quarterly progress report to EPA and Ecology. The details of this report are given in Section 8.2 of the action plan.

5.0 REFERENCES

DOE, 1985, Cost and Schedule Control Systems Criteria for Contract Performance Measurement, DOE Order 2250.1B, U.S. Department of Energy, Washington, D.C.

DOE, 1987, Project Management System, DOE Order 4700.1, U.S. Department of Energy, Washington, D.C.

WHC, 1989, Environmental Investigations and Site Characterizations Manual, WHC-CM-7-7, Westinghouse Hanford Company, Richland, Washington.

DATA MANAGEMENT PLAN

This page left intentionally blank.

CONTENTS

LIST OF FIGURES

LIST OF TABLES

This page left intentionally blank.

1.0 INTRODUCTION AND OBJECTIVES

An extensive amount of data will be generated over the next several years in connection with the RCRA facility investigation/corrective measures study (RFI/CMS) process that will be conducted to evaluate and remediate hazardous waste sites at the Hanford Site. The quality of the data must be beyond reproach because they will be used to evaluate the need, select the method(s), and support the full remediation of the waste sites as agreed upon by the U.S. Department of Energy (DOE), U.S. Environmental Protection Agency (EPA), Washington State Department of Ecology (Ecology), and interested parties. Thus, a comprehensive plan for the management of this extensive amount of data is absolutely essential.

This plan describes a two-component data management system (DMS) for accessing and tracking the receipt, storage, and control of validated data, records, documents, correspondence, and other associated information. These components include the following:

- A computer-based component
- An administrative component to handle, store, and protect physical records and samples.

An all-inclusive DMS is not presently available for supporting the RFI/CMS work planned at the Hanford Site over the next several years. This Data Management Plan outlines the following:

- Types of data and information that are expected to be collected
- Currently available computer-based and administrative components
- Plans for developing any needed interim administrative components
- Plans for developing a comprehensive computer-based component that integrates selected existing and anticipated computer data bases
- Plans for establishing an information repository for maintaining the official paper-copy (hard-copy) records and physical samples associated with each operable unit.

System procedures will be developed for directing project-authorized personnel as to how data are received, stored, tracked, amended, and disseminated so that a record of control is always maintained. These procedures will be developed to ensure that the integrity of the data is maintained. The procedures will be provided in a detailed data system procedure manual that describes how data can be entered, accessed, processed, and amended so that a record of use and changes or modifications to the data is maintained. Access to the data base by all interested parties will allow access as described in the agreement being developed by DOE, EPA, and Ecology.

The data system procedures manual will include the procedures necessary for handling and tracking the information that must be maintained in the official (hard-copy) administrative record for each operable unit as well as physical paper-copy records and archived physical samples associated with each unit. It will also include procedures for operation and control of the computer-based component of the system. Existing procedures will be either modified or used, or new procedures will be developed to address records management for the following general subject areas:

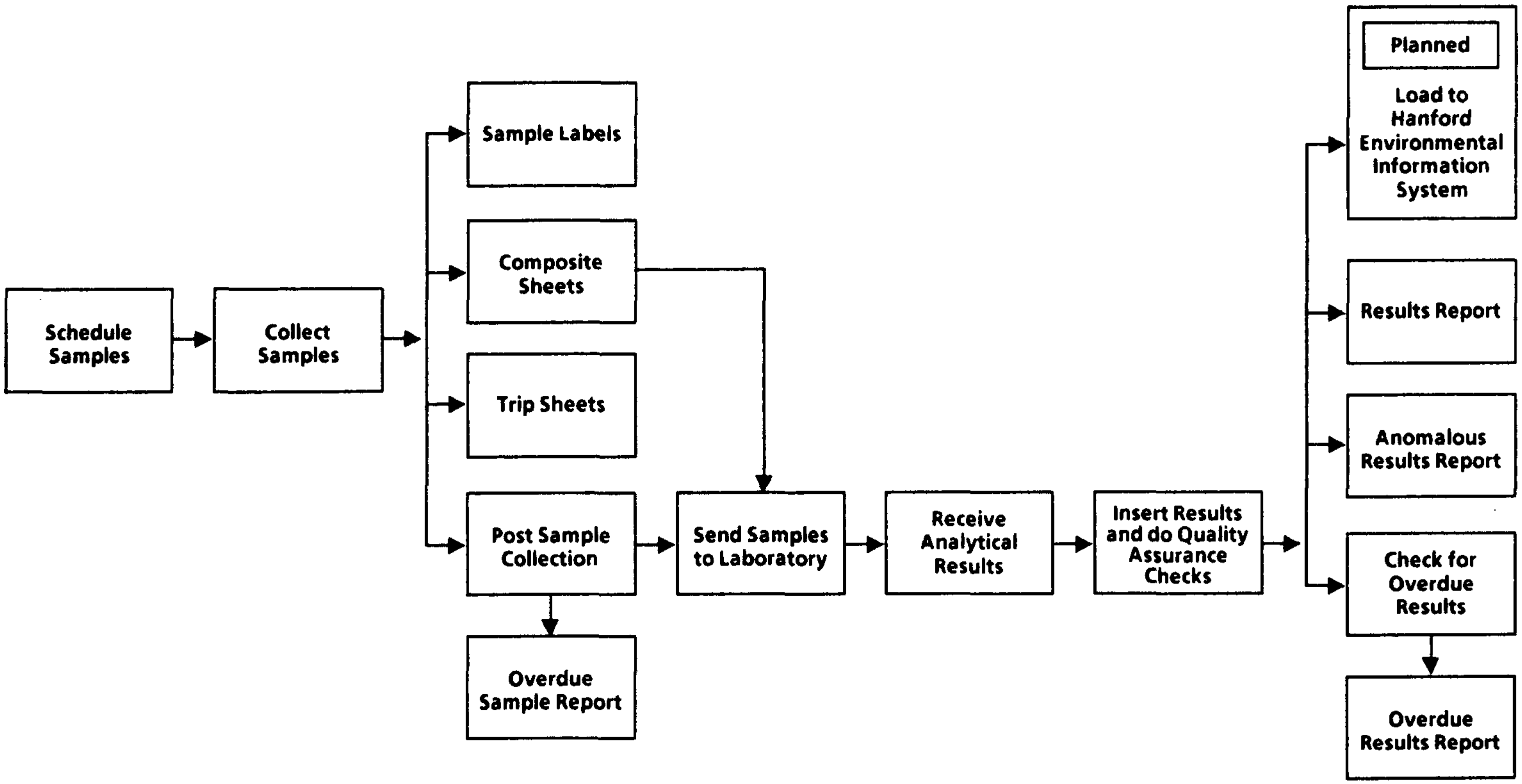
- Congressional inquires and hearings
- Discovery
- Corrective action planning, facility investigation, and corrective measures study
- Corrective measures design and implementation
- EPA and state agency coordination
- Community relations
- Imagery (photographs, maps, illustrations, etc.)
- Enforcement activities
- Contracts
- Financial records.

The Environmental Information Management Plan (WHC 1989) addresses development of the data management system discussed here and includes as a task the development of the data system procedure manual mentioned previously. The plan details requirements, procedures, and responsibilities for managing environmental data.

The computer-based component is the Hanford Environmental Information System (HEIS), currently being developed by Pacific Northwest Laboratory (PNL). HEIS will be used to manage the extensive amount of data that will be collected and generated during the RFI/CMS and corrective action processes. The HEIS is a computer-based information system that is designed to receive, store, and provide for access to quality-assured data concerning Hanford Site environmental and regulatory issues. As shown in Figure 1, HEIS is an integrated data base designed to integrate existing operational data bases and provide facilities for data being gathered as part of the corrective action process. This allows for accessing and evaluating the data that are collected and generated by the individual Hanford Site environmental data base programs [e.g., Hanford Ground Water Data Base (HGWDB), surface monitoring Program Data and Management System (PDMS), Waste Information Data System (WIDS), Hanford Inactive Site Survey (HISS)], while maintaining the integrity of the individual data bases.

The HEIS will provide the following user support capabilities:

- A geographic information system (GIS)
- Integrated graphics support
- Comprehensive user access capabilities
- Access by personal computers via existing networks
- Security of the data bases.



PS90-00055-1

Figure 1. Example Procedure for Collecting, Handling, and Analyzing Samples and for Entry of the Results.

The HEIS computer-based component will serve to list and locate paper records and physical samples. The HEIS will maintain much of the various types of raw-site (operable unit) data, verified program and summary data, and results of approved analytical computer programs. The results of such analyses will be stored separately from the original data files.

The HEIS ability to enter data into raw data files will be restricted to maintain control of validated data. Any changes required to validate data will be procedurally controlled to restrict qualified data from being inadvertently or intentionally altered. All changes will be documented and maintained in the system.

The HEIS official paper-copy records (administrative record as well as other official paper-copy records) and archived physical samples will be maintained in designated areas specified in the data system procedures manual. The designated areas will be designed to meet all applicable protection and security requirements. Backup record copies will be maintained as necessary.

2.0 TYPES OF DATA TO BE COLLECTED AND ANALYZED

Records and types of data to be tracked during the RFI/CMS process at the Hanford Site are shown in Table 1. The "raw data" represents the actual field and laboratory measurements or observations that will be made during the RFI/CMS processes. Standardized IVPAC nomenclature and CAS numbers will be used when reporting chemical data. The "summary data" represents the first-order analyses of the "raw data." "Program tracking" includes information that is programmatic or administrative in nature. It represents the data that are required for the conduct of a project; however, it does not include field or laboratory data.

To the extent possible, validated data gathered during RFI/CMS investigations will be kept separate from other Hanford Site project data. However, many of the ongoing Hanford Site projects will provide data that will undoubtedly be very useful for the Hanford Site RFI/CMS investigations. Data will be stored such that they may be accessed for analyses, the results of which will be stored separately.

A reference collection of applicable EPA, Ecology, DOE, and Hanford Site contractor documents, drawings, and correspondence will be maintained to support site characterization and RCRA facility investigation activities. The applicable or relevant and appropriate requirements (ARARs) drawn from Federal and state requirements and standards will also be kept and updated in a timely manner. Compliance requirements will also be maintained and updated periodically.

Table 1. Types of RCRA Facility Investigation/Corrective Measures Study Information and Data to be Collected.

	Site characterization
Raw data/sample analyses	Groundwater samples Sediment samples Surface water samples Atmospheric samples Personnel exposure monitoring records Geophysical information Biota samples Site descriptive information (topography, geological and ecological features) Pilot/bench test data Engineering design data
Summary data	Analytical results of environmental media by time, location, depth, contaminant, etc. Health risk assessment results Engineering test results Graphic information system outputs
Sampling/analyses/data handling	Sampling schedule Sample collection procedures Field/laboratory notebooks Analyses scheduling Laboratory quality assurance/quality control Calibration tracking Instrument coordination Data entry procedures Data reduction, validation, storage, and transfer procedures
	Program tracking
Project management	Project schedule and milestones Project costs Equipment, personnel, and supplies scheduling Document tracking Subcontracts Project quality assurance/quality control procedures
Personnel	Personnel training and qualifications Occupational exposure reports Personnel health and safety records
Compliance/regulatory	Applicable or relevant and appropriate requirements (ARAR) Screening levels Guidance document tracking Compliance issues Problem resolution

3.0 DATA MANAGEMENT PLAN SCOPE RELATIVE TO OTHER RCRA FACILITY INVESTIGATION/CORRECTIVE MEASURES STUDY WORK PLAN COMPONENTS

The DMS will receive and control validated data obtained through implementation of the 100-DR-1 operable unit Work Plan, the Field Sampling Plan (FSP), and the Health and Safety Plan (HSP). The Quality Assurance Project Plan (QAPP) provides the specific procedural direction and control for obtaining and analyzing samples in conformance with requirements to ensure quality data and results of analyses. The FSP provides the detailed logistical methods for selecting the location, depth, frequency of collection, etc., of media to be sampled and methods for obtaining samples of the selected media for cataloging, shipment, and analyses. The data that result from the analyses will be entered into the DMS for subsequent control and tracking. Similarly, data from field and bench tests of potential remedial techniques will be entered into the DMS. Procedural control for such testing will be found in the QAPP. Specific directions and logistical methods for field and bench testing will be provided prior to Phase II RFI activities. Site and personnel health data needed to ensure worker safety will be specified in the HSP, which will also specify the manner in which these data are to be obtained. Personnel health records will be protected as required by the Privacy Act and secured so that only authorized personnel will have access to these data.

4.0 PROCEDURAL CONTROL

The DMS will be procedurally regulated by the data systems procedure manual to be developed. A specific example relating to surface environmental monitoring is given in Figure 2.

5.0 IDENTIFICATION OF EXISTING DATA BASE SYSTEMS

Several data bases are currently in use at the Hanford Site. These data bases were developed for a variety of different purposes and uses. However, much of the information and data-handling capabilities associated with these data bases is directly useful to RFI/CMS evaluation of the various operable units located on the Hanford Site. A listing of the existing data bases that are available is provided in Table 2.

Westinghouse Hanford maintains an Environmental Resource Center (ERC) that contains copies of environmental and pertinent Federal and Washington State regulations, documents that have been prepared and submitted to Ecology and EPA pertaining to the regulations, and correspondence in support of environmental matters. The ERC contains Resource Conservation and Recovery Act (RCRA) permit applications and closure plans as well as RFI/CMS work plans

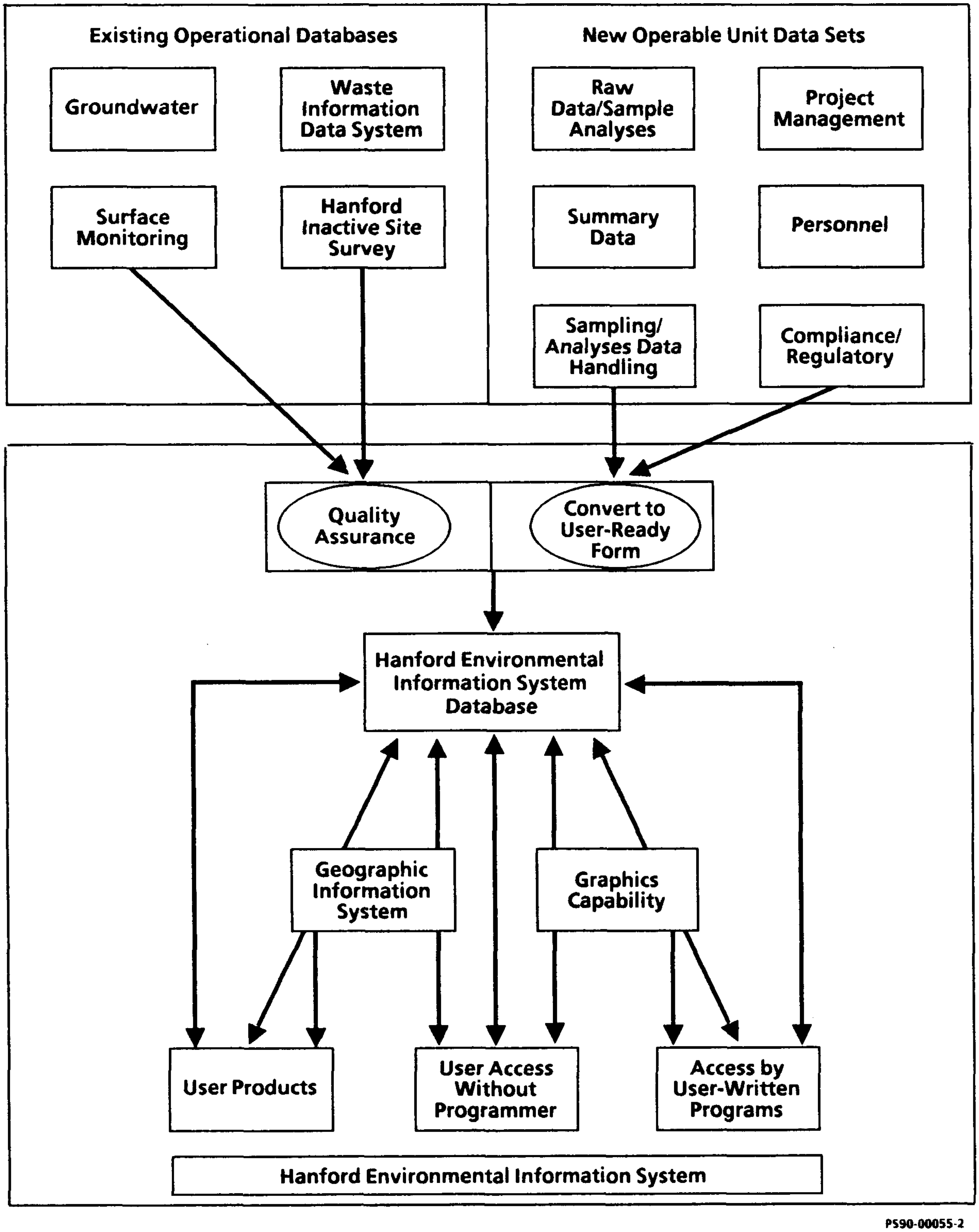


Figure 2. Framework of the Hanford Environmental Information System.

Table 2. Existing Hanford Data Bases. (Sheet 1 of 2)

Data base name	Information type
Hanford Groundwater Data Base (HGWDB)	Contains chemical and radionuclide analytical results for groundwater and sediment samples
Program Data and Management System (PDMS)	Contains chemical and radionuclide analytical results of air, surface water, soil, vegetation, wildlife, and foodstuffs samples
Waste Information Data System (WIDS)	Contains information on the physical and environmental characteristics of waste units at the Hanford Site (radioactive and hazardous chemicals)
Hanford Inactive Site Survey (HISS)	Contains detailed preliminary assessment/site inspection (PA/SI) information on individual waste sites at the Hanford Site
Hanford Environmental Compliance Report (HECR)	Contains information on Hanford Site waste streams for tracking environmental compliance issues
Environmental Compliance Tracking System (ECTS)	Contains regulatory flowsheet information for tracking compliance with Federal, state, and local environmental regulations
Sample Preparation System (SPS)	Generates labels, reports, etc., for sampling preparation and contains information on facilities, location, and time of sampling and chain-of-custody information
BWIP Technical Data System (BTDS)	Contains information on hydrological conditions and some geological data for the Hanford Site; also contains site characterization, hydrological data, hydrochemistry, stratigraphy and constituent data
Warehouse Inventory Management System (WIMS)	Keeps track of all the hazardous material purchased for use on the Hanford Site

Table 2. Existing Hanford Data Bases. (Sheet 2 of 2)

Flow Gemini - Environmental Information System (HEHF's Occupational Hazardous Materials Exposure/Monitoring System)	Contains information associated with onsite monitoring of exposures to hazardous materials for Hanford workers
Flow Gemini - Occupational Health Information System (HEHF's Medical Information Tracking System)	Contains employee medical information
Material Safety Data Sheet (MSDS) System	Contains information on chemicals found at Hanford. Currently this is a manual system operated by HEHF, but it is in the process of being computerized. This effort is being coordinated with the SARA Title III Right-To-Know Program at the Hanford Site
Occupational Radiation Exposure (ORE)	Contains personnel respiratory protection fitting, work restriction, and radiation exposure information
Quality Control Blind Standards Data Base	Contains the results on spiked samples, replicate samples, and interlaboratory comparisons
Training Records Information System (TRIS)	Contains records on individual employee training records
Commitment Control System (CCS)	Tracks correspondence commitments. A network version is available.

also be added. A computer-based indexing system is presently being developed and will allow rapid identification of appropriate documents, copies of which can be obtained from the ERC files. The ERC will contain copies of all correspondence with Ecology and EPA. This will include primary as well as secondary documents.

6.0 EVALUATION OF EXISTING DATA-BASE SYSTEMS

In general, the existing data bases in use on the Hanford Site were designed for specific purposes. They are not integrated to cover anticipated RFI/CMS needs. These existing data bases will provide supplementary, historical data to support the RFI/CMS process. The scope of each data base identified in Table 2 is discussed separately in the following paragraphs.

The Hanford Groundwater Data base (HGWDB) is used to generate the annual "Groundwater Monitoring at Hanford" report. It also contains the Hanford Site's RCRA compliance-monitoring program's groundwater monitoring data. In addition, it has been modified to handle vadose zone (sediment) sample data.

The Program Data and Management System (PDMS) is generally used by the Hanford Site to generate the annual "Surface Environmental Monitoring at Hanford" report. It is an overall data base for tracking routine and special air, surface water, soil, vegetation, wildlife, and foodstuff samples from the Hanford Site.

The Waste Information Data System (WIDS) and the Hanford Inactive Site Survey (HISS) data bases were set up specifically to handle hazardous waste site information. The WIDS contains data on the general physical and environmental characteristics associated with the waste units located on the Hanford Site. The HISS contains preliminary assessment/site inspection (PA/SI) information on inactive sites at the Hanford Site including fairly detailed information on location, date for receiving waste, types and quantities of waste, cleanup actions, and other similar types of information. In addition, the HISS is supported by the PNL Hazard Ranking System (HRS) and Modified Hazard Ranking System (MHRS) Evaluation data base, which contains the detailed HRS and MHRS scoring information, with input parameter justifications, for individual waste sites at the Hanford Site. The WIDS system serves as the official Hanford Site waste units' identification and tracking system.

The Hanford Environmental Compliance Report (HECR) and Environmental Compliance Tracking System (ECTS) are two systems currently used at the Hanford Site to track compliance. The HECR was developed to provide a uniform method for Hanford Site contractors to use in collecting and maintaining regulatory compliance status information on Hanford Site facilities. Data input into HECR centers primarily around compliance with various state and Federal legislation that may apply to a particular discharge point at the facility. The discharge point is the primary level for which compliance data are entered. However, the term "discharge point" can be defined with a great deal of flexibility allowing the system to track individual waste sites or operable units with no difficulty. The HECR provides for entry of additional compliance status information for those points needing follow-up action. This is done to allow tracking of compliance actions on a specific point. The ECTS contains regulatory flowsheet information. It is designed to be used in the evaluation of waste streams for compliance with Federal, state, and local environmental regulations. Waste streams are the primary focus of the ECTS; however, waste streams can be defined with some flexibility to allow the system to be used to track individual waste sites or operable units. The HECR and ECTS can be used in the comprehensive DMS to track compliance status of operable units (or individual sites if conditions warrant).

The Sample Preparation System (SPS) was set up to generate labels for sample bottles and to track sample status at the analytical laboratories. It can generate reports on samples collected, samples currently at an analytical laboratory, and samples with results overdue from the laboratory.

The BWIP Technical Data System (BTDS) was being prepared for the Basalt Waste Isolation Project (BWIP) to contain information on hydrological conditions and some geological data at the Hanford Site. The system was intended to handle data obtained from wells in hydrologic units in the basalt strata giving Lambert coordinates, water pressure, and other similar well information. It was also designed to handle site characterization, hydrological, hydrochemistry, stratigraphy, and constituent data. There is some overlap between the capabilities of the HGWDB and the BTDS. The BTDS is not intended for shallow wells in the unconfined aquifer.

The Warehouse Inventory Management System (WIMS) is a data base established to track, from receipt of material to its shipment to the customer, all stock items and to forward costing data to the Financial Data System. For the purpose of safe storage and transportation, hazardous materials are identified within WIMS. The system will be used in conjunction with the MSDS system and the SARA Title III program.

The Flow Gemini-Environmental Information System, managed by the Hanford Environmental Health Foundation (HEHF), is commonly referred to as the HEX system. It is set up to contain information associated with onsite monitoring of exposures of Hanford workers to hazardous materials. This system is in the process of being modified, so there is considerable flexibility to adjust it to accommodate the onsite monitoring needs of the Westinghouse Hanford Environmental Restoration Program (ERP).

The Flow Gemini-Occupational Health Information System (HEHF's Medical Information Tracking System) contains confidential employee medical evaluation and history information. The HEHF medical surveillance program will need to be given directions from the HSP for each operable unit as to the specific elements that will need to be tracked for the specific individuals involved with its characterization. Once this is done, the HEHF Medical Information Tracking System will contain all of this information.

The Material Safety Data Sheet (MSDS) system contains information on chemicals found at the Hanford Site. Currently, this is a manual system operated by HEHF; however, it is in the process of being computerized. The computerization effort is being done in coordination with the SARA Title III mandated "right-to-know" program at the Hanford Site.

The Occupational Radiation Exposure (ORE) data base system contains personnel respiratory protection fitting and qualifications, work restrictions, and radiation exposure information for all Hanford Site employees. Access to individual employee's records must be tightly controlled to comply with the Privacy Act.

The Quality Control Blind Standards Data Base (QCBSDB) contains information associated with quality control spiked samples, replicate sampling, and interlaboratory comparison results for the Hanford Site RCRA program. The QCBSDB is currently a manually tracked system, but is in the process of being computerized. It can quite readily be expanded to handle these types of data for the ERP as well.

The Training Records Information System (TRIS) contains training records for Westinghouse Hanford employees. The current manual system for handling training records of contractors to Westinghouse Hanford is in the process of being upgraded to an electronic system. The TRIS can be adjusted to include all contractor personnel working on a particular operable unit.

The Financial Tracking System (FTS) contains financial records for tracking and reporting on status of projects at Westinghouse Hanford. It is the system Westinghouse Hanford uses to track the financial aspects of all their projects. It has the capability of tracking projects by cost accounts and can provide status reports on request.

Chapter 3 of the October 1988 Interim Final Draft of EPA's Office of Solid Waste and Emergency Response Directive 9355.3-01 "Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA" addresses data management procedures (EPA 1988). The contents of Table 3 of Section 4.1.4 of the Work Plan, which provides an outline of the file structure necessary for a superfund site, were used as a basis for a list of elements necessary for a data management system. Table 3 shows a listing of these elements and a brief discussion of how the various components of the DMS will address them.

The previous discussions have addressed the existing systems that can be used to provide a historical basis for the RFI/CMS work. However, there are several data-management needs identified in Table 1 for which there is no currently operating or historical data base. These include the following:

- Geophysical (site-by-site basis)
- Soil column analytical data (site-by-site basis)
- Pilot- and bench-scale testing

Table 3. Analysis of Data Needs Based on Environmental Protection Agency's Draft Guidance Directive and Current Historical Hanford Site Data Bases. (Sheet 1 of 3)

File structure/data needs	Applicable data bases
Congressional inquiries and hearings: Correspondence Transcripts Testimony Published hearing records	None available. These will have to be addressed by written procedures
Discovery: Initial investigation Preliminary assessment Site inspection report Hazard ranking system data	Waste Information Data System and Hanford Inactive Site Survey. The Hanford Inactive Site Survey contains hard copy files of the information used for performing the Hazard Ranking System/Modified Hazard Ranking System evaluations of Hanford waste sites.
Corrective action planning: Correspondence Work plans for RCRA facility investigation/corrective measures study RCRA facility investigation/ corrective measures study reports Health and safety plans Quality assurance/ quality control plans RCRA permit modification/ responsiveness summary	The Commitment Control System is presently available to track correspondence. Health and Safety plans and Quality Assurance/ Quality Control plans will be included in each Work Plan that will be developed for each operable unit. The information pertinent to the development of the RFI/CMS reports will be tracked by HEIS using subordinate data bases such as the Hanford Groundwater Data Bases, Program Data Management System, Waste Information Data System, Hanford Inactive Site Survey, Sample Preparation System, BWIP Technical Data System, Warehouse Inventory Management System, Flow Gemini-Environmental Information System, and Quality Control Blind Standards Data Base
Corrective measures implementation: Correctrive measures design reports permits Contractor work plans and progress reports Corps of Engineers agreements, reports, and correspondence	All of these items will be tracked by the design reportsData Management System

Table 3. Analysis of Data Needs Based on Environmental Protection Agency's Draft Guidance Directive and Current Historical Hanford Site Data Bases. (Sheet 2 of 3)

State and other agency coordination: Correspondence Cooperative agreement/ Superfund State contract Interagency agreements Memorandum of Understanding with the State	Parts of these may be tracked by the Hanford Environmental Compliance Report. A record-file system is also currently being developed at the Hanford Site to track many of these items. These will be managed within the Data Management System.
Community relations: Interviews Correspondence Community relations plan List of people to contract, (e.g., local officials, civic leaders, environmental groups) Meeting summaries Press releases News clippings Fact sheets Comments and responses Transcripts Summary of proposed plan Responsiveness summary	There is no known existing system at the Hanford Site available to electronically track community relations information. This information can be handled manually in accordance with the community relations plan or tracking can be added to the Data Management System if desired.
Imagery: Photographs Illustrations Other graphics	The Hanford Inactive Site Survey and associated files contain photographs and maps of sites. Also, the HEIS will have Graphic Information System capabilities.
Enforcement: Status reports Cross-reference to any confidential enforcement files and the person to contact Correspondence Administrative orders	The Hanford Environmental Compliance Report and Environmental Compliance Tracking System will be used to contain the compliance status information by operable unit. Any administrative orders that are formally produced can also be tracked in the Data Management System designed to track formal documents.

Table 3. Analysis of Data Needs Based on in Environmental Protection Agency's Draft Guidance Directive and Current Historical Hanford Site Data Bases. (Sheet 3 of 3)

Contracts: Site-specific contracts Procurement packages Contract status notifications List of contractors	Other than existing project management software systems currently available at the Hanford Site, there is no known electronic system presently available to track contract information such as this. This information can be handled manually by procedures or the Data Management System can track it.
Financial transactions: Cross-reference to other financial files and the person to contact Contractor cost reports Audit reports	The financial operations for the clean up of a Federal facility is different from the normal Environmental Protection Agency-funded Superfund process. The financial information that needs to be tracked for compliance purposes can be tracked manually or by the Data Management System.

- ARAR screening
- Cost tracking
- Calibration tracking
- Instrument coordination
- Quality Assurance/Quality Control (QA/QC) tracking
- Field and laboratory notebook tracking
- Document tracking (both site-specific documents and guidance documents)
- Treatment/alternative screening
- Summarized/analyzed data (involves most of the raw data types).

The Environmental Information Management Plan addressed these needs. Initial development of HEIS will focus on these needs in the order listed.

7.0 REFERENCES

EPA, 1988, Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA, Interim Final, EPA/540/6-89/004, OWSER Directive 9355.03-01, Washington, D.C.

WHC, 1989, Environmental Information Management Plan, WHC-EP-0219, Westinghouse Hanford Company, Richland, Washington.

COMMUNITY RELATIONS PLAN

This page left intentionally blank.

1.0 COMMUNITY RELATIONS PLAN

A Community Relations Plan (CRP) has been developed for the Hanford Site Environmental Restoration Program (ERP). Because community relations activities are so interrelated among operable units, a decision was made to develop a single CRP that will address specific individual concerns associated with each operable unit, but will still provide continuity and general coordination of all ERP activities with regard to community involvement. The site-wide CRP discusses Hanford Site background information, history of community involvement at Hanford, and community concerns regarding the Hanford Site. It also delineates the community relations program that the U.S. Department of Energy-Richland Operations office, the U.S. Environmental Protection Agency-Region X office, and the Washington Department of Ecology will cooperatively implement throughout the cleanup of all operable units at the Hanford Site. All community relations activities associated with the 100-DR-1 operable unit Work Plan will be conducted under this overall Hanford Site CRP.

This page left intentionally blank.