START

0029403

DOE/RL-93-20
Rev. 0

UC-630

RCRA Facility Investigation/Corrective Measures Study Work Plan for the 100-HR-2 Operable Unit, Hanford Site, Richland, Washington

Date Published
June 1993

9312575.0002

(Subject to Regulatory Approval)

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

Approved for Public Release

EXECUTIVE SUMMARY

I. INTRODUCTION

This work plan establishes the operable unit setting and the objectives, approach, tasks, and schedule for conducting the Resource Conservation and Recovery Act (RCRA) Facility Investigation/Corrective Measures Study (RFI/CMS) for the 100-HR-2 operable unit in the 100 Area of the Hanford Site. The 100 area is one of four areas at the Hanford Site that are on the U.S. Environmental Protection Agency's (EPA) National Priorities List under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA).

All work conducted under this work plan will conform to the conditions set forth in the *Hanford Federal Agreement and Consent Order* (Ecology et al. 1990a), and its amendments, signed by the Washington Department of Ecology (Ecology), the EPA, and the U.S. Department of Energy (DOE).

The approach described in this work plan is based on the *Hanford Site Past-Practice Strategy* (DOE-RL 1991a). This strategy streamlines the past-practice remedial action process with a bias for action through optimizing the use of interim actions. This approach culminates with decisions of final remedies on both an operable unit and 100 Area scale. The strategy focuses on reaching early decisions (Interim Remedial Measures [IRM]) to initiate and complete cleanup projects, maximizing the use of existing data (historical and analogous facilities), coupled with focused short time-frame Limited Field Investigations (LFI) where necessary.

The RFI/CMS process for the 100-HR-2 operable unit follows the path detailed in Figure ES-1. The work scope described in the work plan is a result of the scoping process which involved Ecology, EPA, and DOE identified in Figure ES-1. The pathway selected during the scoping process for the solid waste burial grounds in the 100-HR-2 operable unit is the IRM pathway (Figure ES-2). Other sites (low priority sites) will be deferred and will follow the final remedy selection process pathway.

II. OVERVIEW

The investigative approach to waste sites associated with the 100-HR-2 operable unit are listed in Table ES-1. The waste sites in this operable unit fall into three general categories: solid waste burial grounds, low-priority sites, and other sites (sites which have undergone decontamination and decommissioning). None of the sites were identified as priority sites, which for other 100 Area operable units consisted primarily of liquid waste disposal sites.

As a result of the scoping studies and the work done in preparing the work plan, the historical information and the information from other waste sites and similar facilities was determined to be sufficient to formulate conceptual models and perform a Qualitative Risk

Assessment (QRA) following the IRM pathway (Figure ES-2). The emphasis in this work plan (shaded area on Figure ES-2) is on describing those data that will be obtained at solid waste burial ground to refine the conceptual model, conduct the QRA, evaluate the Corrective Action Requirements (CAR), conduct a focused feasibility study (FS), and prepare an IRM plan. Work performed during the scoping phase and in developing this work plan indicates that no intrusive field activities are required during the conduct of the LFI for the 100-HR-2 operable unit. The work on low priority sites will be deferred until the final remedy selection process.

An LFI report for the 100-HR-2 operable unit will be prepared which will include the results of the historical investigations, investigations of similar or analogous sites (when available), process knowledge, field screening, and the scoping phase geophysical surveys; identify the nature and extent of contamination at the solid waste burial grounds; identify the contaminant- and location-specific applicable or relevant and appropriate requirements (ARAR); and provide a summary of the QRA performed for the burial ground sites. The report will include a recommendation of whether each burial ground site should be retained as an IRM candidate site. The LFI report will provide support for the focused FS, which will address final remediation options for the waste sites.

The FS process for the 100 Area will be conducted on both an aggregate area and operable unit basis. This process includes preparation of a 100 Area FS, a focused FS, and implementation of remedial actions for the operable unit.

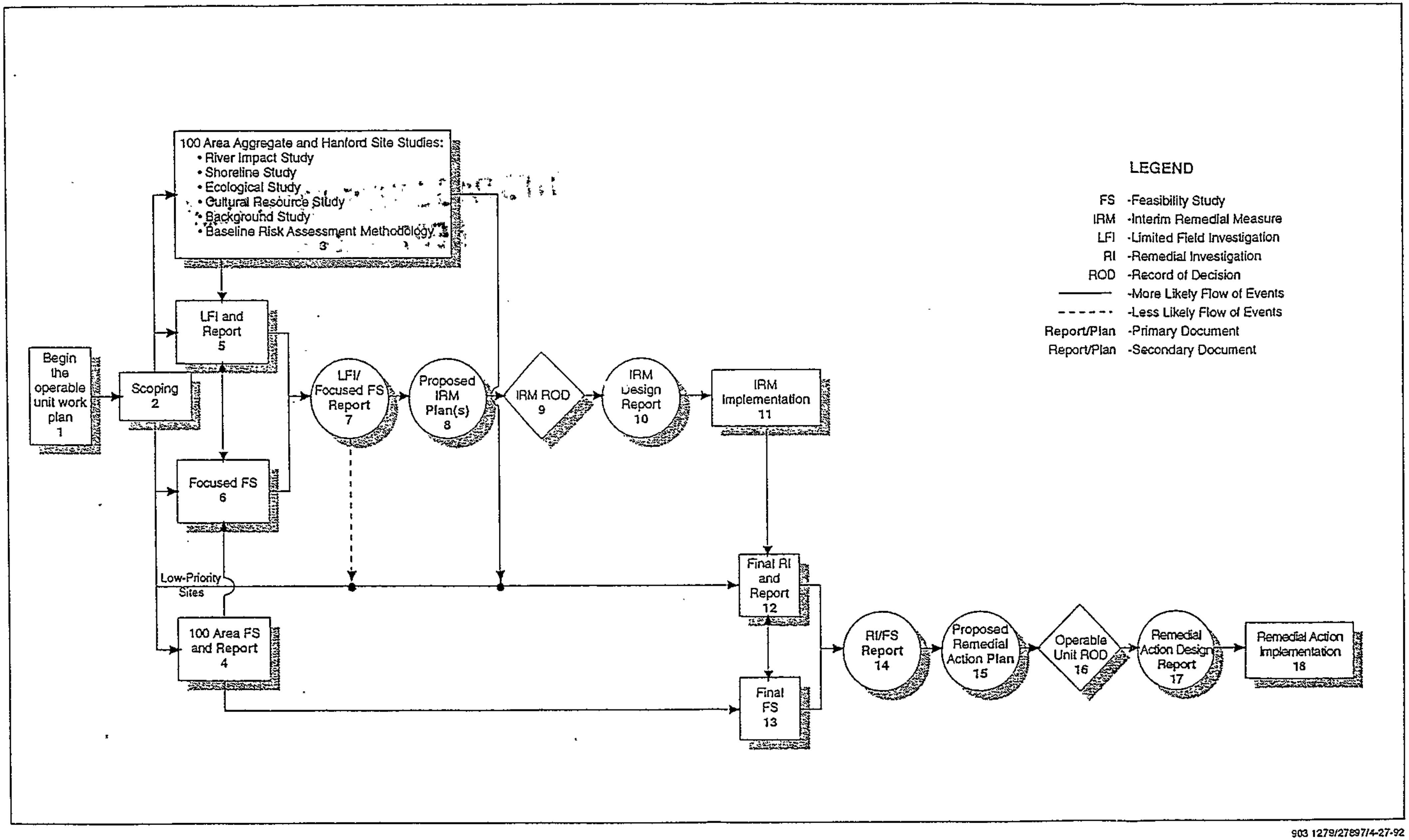
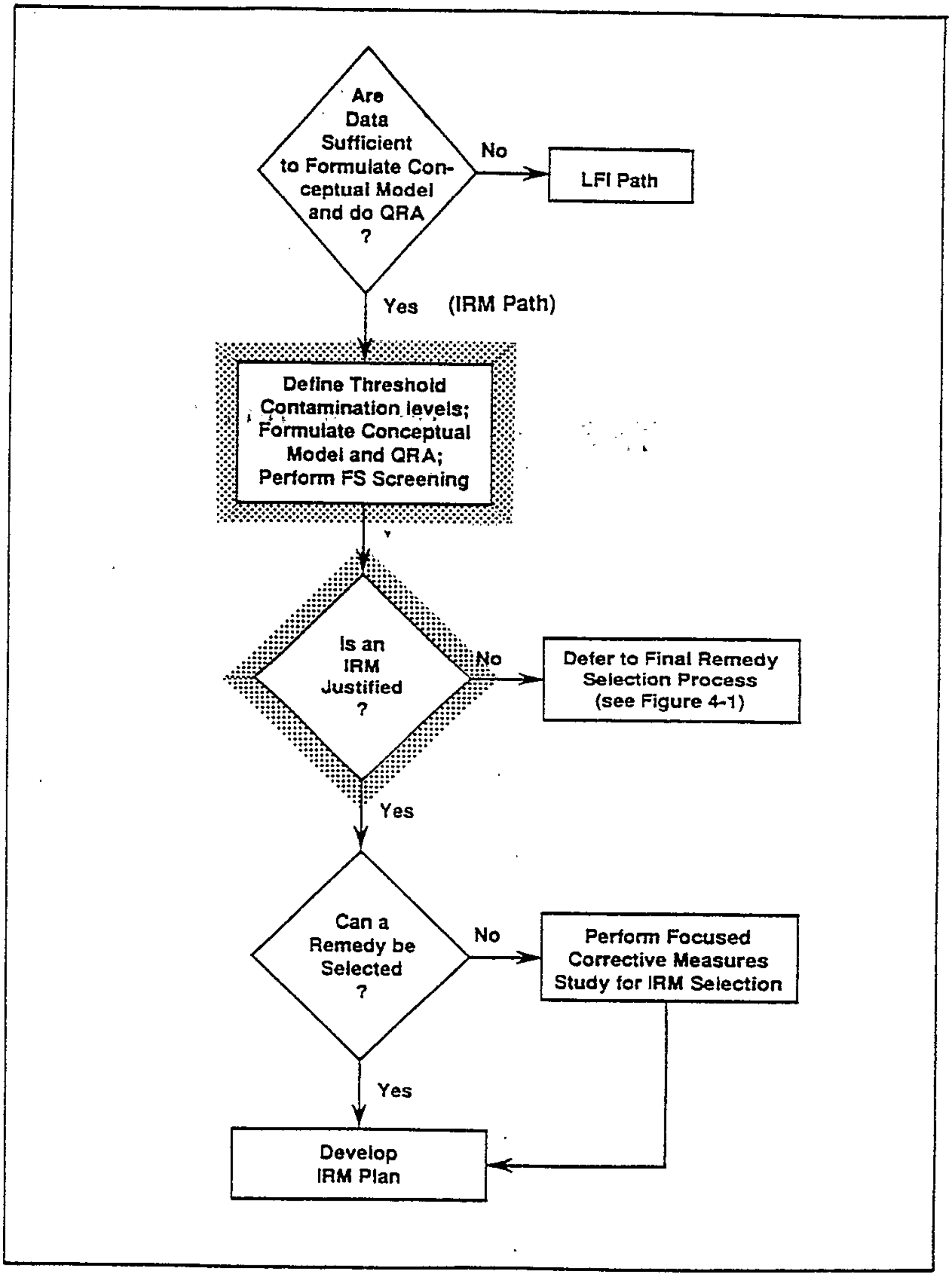


Figure ES-1. RFI/CMS Process for the 100-HR-2 Operable Unit.

THIS PAGE INTENTIONALLY
LEFT BLANK

Figure ES-2. Interim Remedial Measures Selection Process.



NAH\M022593-A

THIS PAGE INTENTIONALLY
LEFT BLANK

Table ES-1. 100-HR-2 Investigation. (1 of 2)

Current Designation (aliases)	Facility Type	Wastes Received or Handled	Strategy	Proposed Boreholes
118-H-1 (100-H Burial Ground #1, 100-H-1)	Burial Ground 700 x 350 ft 20 ft deep	The site received an estimated 10,000 cubic meters of waste consisting of: activated components - dummy elements, process tubing and horiz. control rods; misc. surface contaminated materials - broken hand tools, rags, sweeping compound, light bulbs, sheets of plastic and paper from zones, etc. Misc. wastes were sealed in boxes and placed in different trenches than the activated wastes.	IRM Pathway	0
118-H-2 (100-H Burial Ground #2, H-1 Loop Burial Ground)	Burial Ground 140 x 50 ft 15 ft deep	The site received an estimated 2 cubic meters of waste. The east vault received one stainless steel double-tube with associated hardware (cleaning solutions and misc. capsule components). The west vault was used for disposal of contaminated pipe.	IRM Pathway	0
118-H-3 (Construction Burial Ground)	Burial Ground 100 x 375 x 313 x 400 20 ft deep	The site received an estimated 3,000 cubic meters of waste consisting of sections of contaminated 16-inch pipe used as chutes for removal of thimbles from 105-H, reactor hardware, and components from reactor modification programs.	IRM Pathway	0
118-H-4 (Ball 3X Burial Ground)	Burial Ground 150 x 30 ft 20 ft deep	The site received an estimated 20 cubic meters of irradiated materials, such as vertical safety rod thimbles and guides, from 105-H during the Ball 3X Program.	IRM Pathway	0
118-H-5 (105-H Thimble Pit)	Burial Ground 30 x 2 ft 10 ft deep	The site received an estimated 30 cubic meters of waste. A thimble assembly from the B Experimental Hole from the 105-H X-Level. In 1960 the 105-H Pluto Crib was excavated and placed in this burial ground.	IRM Pathway	0
105-H Rod Cave	Burial Ground 40 x 25 ft	The site is suspected to contain contaminated horizontal control rods and possibly other miscellaneous reactor facility components.	IRM Pathway	0
Buried Thimble	Burial Ground 40 ft long	The site is suspected to contain a verticle safety rod thimble.	IRM Pathway	0
126-H-1 (184-H Powerhouse Ash Pit, 188-H Ash Disposal Area)	Ash Pit	Unknown amounts of coal ash were sluiced to this pit with raw river water. The ash has been analyzed using the EP Toxicity Test in accordance with WAC 173-303, no hazardous materials were found.	defer to final remedy selection process	0
128-H-1 (100-H Burning Pit No. 1)	Burning Pit 100 x 100 ft 10 ft deep	An estimated waste volume is 10,000 cubic meters of wastes. Nonradioactive, combustible materials, such as paint wastes, office wastes and chemical solvents.	defer to final remedy selection process	0

Table ES-1. 100-HR-2 Investigation. (2 of 2)

Current Designation (aliases)	Facility Type	Wastes Received or Handled	Strategy	Proposed Boreholes
128-H-2 (100-H Burning Pit No. 2)	Burning Pit 120 x 80 ft	Unknown amounts of nonradioactive, combustible materials such as vegetation, paint waste, office waste and chemical solvents.	defer to final remedy selection process	0
128-H-3	Burning Pit	Suspected wastes are combustible materials, amounts are unknown.	defer to final remedy selection process	0
1607-H1	Sanitary Septic System tank: 15 x 6 ft field: 56 x 50 ft	An unknown amount of sanitary sewage.	defer to final remedy selection process	0
1607-H3	Sanitary Septic System tank: 19 x 7 ft field: 100 x 50 ft	An unknown amount of sanitary sewage.	defer to final remedy selection process	0
151-H	Electrical Substation	Potential PCB contamination in soils where oil-filled equipment was located.	defer to final remedy selection process	0

ACRONYMS

ALARA	as low as reasonably achievable
ARAR	applicable or relevant and appropriate requirement
CAR	Corrective Action Requirement
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
CFR	Code of Federal Regulations
CLP	contract laboratory program
CMS	corrective measures study
CRP	Community Relations Plan
DOE	U.S. Department of Energy
RL	U.S. Department of Energy, Richland Field Office
DOW	Description of Work
DQO	data quality objective
Ecology	Washington State Department of Ecology
EII	environmental investigations instructions
EIS	environmental impact statement
EPA	U.S. Environmental Protection Agency
ERA	Expedited Response Action
FS	feasibility study
HRS	Hazard Ranking System
HSBRAM	Hanford Site Baseline Risk Assessment Methodology
HSP	Health and Safety Plan
HSWA	Hazardous and Solid Waste Amendments (of 1984)
IMO	Information Management Overview
IRM	interim remedial measure
LFI	limited field investigation
msl	mean sea level
MTCACR	Model Toxics Control Act Cleanup Regulations
NPL	National Priorities List
OSHA	Occupational Safety and Health Administration
PARCC	precision, accuracy, representativeness, completeness, and comparability
PCB	polychlorinated biphenyl
PMP	probable maximum precipitation
PNL	Pacific Northwest Laboratory
QA	quality assurance
QAPjP	Quality Assurance Project Plan
QC	quality control
QRA	Qualitative Risk Assessment
RCRA	Resource Conservation and Recovery Act of 1976
RCW	Revised Code of Washington (State)
RFI	RCRA facility investigation
RI	remedial investigation
ROD	record of decision
TAL	target analyte list

ACRONYMS (cont)

TCL	target compound list
TSCA	Toxic Substances Control Act
TSD	treatment, storage, and disposal
USC	United States Code
USGS	United States Geological Survey
WAC	Washington Administrative Code
WHC	Westinghouse Hanford Company
WIDS	waste information data system

CONTENTS

CONTENTS (cont)

CONTENTS (cont)

FIGURES (cont):

TABLES:

THIS PAGE INTENTIONALLY
LEFT BLANK

1.0 INTRODUCTION

This work plan establishes the operable unit setting and the objectives, approach, tasks, and schedule for conducting the RCRA Facility Investigation/Corrective Measure Study (RFI/CMS) for the 100-HR-2 operable unit in the 100 Area of the Hanford Site. The 100 Area is one of four areas at the Hanford Site (Figure 1-1) that are on the U.S. Environmental Protection Agency's (EPA) National Priorities List under CERCLA.

All work conducted under this work plan will conform to the conditions set forth in the *Hanford Federal Agreement and Consent Order* (Ecology et al. 1990a), and its amendments, signed by the Washington Department of Ecology (Ecology), the EPA, and the U.S. Department of Energy (DOE).

The Tri-Party Agreement requires that the cleanup programs at the Hanford Site integrate the requirements of CERCLA, RCRA, and Washington State's dangerous waste (the state's RCRA-equivalent) program. A comparison of CERCLA and RCRA terminology used in this work plan is provided in Table 1-1. Pursuant to the Tri-Party Agreement, the 100-HR-2 source operable unit is subject to RCRA corrective action authority.

1.1 PROJECT GOALS

The approach described in this work plan is based on the *Hanford Site Past-Practice Strategy* (DOE-RL 1991a). This strategy streamlines the past-practice remedial action process with a bias for action through optimizing the use of interim actions. The goal of the 100-HR-2 operable unit RFI/CMS is to provide sufficient information to optimize the use of IRM to expedite cleanup, while still maintaining a technically sound and cost-effective program of investigations that culminates with decisions of final remedies on both an operable unit and 100 Area scale. The strategy focuses on reaching early decisions (IRM pathway) to initiate and complete cleanup projects, maximizing the use of existing data (historical and analogous facilities), coupled with focused short time-frame Limited Field Investigations (LFI) where necessary. Figure 1-2 displays the organization of the past practice strategy.

Source operable units are units which contain facilities and unplanned release sites that are potential sources of hazardous substance contamination. The 100-HR-2 operable units is one of two source operable units in the 100-H Area: the 100-HR-1 source operable unit which is concerned with reactor liquid effluent sites and the 100-HR-2 source operable unit which is concerned with solid and buried waste sites. These two operable units are underlain by the 100-HR-3 operable unit which is the groundwater operable unit beneath the 100-H and 100-D/DR Areas (Figure 1-3).

The 100-HR-2 operable unit is a solid and buried waste operable unit. It consists predominantly of solid waste burial grounds and also contains septic systems, burn pits and ash pits, and several demolished facilities. It is located near the Columbia River in the northeast portion of the Hanford Site designated as the 100 H Area. The 100-HR-3 operable unit includes all contamination found in the aquifer soils and water within its boundary.

Separate work plans have been initiated for the 100-HR-3 groundwater operable unit (DOE-RL 1992a) and the 100-DR-1 (DOE-RL 1992b) and 100-HR-1 (DOE-RL 1992c) source operable units. LFI have been conducted at these operable units. An Expedited Response Action (ERA) has been initiated at the 100-IU-4 isolated waste site operable unit.

The work scope described in the work plan is a result of the scoping process which involved Ecology, EPA, and DOE. The pathway selected during the scoping process for the solid waste burial grounds in the 100-HR-2 operable unit is the Interim Remedial Measures (IRM) pathway. Thus, the RFI/CMS process for the 100-HR-2 operable unit burial grounds follows the IRM path shown in Figure 1-2. Other low-priority sites will be deferred and will follow the final remedy selection path.

The investigative approach to waste sites associated with the 100-HR-2 operable unit are listed in Table ES-1. The waste sites in the 100-HR-2 operable unit fall into three general categories; solid waste burial grounds, low-priority sites, and other sites (sites which have undergone decontamination and decommissioning). None of the sites were identified as high priority sites, which for other 100 Area operable units consisted primarily of liquid waste disposal sites. The waste sites in the 100-HR-2 operable unit consisted primarily of liquid waste disposal sites. The waste sites in the 100-HR-2 operable unit received very low scores from the Hazardous Ranking system (HRS) evaluation of the Hanford Site (Stenner et al. 1988). Scores in the 100-HR-2 operable unit ranged from 0.08 to 1.17. By comparison, high priority liquid waste disposal sites in the 100 Area scored in the range of 40 to 50. Sites with scores above 28.8 are to be listed on the National Priorities List.

As a result of the scoping meetings with Ecology, EPA, and DOE, and the work done in preparing the work plan, the historical information and the information from similar facilities was determined to be sufficient to formulate conceptual models and perform a Qualitative Risk Assessment (QRA) following the IRM pathway detailed in Figure ES-2. The emphasis in this work plan (shaded area on Figure ES-2) is on describing those data that will be obtained at solid waste burial grounds to refine the conceptual, conduct the QRA, evaluate the Corrective Action Requirements (CAR), conduct a focused Feasibility Study (FS), and prepare an IRM plan. Work performed during the scoping phase and in developing this work plan indicates that no intrusive field activities are required during the conduct of the LFI for the 100-HR-2 operable unit. The work on low priority sites will be deferred until the final remedy selection process.

An LFI report for the 100-HR-2 operable unit will be prepared which will include the results of the historical investigations, analogous site investigations, process knowledge, field screening, and the scoping phase geophysical surveys; identify the nature and extent of contamination at the solid waste burial grounds; identify the contaminant- and location-specific applicable or relevant and appropriate requirements (ARAR); and provide a summary of the QRA performed for the burial ground sites. The report will include a recommendation of whether each burial ground site should be retained as an IRM candidate site. The LFI report will provide support for the focused FS, which will address final remediation options for the waste sites.

The FS process for the 100 Area will be conducted on both an aggregate area and operable unit basis. This process includes preparation of a 100 Area FS, a focused FS, and implementation of remedial actions for the operable unit.

In accordance with the Tri-Party Agreement, relevant EPA guidance documents were consulted in the preparation of the work plan, including the following:

- *Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA* (EPA 1988a)
- *Data Quality Objectives for Remedial Response Activities* (CDM Federal Programs Corporation 1987)
- *Superfund Exposure Assessment Manual* (EPA 1988b)
- *Hanford Site Past-Practice Strategy* (DOE-RL 1991a)
- *Hanford Site Baseline Risk Assessment Methodology* (DOE-RL 1993).

1.2 ORGANIZATION OF THE WORK PLAN

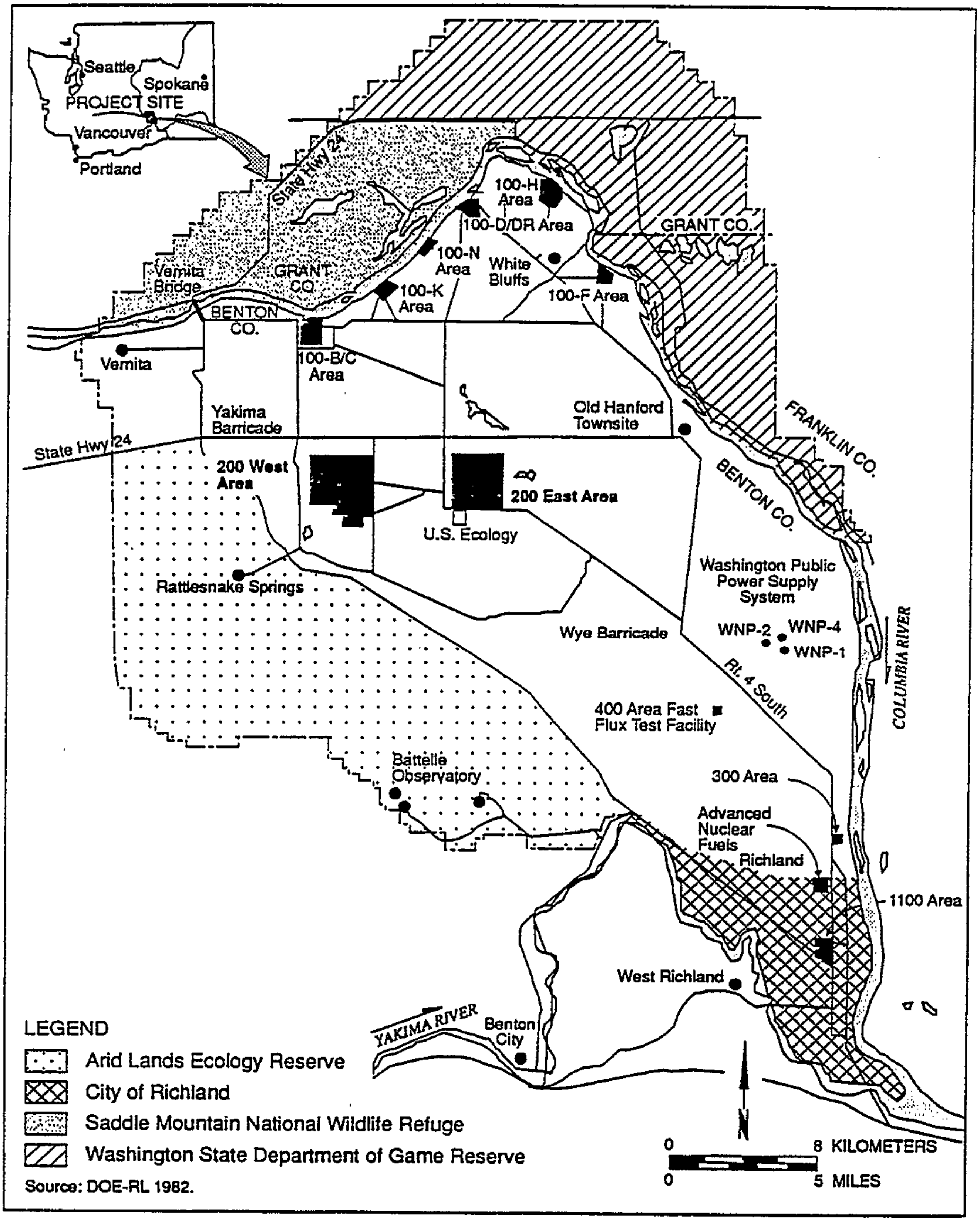
This work plan is organized in the same manner as the 100-HR-1 operable unit work plan, but is utilizing the philosophy of incorporation by reference. The scope of the work plan remains the same, but information that is not specific to the 100-HR-2 operable unit will be referenced to either the 100-HR-1 (DOE-RL 1992c) or 100 HR-3 (DOE-RL 1992a) operable unit work plans.

Generalities regarding processes, strategies and background information will be referred to the *RCRA Facility Investigation/Corrective Measures Study Work Plan for the 100-HR-1 Operable unit, Hanford Site, Richland, Washington* (DOE-RL 1992c) and the *RCRA Facility Investigation/Corrective Measures Study Work Plan for the 100-HR-3 Operable Unit, Hanford Site, Richland, Washington* (DOE-RL 1992a).

1.3 QUALITY ASSURANCE

A quality assurance project plan (QAPjP) applies specifically to the field activities and laboratory analyses performed as part of a Limited Field Investigation (LFI). Inasmuch as no field and laboratory analyses are to be performed as part of the 100-HR-2 LFI, a QAPjP is not required. For purposes of this work plan, the QAPjP in the 100-BC-2 Work Plan can be consulted for relevant information. The 100-BC-2 QAPjP has incorporated the aspects of analyzing to a reduced analyte list in conjunction with SW-846 methods, as has been presented in this work plan. The 100-BC-2 QAPjP will be used as a guide should future circumstances require such field activities. Changes (including the addition of a QAPjP) shall be documented, reviewed and approved as required by Section 6.6 EII 1.9 "Work Plan Review" (WHC 1991b).

Figure 1-1. Hanford Site.



903-1272/26168/8-3-92

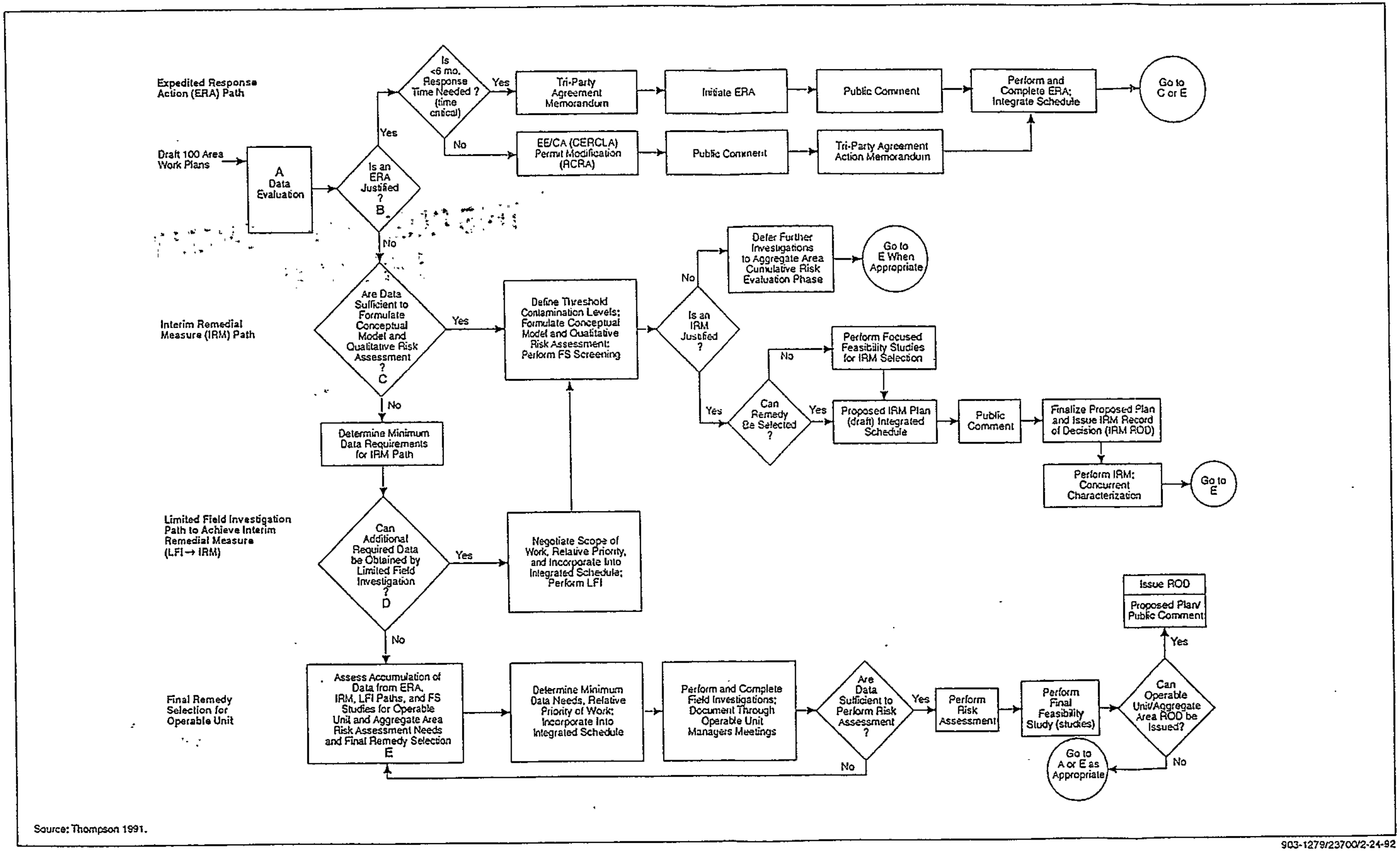
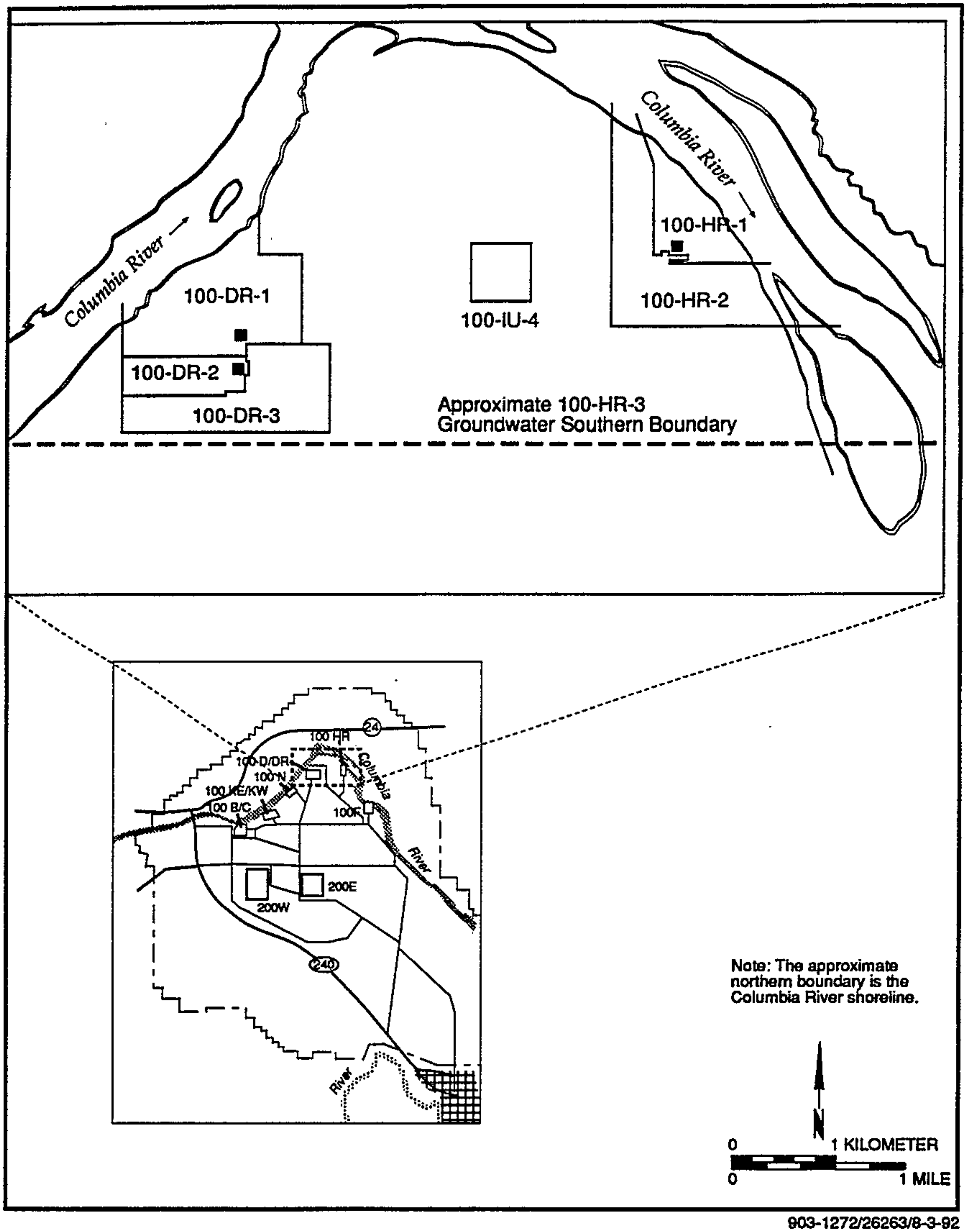


Figure 1-2. Hanford Site Past Practice Strategy for the 100 Area.

THIS PAGE INTENTIONALLY
LEFT BLANK

Figure 1-3. Map of the 100 Area Source and Groundwater Operable Units .



903-1272/26263/8-3-92

Table 1-1. The Relationship Between RCRA and CERCLA Terminology Used in this Work Plan.

RCRA Terminology	CERCLA Terminology
Resource Conservation and Recovery Act Facility Investigation (RFI)	Remedial Investigation (RI)
Corrective Measures Study (CMS)	Feasibility Study (FS)
Limited Field Investigation (LFI)	Limited Field Investigation (LFI)
Focused Feasibility Study (Focused FS)	Focused Feasibility Study (Focused FS)
Expedited Response Action (ERA)	Expedited Response Action (ERA)
Interim Response Measure (IRM)	Interim Response Measure (IRM)
Proposed IRM Plan	Proposed IRM Plan
IRM Record of Decision (ROD)	IRM Record of Decision (ROD)
IRM Design Report	IRM Design Report
IRM Implementation	IRM Implementation
Proposed Corrective Action Plan	Proposed Remedial Action Plan
Corrective Action ROD	Remedial Action ROD
Corrective Action Design Report	Remedial Action Design Report
Corrective Action Implementation	Remedial Action Implementation
Corrective Action Requirement (CAR)	Applicable or Relevant and Appropriate Requirement (ARAR)

2.0 OPERABLE UNIT BACKGROUND AND SETTING

This chapter presents a summary, based on currently available data, of the pertinent physical, historical, biological, and sociological settings for the 100-HR-2 operable unit. Chemical and radiological data representing the known and suspected nature and extent of contamination, as well as the background conditions of the local environmental media, are also presented here.

2.1 OPERABLE UNIT DESCRIPTION

The 100-H Area at the Hanford Site was used by the U.S. Government to produce plutonium for nuclear weapons. These operations resulted in the release of chemical and radioactive wastes into the soil, air, and water. For cleanup purposes, the 100-H Area has been divided into three operable units: 100-HR-1 (concerned with reactor liquid effluent sites); 100-HR-2 (concerned with solid and buried waste sites); and 100-HR-3 (concerned with the groundwater beneath and between the 100-H and 100-D/DR Areas, including all saturated soils, groundwater, surface water and aquatic biota. The 100-D/DR Area is located approximately 3.5 km (2 mi) southwest of the 100-H Area.

The purpose of this section is to describe the location of the 100-H Area, the history of operations in the area, and the facilities and structures located in the 100-HR-2 operable unit with a discussion of contamination for each waste unit.

Radioactive and nonradioactive wastes were produced during operation of the H Reactor and its support facilities. These wastes contributed to the present-day contamination in the 100-HR-2 operable unit. Wastes present can be categorized as follows:

- Radioactive solid wastes
- Nonradioactive solid wastes
- Sanitary liquid wastes.

2.1.1 Location

The 100-HR-2 operable unit is situated within the 100-H Area of the DOE's Hanford Site, in the south-central portion of Washington State. The 100-H Area is located in Benton County along the south bank of the Columbia River in the north-central part of the Hanford Site, approximately 43.4 km (27 mi) north-northwest of the City of Richland, Washington (Figure 1-1).

The 100-HR-2 operable unit is located immediately west and south of the 100-HR-1 operable unit in the west and south portions of the 100-H Area. It covers approximately 40.5 hectares (100 acres). Figure 2-1 shows the approximate boundaries of the 100-HR-2 operable unit as defined by the waste units it includes, and its location with respect to the 100-HR-1 operable unit. It lies primarily within the northeast quadrant of Section 18 of township 14N, range 27E and is located within latitude 46° 42′ 30″ and 46° 42′ 00″ north and longitude 119° 29′ 00″ and 119° 28′ 00″ west. Hanford Site maps locate it within north/south plant coordinates (i.e., Hanford Site coordinates) N92000 and N99000 and east/west plant coordinates W39000 and W41500.

2.1.2 History of Operations

2.1.2.1 Reactor Operations. Between 1943 and 1963, nine water-cooled, graphite-moderated plutonium production reactors were built along the Columbia River upstream from the now-abandoned town of Hanford. These nine reactors (B, C, D, DR, F, H, KE, KW, and N) have been retired from service and are under evaluation for decommissioning.

The 100-H Area contains one reactor, the H Reactor. It operated from 1949 to 1965. The support facilities included an access road, a rail spur, offices, storage buildings for contaminated equipment, warehouses, a laboratory, a substation, a garage, maintenance shops, a paint shop with storage, a fallout shelter, a coal-fired powerhouse with coal storage and fly ash disposal facilities, solid waste burial grounds, solid waste burning grounds, a large water treatment plant with water intake and storage structures, a river pumphouse, a process effluent system, and subsurface sanitary sewage disposal systems (WHC 1988a; General Electric 1963).

2.1.2.2 Post-Reactor Operation Activities. Currently there are no active facilities within the boundaries of the 100-HR-2 operable unit. To minimize the potential spread of radioactive isotopes from the reactors and associated facilities, DOE instituted a program of decontamination and decommissioning of buildings and facilities after the reactors were retired. The process is ongoing, and in the 100-H Area most of the aboveground facilities have undergone decommissioning and no longer exist. The layout of the 100-H Area, illustrating both present and past facilities, is shown in Figure 2-1. Shading is used to indicate structures that have been demolished since reactor deactivation. Facilities presently above ground in the 100-HR-2 operable unit are the 1713 Warehouse and the 1720-HA Munitions Arsenal.

2.1.3 Waste Generation Processes

Radioactive and nonradioactive wastes were produced during operation of the H Reactor and its support facilities. Solid wastes generated in the 100-H Area includes reactor components and associated parts.

The following descriptions of the waste generation processes are limited to a qualitative nature. Quantitative information by burial ground site, to the extent known to date, is summarized in Section 2.1.4.

2.1.3.1 Radioactive Solid Wastes. Radioactive solid wastes generated in the 100-H Area generally consisted of reactor components, contaminated equipment and tools, and miscellaneous contaminated items (paper, rags, structural concrete, etc.). The main source of these wastes was reactor operations in the H Reactor building, and the most highly contaminated solid wastes were the reactor components. Neutron activation of elements in the reactor components caused them to become radioactive. In addition, both the reactor components and other solid objects received surface contamination from contact with radioactive solutions and environments. The predominant radionuclides associated with the reactor components are ^{60}Co and ^{63}Ni (Dorian and Richards 1978). In cases where decontamination and decommissioning have occurred, creating buried pieces of concrete, other materials from demolished buildings, and buried building foundations, radiation levels are low. Contamination in these cases results mainly from surface contact with contaminated air, dust, and liquid solutions.

Other facilities associated with the H Reactor and waste management activities also generated radioactive solid wastes. Examples are air filters in the 132-H-2 exhaust air filter building, equipment used in connection with the cooling water effluent system, and contaminated dirt removed from near the effluent lines. The primary burial ground for H Reactor operations was the 118-H-1 Burial Ground.

2.1.3.2 Nonradioactive Solid Wastes. Nonradioactive solid waste generated in the 100-H Area primarily included miscellaneous materials such as paper, trash, pieces of metal, plastic parts, etc., generated in the facilities, as well as sludges that were a product of the water treatment process.

Other nonradioactive solid waste consisted of concrete, metal parts, and other materials generated during decommissioning and demolition activities. Asbestos, chemical waste, and contaminated solids were removed from the 100-H Area during the decontamination and decommissioning work. Building materials that were not considered to be contaminated were buried in place or in the 183-H Clearwells, which were used as a burial landfill for inert wastes. Some of these materials may have had very low-level radiological contamination.

2.1.3.3 Sanitary Wastes. Sanitary wastes were generated in various buildings in the 100-HR-2 operable unit, routed by sewer lines to underground septic tanks and subsequently discharged to associated tile fields (see Section 2.1.4.3). Nonsanitary wastes such as detergents, cleaning compounds and solvents have likely entered these sewer systems. There are no records of radiological wastes being disposed to these systems.

2.1.4 Facility Characteristics and Identification

The following sections describe the facilities and structures originally located in the 100-HR-2 operable unit. All the of the 100-HR-2 operable unit waste facilities can be grouped into the following general categories:

- Solid waste burial grounds
- Ash disposal basins
- Burning pits
- Sewage transfer, treatment, and disposal facilities.
- Demolished support facilities.

Figure 2-1 shows the locations of the facilities identified in the 100-HR-2 operable unit during the background research phase of this project. Engineering drawings, reports, and field visits were used as much as possible to locate the facilities. Table 2-1 lists each of the facilities by its appropriate Waste Information Data System (WIDS) site identification number, with any alias designations in parentheses for continuity with historical documents, followed by the years in service and present status, the facility description/purpose, and where known, the wastes received or handled.

Two primary numbering systems have been used in the 100 Areas, and several buildings, structures, and waste units have two number designations. Under the original Hanford Site numbering system, buildings, structures (such as river outfalls), and some waste handling units (such as retention basins) were given a unique number (e.g., 105-H for the H Reactor and 107-H for H Area retention basin). Most waste units were not assigned a unique number, but instead were referred to by the number of a nearby or associated building (e.g., 105-H Pluto Crib or 184-H Powerhouse Ash Pit). More recently most of the waste units and some buildings and structures were assigned site designation numbers (e.g., 116-H-4 for the 105-H Pluto Crib and 126-H-1 for the 184-H Powerhouse Ash Pit). The recently assigned identification numbers are used by the WIDS and throughout Chapters 2.0 and 3.0 of this work plan.

It is important when interpreting the data in this section that attention be paid to the amount of radioactive decay that has taken place since the data were gathered. Where possible, the dates for radionuclide inventories have been given, but no attempt has been made to calculate the decayed inventories through the present.

Dimensions in the following sections are presented in metric units followed by standard english units in parentheses. As a note, measurements were originally taken in english units and converted to metric rounding-off to one decimal place.

2.1.4.1 Solid Waste Burial Grounds. Operation of the original reactor facilities began in 1944. During the course of reactor operation, 23 radioactive solid waste burial grounds were established in the deactivated 100 Areas. Two additional burial grounds were also established in 100-F Area as the result of the biology laboratories.

Because the types of solid wastes generated by various facilities at Hanford are different and because the geological conditions at various burial ground locations in the operating areas of Hanford are different, distinctive disposal practices have been developed for different burial grounds. The 100 Area burial grounds are near the river and are relatively close to the water table; the soils beneath some of these burial trenches have little ion adsorption capacity. Historically, radioactive materials placed in the 100 Area trenches were normally well fixed, of short half life, or considered of little biological significance. Consequently, once these materials were properly disposed in the burial grounds, radiological effects on the environs were believed to be minimal (Backman et al. 1963).

The majority of waste generated from routine reactor operations was placed in primary burial grounds associated with their respective reactors. Other burial grounds resulted from reactor upgrade projects, major maintenance projects, or served special programs such as thimble removal, retention basin repair and effluent line modifications or the tritium separations program. Definitions for reactor components and parts discussed in this section are provided in Section 2.1.3. Table 2-2 provides a listing of 100 Area burial grounds categorized by area location and purpose or general use. Table 2-3 provides a description of some of the buried components and includes some general information on the estimated quantities of these components. The quantitative estimates are based on an "all reactor" basis which are then broken down to Area estimates based on reactor maintenance records (Stenner et al. 1988 and Dorian and Richards 1978).

A typical primary burial ground which served a reactor area was a few hundred feet wide by several hundred feet long with burial trench depths generally 6.1 m (20 ft). The water table at the 100-H Area burial sites is about 12.8 to 13.4 m (42-44 ft) below grade. These large burial grounds contained numerous burial trenches and pits of various sizes and orientations depending upon the material being buried. Pieces of equipment that had high dose rates (e.g., thermocouple stringers, horizontal control rods, etc.) were often placed into narrow but deep trenches and partially covered with earth fill to reduce dose rates until trenches were filled and then backfilled to above grade. Small crib pits [2.4 x 2.4 m (8 x 8 ft) pits made from railroad ties] were often used for disposal of small reactor hardware having high dose rates, such as dummies. Vertical steel pipes and/or culverts (silos) 1.5 to 1.8 m (5-6 ft) in diameter were also used for such wastes. Smaller burial grounds consisting of just one trench or pit were dug near the reactor buildings (Dorian and Richards 1978).

There are seven burial grounds in the 100-H Area. Three of them, 118-H-1, 118-H-2 and 118-H-3, fall under the typical major burial ground definition. The major burial grounds are located outside the reactor exclusion area fence and are permanently marked around their perimeters with concrete posts. The other four—118-H-4, 118-H-5, 105-H Rod Cave, and the Buried Thimble Site—are of the smaller, single-use type. The 118-H-4, and 118-H-5 and 105-H Rod Cave burial grounds are located inside the reactor exclusion area fence and are marked only with two concrete monuments, one at each end of the burial area. The Thimble Burial Site is outside of the exclusion fence and has only one concrete marker.

All 100-H Area burial grounds have been covered with a minimum of 1.2 m (4 ft) of clean soil. The soil has been stabilized with gravel to prevent erosion by wind. In addition, burial grounds are treated with herbicides as needed to prevent radioactive migration by deep-rooted weeds. They are also routinely surveyed to ensure that contamination is not spreading to the environs (Dorian and Richards 1978).

In the following discussions the radioactive half-life is shown in parenthesis behind its respective radionuclide, i.e., ^{51}Cr (28-day).

The majority of the burial grounds in 100-HR-2 contain two general types of radioactive waste: neutron-activated reactor components and surface-contaminated material and equipment. The activated components consist almost entirely of steel and aluminum. The most significant radionuclide contained in those materials is ^{60}Co (5-year). The surface contaminants are primarily corrosion and activation products of the reactor cooling water effluent, of which the long-life emitter is ^{65}Zn (245-day). The removed aluminum process tubes contain more radioactivity than all the other buried materials. The highest concentration of radioactivity will be found in the thermocouple wires which, because of their high nickel content, have a high concentration of ^{60}Co after irradiation.

Typical examples of neutron-activated components are aluminum dummies and process tubing, steel gun barrels and step plugs, thermocouple wires, and balls from the 3X safety system. Radionuclides created in irradiated aluminum are ^{51}Cr (28-day), ^{181}Hf (45-day), ^{59}Fe (45-day), ^{175}Hf (70-day), ^{46}Sc (85-day), ^{65}Zn (245-day), and ^{60}Co (5-year). Radionuclides created in steel and iron are ^{51}Cr (28-day), ^{59}Fe (45-day), ^{54}Mn (314-day) and ^{60}Co (5-year). These activated components, within a few years, lose all of their radioactivity except for that due to ^{60}Co.

Typical examples of surface-contaminated materials, usually referred to as miscellaneous, contaminated waste, include such things as broken hand tools, rags and sweeping compound used in decontamination work, light bulbs removed from the storage basin, and sheets of plastic and paper used to keep floors and equipment free of contamination. This type of material was usually sealed in cardboard boxes and placed in separate trenches from the activated components. The surface contaminants are primarily water-activation products: ^{46}Sc (85-day), ^{65}Zn (245-day), ^{54}Mn (314-day), ^{60}Co (5-year), and ^{152}Eu (13-year). Fission products form a minor part of the surface contaminants. Aged fission products are reduced in three years to ^{144}Ce and ^{144}Pr (290-day), ^{147}Pm (2.6-year), ^{90}Sr and^{90}Y (25-year), ^{137}Cs and ^{137}Ea (30-year), and ^{151}Sm (93-year) (Herman, Jr. 1965).

A summary of estimated quantities of different types of metallic wastes buried in the 100-H Area Burial Grounds is shown below (Dorian and Richards 1978).

Aluminum Tubes	24.0 tons
Irradiated Facilities	190.0 lbs
Expendables	60.0 tons
Thermocouples	23.0 lbs
Aluminum Horizontal Control Rods	1,130.0 lbs
Aluminum Thimbles	3.0 tons

The inventories were based upon a review of past burial records and a limited sampling of the different types of discarded reactor hardware and wastes that went to the burial grounds. Burial records prior to 1955 are poor, containing minimal information. However, the power levels of the production reactors were fairly low prior to the middle 1950's when, through reactor redesign and modifications, the power levels were increased substantially. Radiation levels in activated reactor hardware wastes disposed of prior to this date were, therefore, substantially lower than in later years (Dorian and Richards 1978).

Previous sampling of any of the 100 Area solid waste burial grounds was limited to the 118-B-1 Burial Ground, done in 1976 and reported in Dorian and Richards (1978). The sampling was not directed at establishing the radionuclide inventory, however. It was intended to establish the following parameters:

- Identify the radionuclides present with particular emphasis on the measurement of $^{239/240}$Pu, ^{63}Ni, and ^{90}Sr.
- Identify the concentration of radionuclides present.
- Identify the horizontal and vertical distribution of radionuclides present.

- Compare the specific activities in older trenches used before reactor power upgrade modifications were made as compared to those in trenches used after reactor power operating levels were increased.

Drilling was initiated on April 5, 1976 and completed on April 29, 1976. Results are reported in Dorian and Richards (1978). It is reasonable to assume that 100-H burial grounds would contain analogous wastes, concentrations and exhibit similar conclusions. Some general results of that sampling are as follows:

- No measurable migration of radionuclides was indicated by the data.

- The maximum $^{239/240}$Pu concentration detected in samples was 1 pCi/g. $^{239/240}$Pu is generally not detectable.

- The primary radionuclide identified was ^{60}Co through ^{152}Eu. $^{154/155}$Eu, $^{134/137}$Cs, ^{90}Sr and ^{63}Ni were also present.

- The maximum beta-gamma concentration detected in samples was 1.8 $\times 10^5$ pCi/g of which 1.7$\times 10^5$ pCi/g is ^{60}Co.

- ^{63}Ni was detected up to 7.5$\times 10^1$ pCi/g. Based on sampling of the 105-DR Reactor core, considerably higher ^{63}Ni concentrations are probably present in metallic wastes within this burial ground.

- Specific activities of samples taken in older trenches used before reactor power upgrade modifications were made are considerably less than that for trenches used after the reactor power operating levels were increased.

The 105-DR Reactor core sampling performed as part of that study, indicated ^{63}Ni was present in the metallic wastes with concentrations of up to about two percent of ^{60}Co concentrations. ^{63}Ni is a pure beta emitter, and therefore was not detected in the gamma analyses which were used to establish the current inventory estimates. ^{63}Ni has a half-life of 92 years. A more practical way to improve estimates of the 100 Area burial ground inventories in the future might be to sample selected reactor hardware from one of the reactors, and perform comprehensive radionuclide analyses for these samples. This approach would establish the individual radionuclide concentrations, and in combination with the estimated quantities of metallic wastes buried, could refine the current inventory estimates (Dorian and Richards 1978).

Estimated waste quantities of the following primary burial grounds were based on volume calculations from site dimensions and therefore include overburden soils as well as actual waste volumes.

2.1.4.1.1 118-H-1. This burial ground, formally called 100-H Burial Ground No. 1, was opened in 1949, enlarged in 1955, and active until 1965. It was the first and is the largest burial ground in 100-H Area, located approximately 397 m (1,300 ft) southwest of the 105-H Reactor Building (Herman Jr. 1965). The site boundaries are permanently marked with concrete posts numbered H-65-1 through H-65-23. The site is generally the shape of a rectangle approximately 213.4 m long by 106.7 m wide (700 x 350 ft) and runs in an east-west direction. It consists of numerous trenches of various dimensions, generally running north and south. The depth is estimated at 6.1 m (20 ft) (Stenner et al. 1988). All trenches and pits were backfilled to grade, which ranged from 0.6 to 1.8 m (2-6 ft) of soil cover. Activated components (dummy elements, process tubing, etc.) as well as miscellaneous solid wastes (surface contaminated materials) were buried here. Near the southwest corner of the burial ground, portions of several horizontal control rods were buried in slit trenches. Two trenches were used during the deactivation of H Plant (Herman, Jr. 1965). An as-built status was drawn in July of 1962. That drawing is depicted in Figure 2-2. The estimated volume of material in the trenches is 10,000 m^3. An estimated radionuclide inventory and metallic waste breakdown is as follows (Stenner et al. 1988):

Constituent	Quantity in Ci (decayed through 4/1/86)
^{14}C	0.66
^{60}Co	610.00
^{137}Cs	1.00
^{152}Eu	14.20
^{154}Eu	25.10
^{3}H	3.50
^{90}Sr	1.00

Metallic Constituent	Quantity in Kg
Aluminum Tubes	12,700
Aluminum Spacers	25,401
Aluminum Poison Slugs	5,080
Lead-Cadmium Poison Slugs	
Lead	74,933
Cadmium	3,175
Graphite	43
Desiccant	16
Boron Poison Splines	725
Lead	19,050
Miscellaneous Metallic Waste	13,154

2.1.4.1.2 118-H-2. This burial ground, formally called 100-H Burial Ground No. 2 and also known as the H-1 Loop Burial Ground, was active from 1955 to 1965. It is located approximately 457.4 m (1,500 ft) due west of The 105-H Reactor Building. The site boundaries are permanently marked with concrete posts numbered H-65-24 through H-65-29 (Herman Jr. 1965). The site is a rectangle approximately 42.7 m long by 15.2 m wide (140 x 50 ft) running in an east-west direction. It consists of two in-line concrete vaults buried roughly 4.6 m (15 ft) deep (Stenner et al. 1988). Both vaults were covered to grade with 3.7 m (12 ft) of soil (Herman Jr. 1965). Reportedly the vaults were filled with gravel and 0.6 m (2 ft) of gravel was added on top of the entire site (WHC 1991c). The east vault received one stainless steel double tube removed from the reactor in 1955 after several years of irradiation. The west vault was constructed in 1958 and used during the deactivation of H Plant for disposal of a small amount of contaminated pipe (Herman Jr. 1965). The estimated waste volume is 2 m^3 and an estimated radionuclide inventory is 1.00 Ci of ^{60}Co decayed through April 1, 1986 (Stenner et al. 1988).

2.1.4.1.3 118-H-3. This burial ground, also referred to as the Construction Burial Ground, was active from 1953 to 1957. It is located approximately 243.8 m (800 ft) due south of the 105-H Reactor Building (Stenner et al. 1988). The site boundaries are permanently marked with concrete posts numbered H-81-1 through H-81-13. The shape is an uneven polygon with side lengths of approximately 30.5 by 114.3 by 95.4 by 121.9 m (100 x 375 x 313 x 400 ft) running in a northeast-southwest direction. The site is roughly 6.1 m (20 ft) deep. Reportedly there are only two trenches in this burial ground and they have been covered to grade with 1.8 m (6 ft) of soil (Heid 1956). It received sections of contaminated 16-in. pipe used as chutes for the removal of thimbles from the 105-H Reactor during outages, reactor hardware, and components from reactor modification programs. The estimated waste volume is 3,000 m^3 and an estimated radionuclide inventory is 1.00 Ci of ^{60}Co decayed through 4-1-86 (Stenner et al. 1988).

2.1.4.1.4 118-H-4. This burial ground, also known as the Ball 3X Program Burial Ground, consists of one trench dug in 1953. It is different from the other burial grounds in that it is much smaller, it is located within the 105-H exclusion area and was intended to be used as a "one-time" burial pit. It is located approximately 30.5 m (100 ft) directly west of the 105-H Reactor Building, within and adjacent to the 105-H Exclusion Area fence. It is approximately 45.7 m long by 9.1 m wide (150 x 30 ft) running north and south, and is roughly 3.1 m (10 ft) deep (Stenner et al. 1988). Concrete monuments mark the north and south ends of the burial ground. The trench has been covered to grade with 1.5 m (5 ft) of soil (Herman Jr. 1965). It contains approximately 20 m^3 of irradiated gear such as vertical safety rod thimbles and guides removed from 105-H Reactor Building during the Ball 3X Program. An estimated radionuclide inventory is 1.00 Ci of ^{60}Co decayed through April 1, 1986 (Stenner et al. 1988). No 3X balls are buried at this site as its alias name implies. The name originated from the project upgrading the 3X safety system not from its contents.

2.1.4.1.5 118-H-5. This burial ground, also referred to as the 105-H Thimble Pit, is also located within the 105-H Exclusion Area approximately 61 m (200 ft) south of the 105-H Reactor Building, adjacent to the exclusion area fence. It was dug in 1953 and consists of one trench approximately 9.1 m long by 0.6 m wide and roughly 3.1 m deep (30 x 2 x 10 ft) (Stenner et al., 1988). It too was intended to be used as a one-time burial pit to bury a thimble assembly used in the "B" Hole of the 105-H X-level (Heid 1956). However, in 1960 the 105-H Pluto Crib was excavated, due to the construction of the 105-H confinement system, and buried at this site, reportedly in the north end. Concrete monuments mark the ends of the burial ground. The trench has been covered to grade with 1.5 m (5 ft) of soil (Herman Jr. 1965). The estimated waste volume is 30 m^3 and an estimated radionuclide inventory is 1.00 Ci of ^{60}Co decayed through April 1, 1986 (Stenner et al. 1988).

2.1.4.1.6 105-H Rod Cave. This burial ground is located inside the 105-H Exclusion Area fence. It is approximately 22.9 m (75 ft) west of the 118-H-5 Thimble Pit. It consists of an underground, concrete-lined structure, about 12.2 long by 7.6 m wide (40 x 25 ft). Gravel has been mounded over the top of the aboveground portion. The site is suspected to contain contaminated horizontal control rods and possibly other miscellaneous reactor facility components.

2.1.4.1.7 Buried Thimble Site. This site is located just south of the 116-H-2 Crib. It is in between and at the convergence of two railroad spurs running north and south. One concrete monument marks the site. It is reportedly 12.2 m long (40 ft). The site is suspected to contain a vertical safety rod thimble.

2.1.4.2 Ash Disposal Basins and Burning Pits. The 100-H Powerhouse produced process steam from coal-fired boilers. Adjacent to it were large storage areas that received railroad carloads of coal, as well as disposal areas for fly ash/clinker disposal. **126-H-1** is the ash disposal basin for the 100-H Area.

Burning pits were used to incinerate nonradioactive combustible material, mostly trash, office waste, and small amounts of solvents and paint wastes. There are three burning pits in the 100-HR-2 operable unit, **128-H-1, 128-H-2** and **128-H-3.** No waste inventories have been found for these burning facilities nor has any sampling been conducted.

2.1.4.2.1 126-H-1. This site has been referred to in the past as the 184-H Powerhouse Ash Pit or the 188-H Ash Disposal Basin. It is located due west of the 184-H Powerhouse (demolished) and Coal Storage Area and was in service from 1948 until 1965. Unknown amounts of coal ash were sluiced to this pit with raw river water. Studies have shown ash from Hanford Site power plants to be nonradioactive and nonhazardous according to WAC 173-303 (Rasmussen and Carlson 1987; Dworzak 1983). Table 2-4 summarizes the results of analysis of Hanford Site coal ash.

2.1.4.2.2 128-H-1. This burning area is approximately 30.5 m (100 ft) square and 3.1 m (10 ft) deep. It was in service from 1949 until 1965 and is located in the northwest corner of 100-H Area about 15.2 m (50 ft) east of the west perimeter road. An estimated waste volume is 10,000 m^3 (Stenner et al. 1988). The burning of solvents has been reported by a past employee, to have taken place along the east side of the site.

2.1.4.2.3 128-H-2. This burning area is a depression roughly 36.7 m by 24.4 m (120 x 80 ft) located directly west of the 118-H-1 Burial Ground. It is a graded rocky area with little soil. There is little surface evidence; however, there are rocks that have been exposed to fire. This site location has been verified by employees who used it (WHC 1991c).

2.1.4.2.4 128-H-3. This burning area is west of the 118-H-1 Burial Ground and north of 128-H-2 Burn Pit about 152.4 m (500 ft) east of the west perimeter road. It is covered with small rocks and very little dirt. It looks very similar to 128-H-2, but was not verified by past employees (WHC 1991c).

2.1.4.3 Sanitary Sewage Transfer, Treatment, and Disposal Facilities. Sanitary sewage generated at 100-H Area was treated in underground septic tanks and subsequently discharged to associated tile fields. There are no records of hazardous wastes being disposed of in any of these units. It is currently unknown when sludges were pumped from the septic system and where they were disposed of. None of the units received scores from the Hazardous Ranking System (HRS) evaluation of the Hanford Site (Stenner et al. 1988), which in turn were used in the NPL nomination. However, because of the diversity of the support functions carried out in the 100-H Area (e.g., laboratory and maintenance shops), it is conceivable that some chemical or radiological wastes could have been disposed of in these units.

2.1.4.3.1 Sanitary Sewer Pipelines. Sanitary sewage was collected from the various buildings within the 100-H Area and transported to four different septic systems. Two of these septic systems are located in the 100-HR-2 operable unit and two, which are not discussed here, are in the 100-HR-1 operable unit. No details as to the construction of these pipelines are available, however, sewer and water plot plans and septic tank and tile field details do exist. These drawings show the lines as being vitrified clay pipe. These pipelines, although no longer in use, are presumably still in existence.

2.1.4.3.2 1607-H1 Sanitary Septic System. This unit is located southwest of the now demolished 151-H Primary Substation. It was designed to handle 1,750 gal/day from the 151-H and 105-H Buildings with a 50-person capacity. Design drawings show the septic tank measuring 4.6 m long by 1.7 m wide by 4.4 m deep (15 x 5.5 x 14.5 ft) and the associated tile field measuring 17.1 by 15.2 m (56 x 50 ft) in a northeast-southwest orientation. This unit was reactivated in about 1985 and is still active. No waste inventories exist for this facility nor has any sampling been conducted.

2.1.4.3.3 1607-H3 Sanitary Septic System. This unit is located at the entrance to 100-H Area. It is northeast of the now demolished 1709-H Fire Station. It had a 100-person capacity and was designed to handle 3,500 gal/day from the 1701-H Badge House, the 1720-H Security Patrol Change Room and offices, and the 1709-H Fire House. These buildings are all in the same general location at the entrance to 100-H Area and have all been demolished. Design drawings show the tank measuring 5.6 m long by 2.1 m wide by 4 m deep (18.5 x 7 x 13 ft) and the associated tile field measuring 15.2 by 30.5 m (50 x 100 ft) oriented in-line with the tank in a northeast-southwest direction, approximately 24.4 m (80 ft) from the tank. No waste inventories exist for this facility nor has any sampling been conducted.

2.1.4.4 Support Facilities. The majority of the following facilities have been demolished and no longer exist. In some cases, decommissioning has been limited to removing equipment, electrical hardware, piping, and other items from the buildings. In other cases, these internal components have been removed and the entire structure has been demolished, with the debris either buried in situ or transported to a burial ground elsewhere on the Hanford Site. The only two remaining are the 1713-H Warehouse and the 1720-HA Arsenal.

2.1.4.4.1 151-H Primary Substation. This facility was located approximately 243.8 m (800 ft) due west of the 105-H Reactor Building. It supplied all normal electrical power to the 100-H Area from 1948 until about 1965. It contained two power transformers rated at 31,250 kva and associated transformers, capacitors, switchgear, etc. The building was demolished in 1978, in situ, placing the debris in the basement and backfilling. The switchgear was reused at the 151-B Substation. Although there is a potential PCB contamination in soils where oil-filled equipment was located, samples taken in 1991 (WHC 1992) indicate PCB levels are below TSCA cleanup levels.

2.1.4.4.2 184-H Powerhouse. This facility, located approximately 487.7 m (1,600 ft) northwest of the 105-H Reactor Building, was 61 m by 18.3 m by 24.4 m high (200 x 60 x 80 ft high). It provided steam and emergency electrical power to the 100-H Area facilities from 1948 until 1965. It was constructed of a steel frame and concrete blocks, with two 91.4 m (300 ft) concrete exhaust stacks. It housed one steam turbine-driven generator and two coal fired boilers. The facility was demolished in 1973.

2.1.4.4.3 1701-H Gate House. This building was located at the entrance of the 100-H Area, in the southern tip of the area. It served as the area badge house and security check point from 1948 until a later unknown date. It was a 134.7 m^2 (1,450 ft^2), two-story, wood framed structure with a concrete foundation and first floor. The second floor was wooden, the siding was shake, and the roof was flat with a tar and gravel surface. The building was demolished some time between 1973 and 1978, during the cleanup of the 100-H Area.

2.1.4.4.4 1709-H Fire Headquarters. This building was also located at the entrance to the 100-H Area. It served as the Area fire headquarters and provided office space to Area personnel from 1948 until a later unknown date. It was approximately 34.1 m by 17.7 m by 3.7 m high (112 x 58 x 12 ft high). It consisted of a single-story, wood-framed structure with asbestos shake siding, a concrete floor and foundation, and a gabled roof with composition shingles. The building was demolished some time between 1973 and 1978, during the cleanup of the 100-H Area.

2.1.4.4.5 1713-H Warehouse. This building has been in service since 1948 and is located west of the 183-H Solar Evaporation Basins and in between the now demolished 151-H and 184-H buildings. It is approximately 47.5 m by 18.9 m (156 x 62 ft). It is constructed of a steel frame with corrugated transite siding. The foundation and floor are concrete, and the roof is builtup tar and gravel over flat prefabricated concrete tiles (re-roofed in 1987). There is approximately 1,207.7 m^2 (13,000 ft^2) storage space and it is currently being used for storage of materials and equipment associated with the 183-H Evaporation Basins and environmental restoration projects.

2.1.4.4.6 1720-H Patrol Headquarters. This building was located at the entrance to the 100-H Area, in the southern tip of the area. It provided office space and associated facilities for the area security patrol from 1948 until a later unknown date. It was a single-story, wood-framed structure approximately 27.7 m by 9.8 m by 4.6 m high (91 x 32 x 15 ft high). The foundation and floor were concrete, the siding was asbestos shake, and the roofing was composition shingles. The facilities included locker, assembly, supply, wash and shower rooms, offices, and a radio room. The building was demolished some time between 1973 and 1978, during the cleanup of the 100-H Area.

2.1.4.4.7 1720-HA Arsenal. This building is located at the entrance to the 100-H Area, in the southern tip of the area. It is a 2.4 m by 1.8 m (8 x 6 ft) concrete structure that was used as a central storage area for ammunition used by the security patrol. It was also used to house explosives for decommissioning projects.

2.1.5 Interactions with Other Operable Units

The 100-HR-2 operable unit is bordered on the east and north by the 100-HR-1 operable unit (see Figure 2-1). The 100-HR-1 operable unit is designated as a reactor effluent waste source and contains most of the important facilities involved in plutonium production at the 100-H Area, including the reactor and its cooling system. The groundwater/surface water operable unit associated with 100-HR-2 is the 100-HR-3 operable unit. The 100-HR-3 operable unit underlies the 100 D/DR Area, the 100 H Area and the 600 Area between them (see Figure 1-3). It includes all contamination found in the aquifer soils and water within its boundary. Information gained from CMS/FS work at the 100-HR-1 and 100-HR-3 operable units will be used as much as possible to guide activities at the 100-HR-2 operable unit.

The CMS/FS and RI/FS activities to be performed at other operable units at the Hanford Site 100 Area will also be integrated with the work in the 100-HR-2 operable unit. Operable units for which work plans have been approved and work is under way are 100-BC-1, 100-BC-5, 100-DR-1, 100-FR-1, 100-FR-3, 100-HR-1, 100-HR-3, 100-KR-1, 100-KR-4, 100-NR-1, and 100-NR-2. Information gathered at one operable unit will be evaluated for relevance by investigators at other operable units and used where appropriate (DOE-RL 1991a).

2.1.6 Interactions with the Resource Conservation and Recovery Act of 1976

According to Appendix B of the Tri-Party Agreement (Ecology et al. 1990a), there are no RCRA treatment, storage, or disposal (TSD) facilities located in the 100-HR-2 operable unit.

2.2 OPERABLE UNIT SETTING

This section is designed to discuss the physical setting of the 100-HR-2 operable unit, including topography, geology, hydrogeology, surface hydrology, meteorology, environmental resources, and human resources. Because of the general nature of the physical setting information across the 100-H Area, detailed information describing the physical setting of the 100-HR-2 operable unit can be found in Section 2.2 of the 100-HR-1 operable unit work plan (DOE 1992c).

2.2.1 Topography

The 100-HR-2 operable unit is situated on an essentially flat, semiarid bench within the Pasco Basin (a structural and topographical basin that includes the Hanford Site) immediately southwest of the free-flowing Hanford Reach of the Columbia River. The elevation of the land surface is approximately 125 m above mean sea level (Figure 2-3).

2.2.2 Geology

The geology of the area is typified by a representative stratigraphic column shown in Figure 2-4 which shows the three uppermost stratigraphic units, in ascending order; the Saddle Mountains Basalt of the Columbia River Basalt Group; the Ringold formation; and the Hanford formation (informal name). The figure shows the order, the principal lithologic units, and the average elevation of these formations.

2.2.3 Hydrogeology

The four principal hydrostratigraphic units are, in ascending order; The lower confined aquifer of the Ellensburg Formation (within the Saddle Mountains Basalt Formation); the confining layers of the Elephant Mountain Member; the upper confined and unconfined aquifers of the Ringold Formation (including the confining layers in between); and the saturated and unsaturated sediments if the Hanford Formation (Figure 2-4). Well locations in the 100-H Area are shown in Figure 2-5. Water-level measurements from monitoring wells in the 100-H Area indicate that there is a significant upward gradient of groundwater flow from the confined aquifers to the unconfined aquifer and to the river (Figure 2-6).

2.2.4 Surface Hydrology

Because of the relatively flat topography, there are no well-defined surface drainage channels within the 100-HR-2 operable unit. The northern and southeastern boundaries of the 100-HR-2 operable unit is formed by the free-flowing reach of the Columbia River (Figure 2-3).

2.2.5 Meteorology

Climatological data are available from the Hanford Meteorological Station. Average annual precipitation for the Hanford Site is 16 am (6.3 in). Average monthly temperatures range from -1.5 C (29.3 F) in January to 24.7 C (76.4 F) in July. The prevailing wind directions are from the northwest throughout the year as shown at Stations 5 and 13 in Figure 2-7.

2.2.6 Environmental Resources

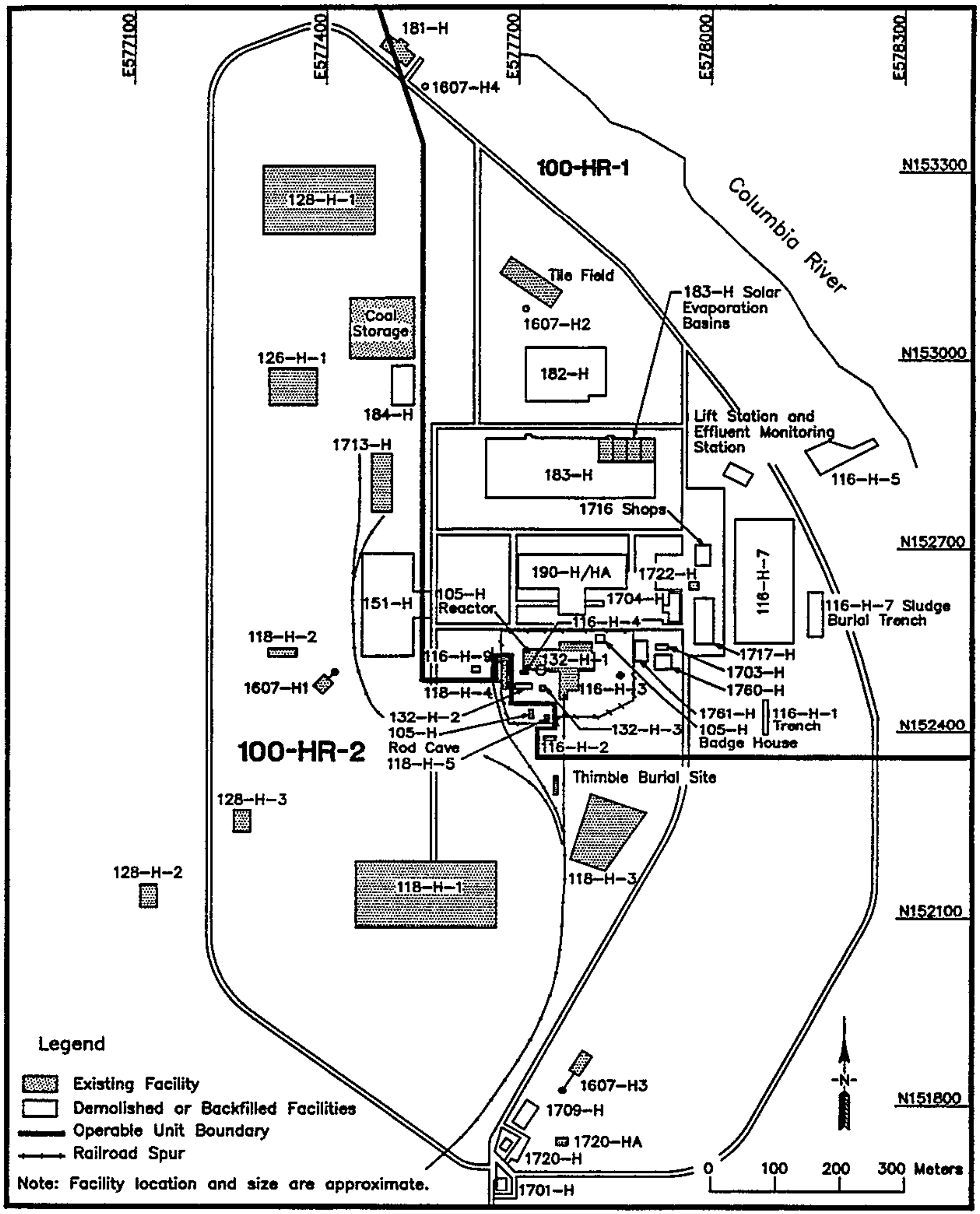
The flora on the semi-arid bench above the Columbia River consists mostly of sparse covering of desert shrubs and drought-resistant grasses. Predominant fauna typically found in the 100-H Areas are the cottontail rabbit (*Sylvilagus nuttalli*), jackrabbit (*Lepus* spp.), Great Basin pocket mouse (*Perognathus parvus*), horned lark (*Eromophila alpestris*), and the western meadowlark (*Sturnella neglects*). Mule deer (*Odocoileus hemionus*), coyotes (*Canis latrans*), and various species of raptors forage in this habitat type, and grasshoppers (*Ornithoptera*) are the most conspicuous insects in the community. The bald eagle, a threatened species is known to frequent the environs near the 100-HR-2 operable unit.

The Hanford Site land use is maintained through the Hanford Site development planning process. Land use on federal property is subject to federal approval and control.

2.2.7 Human Resources

There are no residents living within 4.8 km (3 mi) radius of the 100-H Area and other than workers and Site visitors there are no regular inhabitants of the 100-H Areas.

Figure 2-1. 100-HR-2 Existing and Original Facilities.



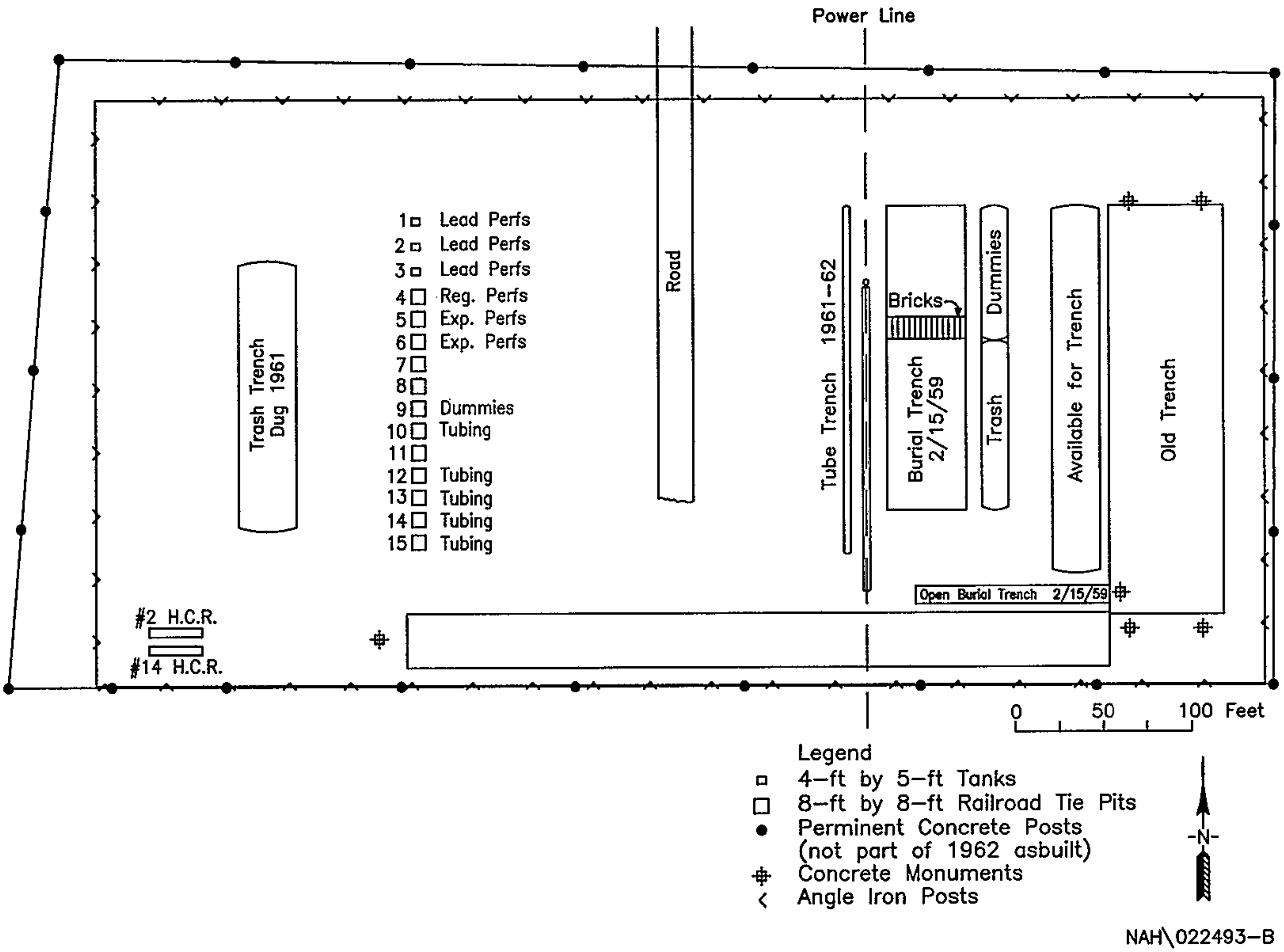
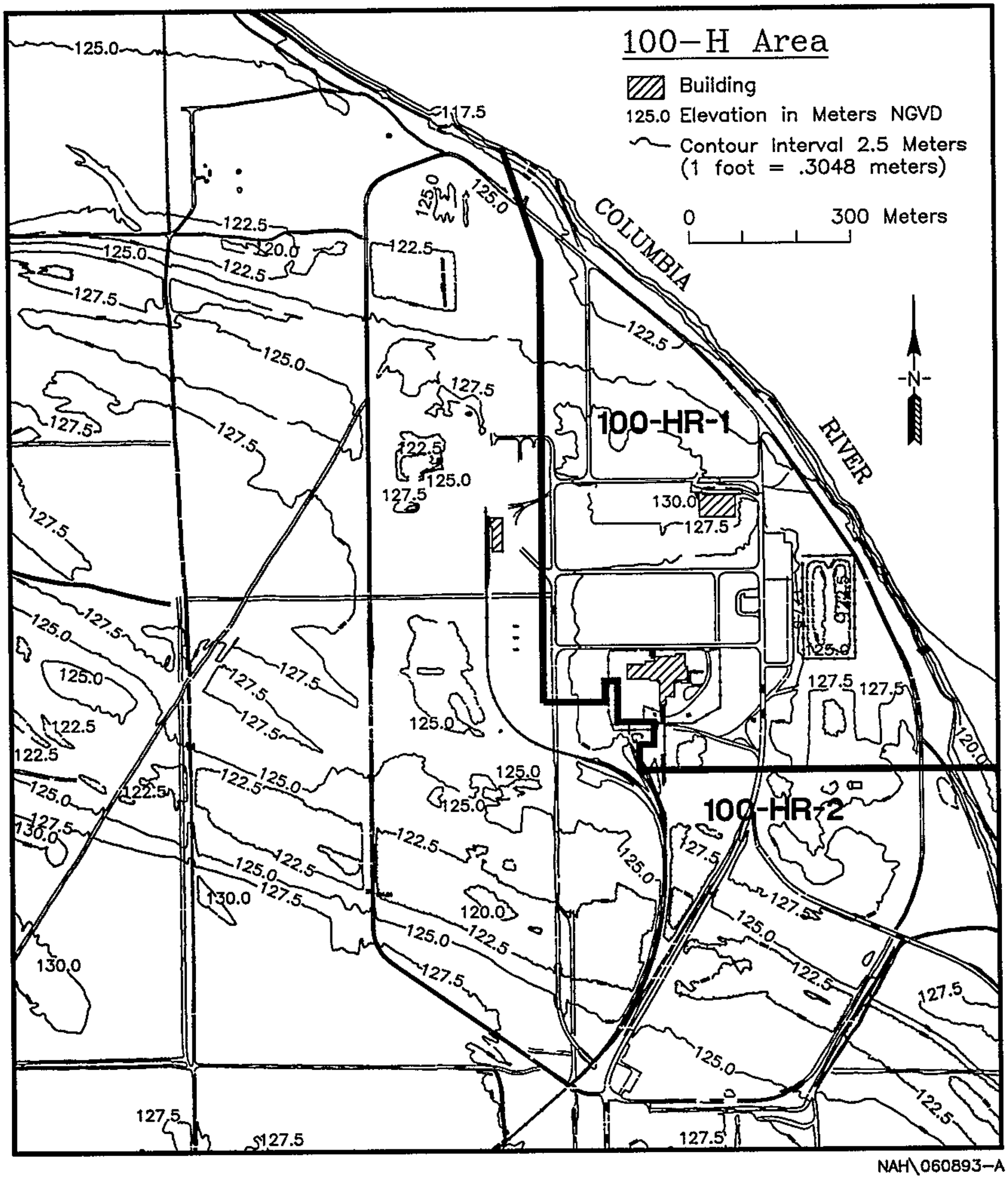


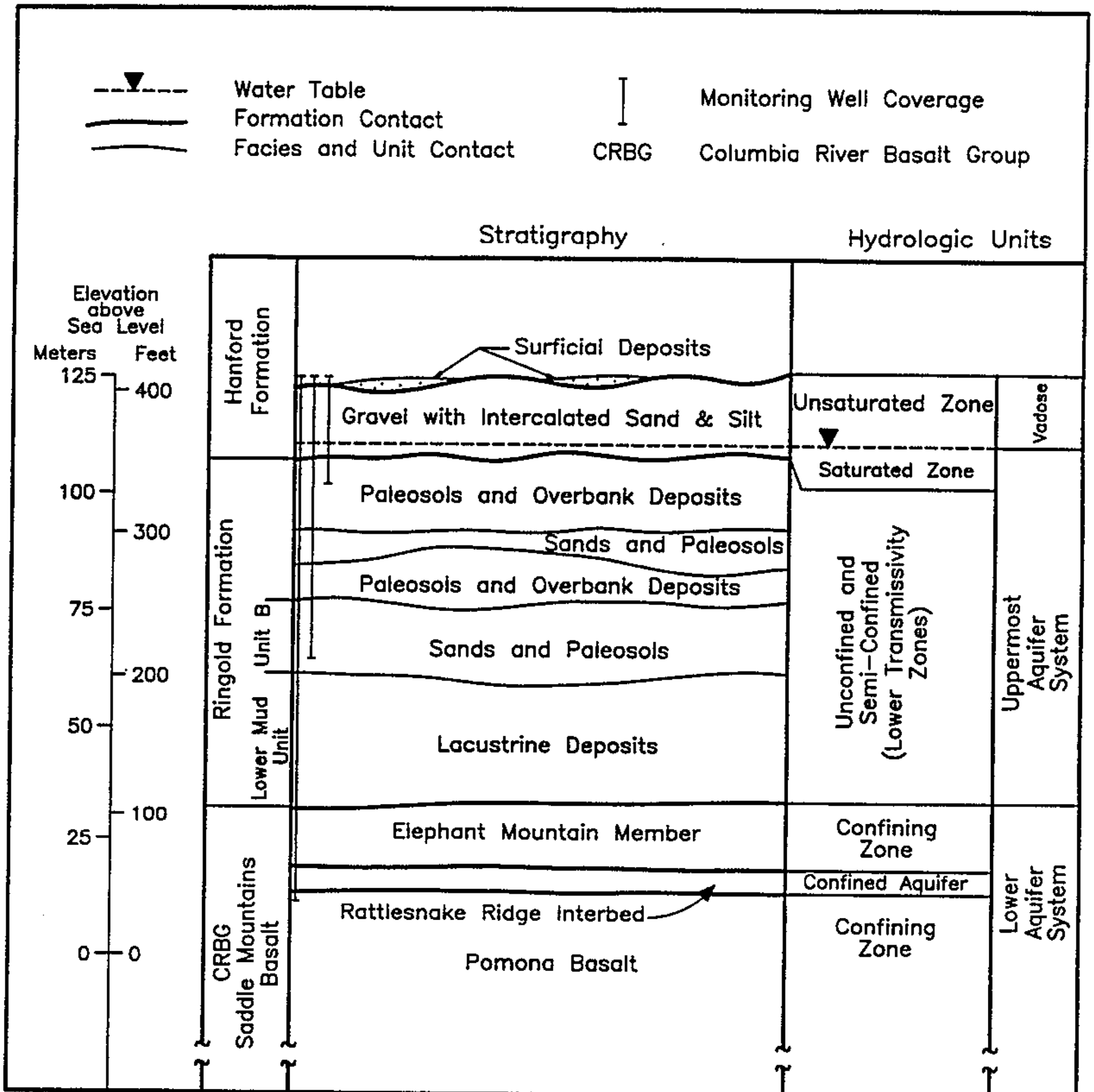
Figure 2-2. Asbuilt Status of 118-H-1 in July 1962.

Figure 2-3. Topographic Map of 100-H and Surrounding Area.



9312975.1035

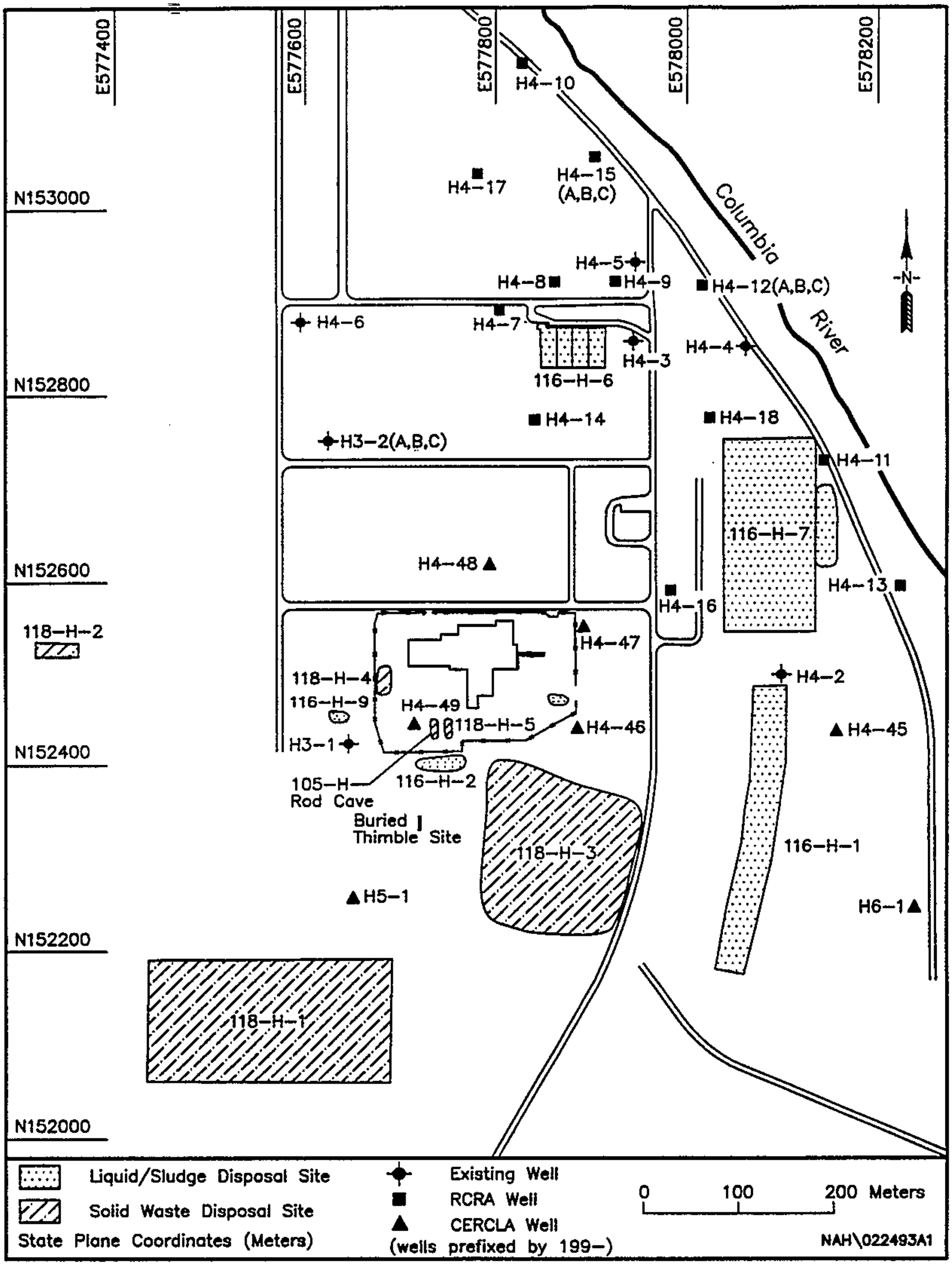
Figure 2-4. Generalized Hydrogeologic Setting of the 100-H Area.



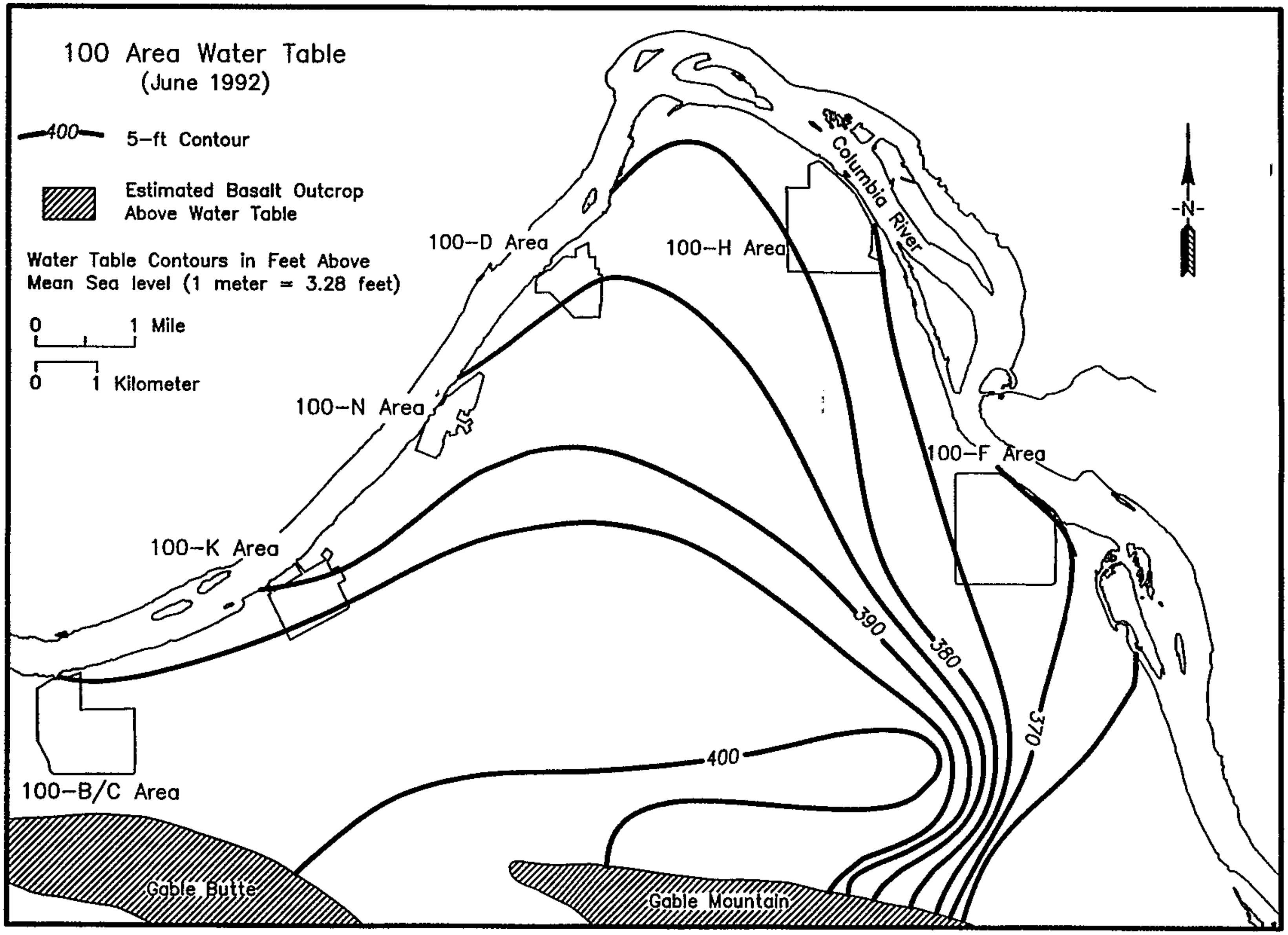
Adapted from Lindsey and Jaeger, 1993

KAL\021993A1

Figure 2-5. 100-H Area Well Locations.



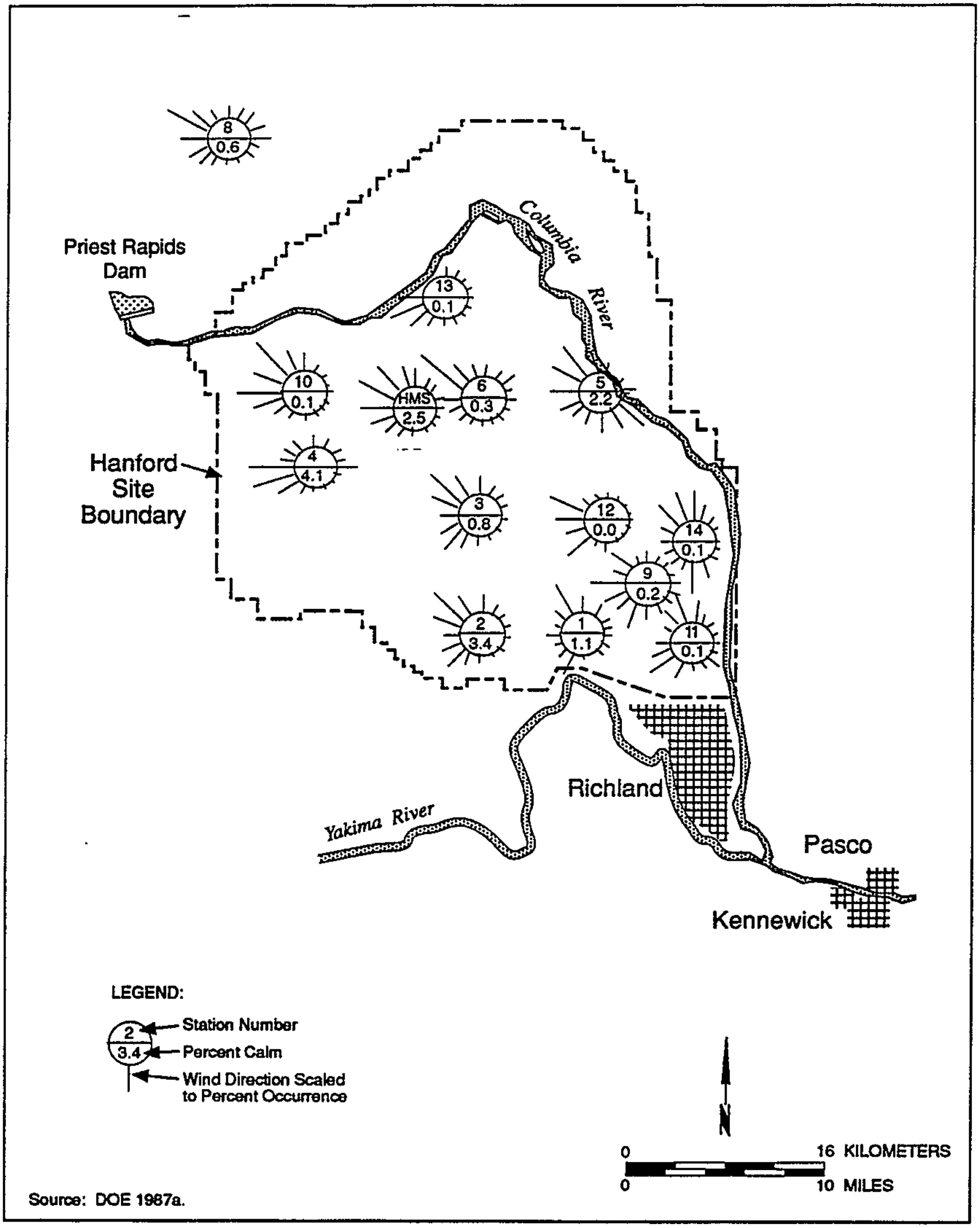
9312975.0004



NAH\060193-A

Figure 2-6. Water Table Elevations for June 1987.

Figure 2-7. Wind Roses for the Hanford Site.



903 1272/26030/8-4-92

Table 2-1. Summary Description of Original and Existing Facilities in the 100-HR-2 Operable Unit (1 of 4)

Current Designation (aliases)	Facility Type	Service Dates (status)	Facility Description/Purpose	Wastes Received or Handled
Burial Grounds				
118-H-1 (100-H Burial Ground #1, 100-H-1)	Burial Ground	1949 - 1965 Inactive	The site, located 1,300 ft. southwest of the 105-H Reactor Building, is approximately 700 ft by 350 ft and runs in an east-west direction. It consists of numerous trenches of various dimensions, generally running north and south. It is roughly 20 ft deep.	The site received an estimated 10,000 m^3 of waste consisting of: activated components - dummy elements, process tubing and horiz. control rods; misc. surface contaminated materials - broken hand tools, rags, sweeping compound, light bulbs, sheets of plastic and paper from zones, etc. Misc. wastes were sealed in boxes and placed in different trenches than the activated wastes.
118-H-2 (100-H Burial Ground #2, H-1 Loop Burial Ground)	Burial Ground	1955 - 1965 Inactive	The site, located 1,500 ft due west of the 105-H Reactor Building, is approximately 140 ft by 50 ft by 15 ft deep, and consists of two, in-line concrete vaults oriented in an east-west direction.	The site received an estimated 2 m^3 of waste. The east vault received one stainless steel double-tube with associated hardware (cleaning solutions and misc. capsule components). The west vault was used for disposal of contaminated pipe.
118-H-3 (Construction Burial Ground)	Burial Ground	1953 - 1957 Inactive	The site is located 800 ft due south of the 105-H Reactor Building. It is an uneven polygon with side lengths of approximately 100 ft, 375 ft, 313 ft and 400 ft. It runs in a northeast-southwest direction and is roughly 20 ft deep. There are only two trenches in this burial ground.	The site received an estimated 3,000 m^3 of waste consisting of sections of contaminated 16-inch pipe used as chutes for removal of thimbles from 105-H, reactor hardware, and components from reactor modification programs.
118-H-4 (Ball 3X Burial Ground)	Burial Ground	1953 - 1953 Inactive	The site is located inside the 105-H Exclusion Area fence, 100 ft directly west of the 105-H Reactor Building. It is approximately 150 ft by 30 ft, runs north and south, and consists of one trench roughly 10 ft deep.	The site received an estimated 20 m^3 of irradiated materials, such as vertical safety rod thimbles and guides, from 105-H during the Ball 3X Program.
118-H-5 (105-H Thimble Pit)	Burial Ground	1953 - 1960 Inactive	The site is inside the 105-H Exclusion Area fence, 200 ft south of the 105-H Reactor Building. It consists of one trench 30 ft by 2 ft and is roughly 10 ft deep.	The site received an estimated 30 m^3 of waste. A thimble assembly from the B Experimental Hole from the 105-H X-Level. In 1960 the 105-H Pluto Crib was excavated and placed in this burial ground.
105-H Rod Cave	Burial Ground	? - ? Inactive	The site is located inside the 105-H Exclusion Area fence, approximately 75 ft west of the 118-H-5 Thimble Pit. It consists of a concrete lined structure, approximately 40 ft by 25 ft, mostly underground. Gravel has been mounded over the top of the above ground portion.	The site is suspected to contain contaminated horizontal control rods and possibly other miscellaneous reactor facility components.
Buried Thimble Site	Burial Ground	? Inactive	The site is located, just south of the 116-H-2 Crib. It's in between and at the convergence of two railroad spurs running north and south. One concrete monument marks the site. It is reportedly 40 ft long.	The site is suspected to contain a vertical safety rod thimble.

Table 2-1. Summary Description of Original and Existing Facilities in the 100-HR-2 Operable Unit (2 of 4)

Current Designation (aliases)	Facility Type	Service Dates (status)	Facility Description/Purpose	Wastes Received or Handled
Low Priority Sites				
126-H-1 (184-H Powerhouse Ash Pit, 188-H Ash Disposal Area)	Ash Pit	1948 - 1965 Inactive	The site is located due west of the 184-H Powerhouse (demolished) and coal Storage Area.	Unknown amounts of coal ash were sluiced to this pit with raw river water. The ash has been analyzed using the EP Toxicity Test in accordance with WAC 173-303, no hazardous materials were found.
128-H-1 (100-H Burning Pit No. 1)	Burning Pit	1949 - 1965 Inactive	Located in the northwest corner of 100-H Area, the site is approximately 100 ft square by 10 ft deep.	An estimated waste volume is 10,000 m^3 of wastes. Nonradioactive, combustible materials, such as paint wastes, office wastes and chemical solvents.
128-H-2 (100-H Burning Pit No. 2)	Burning Pit	? - 1965 Inactive	The site is a depression roughly 120 ft by 80 ft located directly west of 118-H-1. It is a graded rocky area with little soil. There is little surface evidence, however, there are rocks that have been exposed to fire. The location of this site was verified by employees who used it.	Unknown amounts of nonradioactive, combustible materials such as vegetation, paint waste, office waste and chemical solvents.
128-H-3	Burning Pit	? - ? Inactive	The site is west of 118-H-1 and north of 128-H-2. It is covered with small rocks and very little dirt, it looks very similar to 128-H-2, but was not verified by past employees.	Suspected wastes are combustible materials, amounts are unknown.
1607-H1	Sanitary Septic System	1948 - ? Inactive Reactivated 1985 - present	The site consists of a septic tank and its associated tile field. It is located southwest of the 151-H Primary Substation. It serviced the 151-H and 105-H Buildings with a 50 person capacity. It now services people housed in the 100-H area. The tank is 15 ft by 5.5 ft by 14.5 ft deep, the tile field is 56 ft by 50 ft.	An unknown amount of sanitary sewage.
1607-H3	Sanitary Septic System	1948 - 1968 Inactive	The site consists of a septic tank and its associated tile field. It is located at the entrance to 100-H Area. It has a 100 person capacity and serviced the 1701-H Badge House, the 1720-H Security Patrol Change Room and the 1709-H Fire House. The tank is 18.5 ft by 7 ft by 13 ft deep and the tile field is 50 ft by 100 ft.	An unknown amount of sanitary sewage.
151-H	Electrical Substation	1948 - ?? Demolished (1978)	This facility was located approximately 800 ft due west of the 105-H Reactor Building. It supplied all normal electrical power to the 100-H Area. It contained two power transformers rated at 31,250 kva and associated transformers, capacitors, switchgear, etc. The building was demolished in situ, placing the debris in the basement and backfilling. The switchgear was reused at the 151-B Substation.	Potential PCB contamination in soils where oil-filled equipment was located.

Table 2-1. Summary Description of Original and Existing Facilities in the 100-HR-2 Operable Unit (3 of 4)

Current Designation (aliases)	Facility Type	Service Dates (status)	Facility Description/Purpose	Wastes Received or Handled
<u>Other Sites</u>				
184-H	Powerhouse	1948 - 1965 Demolished (1973)	The facility, located approximately 1,600 ft northwest of the 105-H Reactor Building, was 200 ft by 60 ft by 80 ft high. It provided steam and emergency electrical power to the 100-H Area facilities. It was constructed of a steel frame and concrete blocks, with two 300 ft concrete exhaust stacks. It housed one steam turbine-driven generator and two coal fired boilers.	Not applicable.
1701-H	Gate House	1948 - ? Demolished	The building was located at the entrance of the 100-H Area, in the southern tip of the area. It served as the area badge house and security check point. It was a 1,450 sq ft, two-story, wood framed structure with a concrete foundation and first floor, the second floor was wooden, the siding was shake and the roof was flat with tar and graveled surface.	Not applicable.
1709-H	Fire Headquarters	1948 - ? Demolished	The building was located at the entrance to the 100-H Area, in the southern tip of the area. It served as the area fire headquarters and provided office space for area personnel. It was approximately 112 ft by 58 ft by 12 ft high. It consisted of a single-story wood framed structure with asbestos shake siding, a concrete floor and foundation, and a gabled roof with composition shingles.	Not applicable.
1713-H	Warehouse	1948 - present	This building is located west of the 183-H Solar Evaporation Basins and in between the now demolished 151-H and 184-H buildings. It's "L" shaped approximately 156 ft by 62 ft and 72 ft by 60 ft, constructed of a steel frame with corrugated transite siding. The foundation and floor are concrete; the roof is built-up tar and gravel over flat prefabricated concrete tiles (re-roofed in 1987). There is approximately 13,000 sq ft of space and it is currently being used to store materials and equipment associated with the 183-H Evaporation Basins.	No wastes are handled at this facility.

9312975.0047

Table 2-1. Summary Description of Original and Existing Facilities in the 100-HR-2 Operable Unit (4 of 4)

Current Designation (aliases)	Facility Type	Service Dates (status)	Facility Description/Purpose	Wastes Received or Handled
1720-H	Patrol Headquarters	1948 - ? Demolished	This building was located at the entrance to the 100-H Area, in the southern tip of the area. It provided office space and associated facilities for the area security patrol. It was a single-story wood framed structure approximately 91 ft by 32 ft by 15 ft high. The foundation and floor were concrete, the siding was asbestos shake and the roofing was composition shingles. The facilities included locker, assembly, supply, wash and shower rooms, offices and a radio room.	Not applicable.
1720-HA (Arsenal)	Munitions Storage	1948 - ? Retired	The building is located at the entrance to the 100-H Area in the southern tip of the area. It is an 8 ft by 6 ft concrete structure that was used as a central storage area for ammunition used by the security patrol. It was also used to house explosives for decommissioning projects.	Not applicable.

Table 2-2. 100 Area Burial Ground Matrix

HANFORD AREA	LARGE SCALE BURIAL GROUNDS (multipurpose)		SMALL SCALE BURIAL GROUNDS (single purpose)		
	Primary Reactor Operations	Construction/Maintenance Modifications	Ball 3X Upgrade	Horizontal Control Rod Caves	Miscellaneous
100-BC	118-B-1 118-C-1	118-B-2 118-B-3	118-B-5	118-C-4	118-B-4 (spacers) 118-B-6 (^{3}H program metal waste) 118-C-2 (3X balls)
100-D/DR	118-D-1 118-D-2 118-D-3	118-D-4	118-D-5		118-DR-1 (gas loop components)
100-F	118-F-1	118-F-2	118-F-3		118-F-4 (silica gel) 118-F-7 (misc. components)
100-H	118-H-1	118-H-3	118-H-4	105-H Rod Cave	118-H-5 (thimbles) 118-H-2 (stainless steel tube) Buried Thimble Site
100-KE/KW	118-K-1				

Note: Two burial grounds not listed in the table are 116-F-5 and 116-F-6. They are biological burial grounds and do not contain reactor related wastes.

THIS PAGE INTENTIONALLY
LEFT BLANK

Table 2-3. Description of Reactor Components Disposed in 100-HR-2 Burial Grounds. (1 of 2)

Component	Function or Use	Description/ Dimensions	General Composition	Buried at 100-H Area
3X Balls	Used in the 3X safety system (backup to the VSRs). Replaced thimbles and liquid boron.	3/8" or 7/16" dia	70% nickel-plated boron steel 30% carbon steel	0 (~10 ton in 118-C-2)
Spacers (perfs)	Used to center the fuel column within the process tube and to prevent fuel elements from flushing to the rear cap. "Regular" spacers were recoverable for reuse, "expendables" were not, due to high dose rates from induced radiation.	8" long 1.4" O.D. perforated along the axis	Aluminum (6063 T6 alloy)	42.5 ton (total) 37.5 ton (irradiated)
Lead-Cadmium Element (dummies)	Laid end-to-end in the process tube for form a tube of "poison" (high neutron absorber). Used for eithr supplimental control during reactor start-up and operation or as total control during extended outages.	6" long 1.4" O.D.	95.88% lead 3 - 4% cadmium sealed in an aluminum casing	105.9 ton lead 4.4 ton cad.
Lead Brick	Used extensively for shielding purposes.	standard 25 lb brick	lead	16.1 ton
Lead Sheeting	Used for shielding.	.5 to .062 " thick	lead	.9 ton
Lead Casks	Used for shipping, Handling and shielding purposes.	2 to 4" of lead sandwiched between stainless steel, fabricated into different configurations.	lead	8.6 ton
Lead Wool	Used for calking or blanket sheilding.	similar to steel wool.	lead	.2 ton
Gun Barrels	Supports and protects the process tube as it passes through the gas plenum and the biological and thermal shields. Provides support and connection point for nozzle assemblies.	~7.5 ft long 1.8" O.D. approx. first 10" gets irradiated.	SCH 40 carbon steel	1 ton
Horizontal Control Rod (HCR)	Controls reactor power level.	~75.5 ft long total poison tip is 29 to 32" long with a 3.5 x 1.5" cross section.	aluminum (63-ST-S) poisin is sintered boron-carbide and aluminum	1.2 ton

Table 2-3. Description of Reactor Components Disposed in 100-HR-2 Burial Grounds. (2 of 2)

Component	Function or Use	Description/ Dimensions	General Composition	Buried at 100-H Area
Vertical Saftey Rod (VSR)	Saftey system designed to shut down the reactor and hold it subcritical.	~40 ft long total 3" O.D. poison tip ~32 ft	chrome plated carbon steel tube with a 5% boron 95% graphite core	2.2 ton
Thimble	Was used as part of the first 3x safety system (backup to the VSR sys). Was the sleeve lining the VSR channel, the bottom was capped. Also lined the HCR channels as a seal.	~35 ft long 3.5" dia .15" thick	aluminum	2.75 ton
Nozzle Assemblies (nozzel and pigtail)	Mounted on the front and rear of each process tube. Provides entry or exit of fuel elements from the process tubes, also provides connection point (via the pigtail) for cooling water and a flow measuring device.	nozzle ~10 lb pigtail ~2 lb	nozzles were aluminum cast or carbon steel cast pigtails were aluminum or stainless steel	15 ton
Thermocouple Wires	Used to monitor temperatures. Strung in pairs (positve and negitive leads), in selected process tube channels.		pos. 80% Ni 20% Cr neg. 97% Ni 3% silicon	37 lb
Splines	Used as a supplemental power control during reactor operation.	~30 ft long .5" wide .05" thick	12% boron-carbide sintered with 88% aluminum	7 ton
Process Tubes	Housed fuel elements through the reactor core.	~40 ft long 1.75" I.D. .125" wall thick	Aluminum or Zircaloy-2	26.6 ton

Table 2-4. Evaluation of Hanford Coal Ash as a Potential Dangerous Waste.

Contaminant	EP toxicity analysis of 6 composite samples of Hanford Site coal ash (mg/ml in extract)	EPA guidelines* EP toxicity list minimum dangerous waste concentrations (mg/ml in extract)
Arsenic	<0.2	5
Barium	2.9	100
Cadmium	<0.05	1
Chromium	<0.05	5
Lead	<0.1	5
Mercury	<0.001	0.2
Selenium	<0.1	1
Silver	0.01	5

Source: Rasmussen and Carlson (1987)
*WAC 173-303
EP = Extraction Procedure

THIS PAGE INTENTIONALLY
LEFT BLANK

3.0 INITIAL EVALUATION

This chapter provides an initial evaluation of contamination in the 100-HR-2 operable unit. It includes a summary of information on contaminants, an evaluation of Corrective Action Requirements (CARs) which are potential legally applicable or relevant and appropriate requirements, a preliminary site conceptual model of contaminant transport, and an evaluation of the potential impacts to human health and the environment.

The waste sites in the 100-HR-2 operable unit received very low scores from the Hazardous Ranking System (HRS) evaluation of the Hanford Site (Stenner et al. 1988). Scores in the 100-HR-2 operable unit ranged from 0.08 to 1.17. By comparison, high priority liquid waste disposal sites in the 100 Area scored in the range of 40 to 50. Sites with scores above 28.8 are to be listed on the National Priority List.

3.1 KNOWN AND SUSPECTED CONTAMINATION

To determine the presence or extent of contamination at a site caused by a given event or activity, a summary of background levels of the pollutants must be made. Westinghouse Hanford has proposed a Hanford-Site-wide approach to the characterization and use of background data for environmental restoration at the Hanford Site, and has developed a plan for systematic sampling of the vadose zone (Hoover and LeGore 1991). An evaluation of existing groundwater background data and models is also planned for fiscal year 1992, followed by groundwater sampling and analysis (Hoover and LeGore 1991).

The only previous burial ground sampling efforts in the 100 Areas is reported in Dorian and Richards. It was limited to the 118-B-1 Burial Ground in the 100-BC-2 operable unit and focused on characterizing radiological contamination with no sampling for hazardous chemical contaminants. There are similarities between the 118-B-1 Burial Ground and some of the burial grounds in 100-HR-2, for example, some of the reactor component wastes are similar as are some of the site characteristics. As historical records are examined in more detail, some facility characteristics may be determined to be analogous such that data from these facilities may be useful in describing similar burial grounds in the 100-HR-2 operable unit.

Some sampling has been conducted for the 100-HR-1 operable unit addressing both radiological and chemical contaminants, however, the sampling pertains to liquid waste source units and may only be indirectly applicable to the solid waste source units in the 100-HR-2 operable unit. Some historical data on the general use of inorganic chemicals are available but quantification of nonradioactive inorganic species is minimal. Recent investigations in other 100 Area operable units should provide useful data, with respect to septic system and burn pits, to the investigations in the 100-HR-2 operable unit.

Much of the available related to the 100-HR-2 operable unit are presented and evaluated in Chapter 2; therefore the goal here is to describe the contaminants of concern as a whole based on information presented in Chapter 2. Data from the 100-HR-3 Source Data Compilation will be used as appropriate. Groundwater and biota investigations are referenced to, Sections 3.1.3, 3.1.4, and 3.1.6 respectively, of the 100-HR-3 operable unit work plan (DOE-RL 1992a).

3.1.1 Sources

The 100-HR-2 operable unit includes sources generated from the operation of H Reactor and its ancillary facilities. These sources have been described in Section 2.1.4 and the waste generating processes have been described in Section 2.1.3 of this work plan. Figure 2-1 shows the approximate location of the waste units (118-H-1, 118-H-2, 118-H-3 118-H-4, 118-H-5, 105-H Rod Cave, Thimble Burial Site, 126-H-1, 128-H-1, 128-H-2, 128-H-3, 151-H, 1607-H1, and 1607-H3). Information on the potential contaminants originating from these waste units is summarized in Table 3-1. Facilities (existing and demolished), not considered potential waste sites; are the 184-H Powerhouse, the 1701-H Badge House, the 1709-H Fire Station, the 1713-H Warehouse, the 1720-H Security Patrol Change Room and offices, and the 1720-HA Arsenal (Figure 2-1).

These facilities, waste management units, and the soils beneath them are the contamination sources which will be considered in this RFI/CMS. Primary references for radionuclide inventories are Stenner et al. (1988) and Dorian and Richards (1978). The inventories are based on documented disposal information rather than measurements at the waste units. It is important when interpreting the data in this section that attention be paid to the amount of radioactive decay that has taken place since the data were gathered.

The preliminary contaminants of concern at the 100-HR-2 operable unit are listed in Table 3-1. The list was developed based on the types and quantities of wastes presented in Section 2.1.4. Further review of historical information or determination of analogous facilities may identify other potential contaminants of concern.

3.1.2 Soil

Except for septic tank effluents, most wastes intentionally disposed of directly into the 100-HR-2 operable unit soils were composed of solid wastes. Herbicides are routinely applied to burial ground covers to prevent the establishment of deep-rooted plants and subsequent uptake of radionuclides. In general no herbicides have been detected in the groundwater under the monitoring program described in the 100-HR-3 operable unit work plan (DOE-RL 1992a). Some burning pits may have also discharged some contaminants to the soil.

3.1.2.1 Background Soil Quality. No background soil data have been taken specifically for the 100-HR-2 operable unit RFI/CMS. Surface soil samples are collected periodically at a number of locations to determine the extent of contamination both on and off the Hanford Site as part of the Hanford Environmental Monitoring Program (Woodruff and Hanf 1991). These samples are analyzed for a limited range of radionuclides, and are purposely taken from areas where radionuclide levels are most easily detected. Samples on the Hanford Site are collected at locations adjacent to predominant facilities or areas. Off-site samples are collected around the Hanford Site perimeter, generally in a downwind direction, with some being collected upwind at distant locations to establish a background for comparison. The sample locations are shown in Figure 3-1 and data collected in 1991 are presented in Table 3-2. Concentrations of ^{90}Sr, ^{137}Cs, ^{239,240}Pu, and uranium taken in 1991 did not significantly differ from those obtained in previous years. Also, on-site concentrations did not differ significantly when compared to off-site concentrations. Figure 3-2 shows median, maximum, and minimum values for 1991 and the preceding five years.

A preliminary soil background study was conducted in 1991 (Hoover and LeGore 1991) that analyzed soil samples for inorganic constituents. Figure 3-3 shows the sample locations and the provisional soil background threshold values derived from these analyses as shown in Table 3-3. The background threshold value represents the level at which samples are considered to within the natural background range, or conversely, above which samples may be considered to exceed background levels.

3.1.2.2 Soil Contamination. No surface or subsurface soil sampling stations are located in the 100-HR-2 operable unit as part of the Hanford Environmental Monitoring Program. As part of the near-field environmental surveillance program for the 100 Areas (Perkins 1990), surface soils from two stations in the 100-HR-1 operable unit (shown in Figure 3-4) have been annually analyzed for various radionuclides. Sample locations were chosen adjacent to retired waste disposal facilities to maximize the potential for detecting contamination. The following radionuclides were detected: ^{60}Co, ^{90}Sr, ^{137}Cs, ^{238}Pu, $^{239/240}$Pu.

Results of analyses from 1990 are shown on Table 3-4 (Perkins 1990). These results from 100-H Area will provide indication of soil radionuclide concentrations which might be expected near similar facilities in 100-HR-2.

3.1.3 Groundwater

A substantial amount of information is available on the quality of the groundwater in the 100-H Area. The known nature and extent of groundwater contamination in the vicinity of the 100-HR-2 operable unit is discussed in detail in Section 3.1.3 of the 100-HR-3 operable unit work plan (DOE-RL 1992a). Groundwater in and adjacent to the 100-HR-3 operable unit has been widely contaminated by constituents in wastes disposed of in the 100 Area (Jaqish and Bryce 1990). Detailed studies in the vicinity of the 116-H-6 evaporation ponds indicate that there is contamination up gradient of the facility but that there is a contribution of contaminants from liquid wastes from the facility. Most of the constituents in waste disposed to the basin, other than chromate, do not have obvious distribution patterns, but concentrations are generally lower in wells to the south and southwest than in the north or east (DOE 1992a). Although there does not appear to be significant contamination of groundwater resulting from waste sites in the 100-H area other than from liquid disposal site, groundwater, data from other historical records will be evaluated during the limited investigations.

3.1.4 Surface Water and Sediment

The known and suspected nature and extent of contamination in the Columbia River water column and sediment are discussed in Section 3.1.4 of the 100-HR-3 operable unit work plan (DOE-RL 1992a). The comparison of water quality between Columbia River upstream of Hanford and the Richland Pumphouse, just south of the 300 Area (Figure 1-1), indicates the possible influence of Hanford on surface water quality. In general, concentrations of nonradiological water quality parameters were similar at the two locations (DOE-RL 1992a). Quantification of the 100-HR-3 impact will require specific studies at and adjacent to the 100-HR-3 operable unit. This information, as well as specific runoff events that may have caused potential sources of contamination, will be investigated during the RFI for the 100-HR-3 operable unit.

3.1.5 Air

Current releases of contamination into the air from the 100-HR-2 operable unit could only be from fugitive dust from contaminated areas of the operable unit. Air investigations and contamination are discussed in greater detail in Section 3.1.5 of the 100-HR-1 operable unit work plan (DOE-RL 1992c). Air quality monitoring results documented in the 100-HR-1 work plan indicate that measured constituents do not exceed average background concentrations by more than two standard errors of deviation of the instrument backgrounds (Table 3-5).

3.1.6 Biota

Information pertaining to contamination of terrestrial biota exclusive of the riparian zone can be found in Section 3.1.6 of the 100-HR-1 operable unit work plan (DOE-RL 1992c). The results of sampling of terrestrial flora and fauna is presented in Table 3-6 and Table 3-7 respectively. Information regarding contamination of aquatic biota in the Columbia River and the riparian zone from releases of hazardous substances from the 100-HR-2 operable unit is evaluated in Section 3.1.6 of the 100-HR-3 operable unit work plan (DOE-RL 1992a).

3.2 POTENTIAL CORRECTIVE ACTION REQUIREMENTS (CARs)

Corrective action at the 100-HR-2 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. As stated in Chapter 1.0, cleanup of the 100-HR-2 operable unit will be addressed under RCRA corrective action authority. Cleanup requirements for RCRA corrective actions (40 CFR 264.100) are not as fully documented as are those for remedial actions under CERCLA. The EPA has, however, identified groundwater protection standards for RCRA corrective actions, and has stated that other "relevant and applicable standards for the protection of human health and the environment" are to be identified in the RFI/CMS process.

Since the investigations described in this work plan are intended to aid in the definition of contaminant characteristics in the 100-HR-2 operable unit, the initial CARs cover a wide scope and are therefore referenced to Section 3.2 of the 100-HR-1 operable unit work plan (DOE-RL 1992c). The contaminant specific requirements addressing currently known or suspected contaminants that may be present in the 100-HR-2 operable unit include the same requirements as listed in Sections 3.2.1.1 and 3.2.1.2 of the 100-HR-1 work plan (DOE-RL 1992c).

3.3 POTENTIAL IMPACTS TO PUBLIC HEALTH AND THE ENVIRONMENT

This section presents a conceptual model of exposure pathways. Information on waste sources, pathways, and receptors is used to develop a conceptual understanding of exposure pathways for evaluation of potential risks to human health and to the environment.

This preliminary assessment is based on current land and water use in the 100-HR-2 operable unit and the Columbia River. This is appropriate since DOE is currently maintaining active institutional controls of the Hanford Site. However, the possibility and consequences of future residential, agricultural, commercial/industrial, or recreational land uses will need to be considered for determining potential risk to receptors under these scenarios. The methodology for conducting both a qualitative and baseline risk assessment for future potential land use scenarios is described in the Hanford Site Baseline Risk Assessment Methodology (DOE-RL 1992d). The conclusions of this section are tentative, and will be subject to refinement based on the risk assessment methodology and as data are gathered throughout the RFI/CMS.

3.3.1 Conceptual Exposure Pathway Model

Based on information presented thus far and the human exposure model presented in the Hanford Site Baseline Risk Assessment Methodology (DOE-RL 1992d), a preliminary conceptual model of potential contaminant exposure pathways for the 100-HR-2 operable unit was developed. This model, which focuses on the current understanding of the operable unit, is presented in Figure 3-5. The model also includes media (i.e., groundwater, surface water and biota) that are specifically investigated under the 100-HR-3 operable unit work plan.

Each exposure pathway must contain the following in order for there to be a potential impact on human health or the environment (EPA 1989a):

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

3.3.1.1 Sources. Potential primary contaminant sources in the 100-HR-2 operable unit include solid waste burial grounds, burning pits, ash pits, and sanitary sewage transfer, treatment, and disposal units. The burial grounds are considered the most significant sources in this operable unit. The burning pits, ash pits and septic systems have been assessed as low priority sites.

Soils at the 100-HR-2 operable unit may serve as a secondary contaminant source. Once a release to the environment occurs, contaminants can be bound in soils before being slowly re-released or they can be directly encountered by intrusion. Soil is indicated in Figure 3-5 as a secondary contaminant source.

Preliminary information on each of the 100-HR-2 operable unit waste facilities and their associated contaminants is presented in Section 2.1.4. Waste inventories have been estimated for some sources, where data are available. A summary of the known extent of soil contamination is provided in Section 3.1.2. Groundwater, surface water, and river sediments are addressed in the 100-HR-3 operable unit work plan.

3.3.1.2 Release Mechanisms. Release mechanisms can also be divided into primary and secondary categories. A primary release is one from a primary contaminant source, such as a release from a septic system's drainage field to the soil; a secondary release is one that occurs for example, from the contaminated soil to the groundwater.

As indicated in Figure 3-5, the primary release mechanisms at the 100-HR-2 operable unit are infiltration and loss of containment. Wastes from septic system have infiltrated into underlying and adjacent soils. This infiltration potential may also exist for solid waste burial grounds, but is considered negligible due to insufficient moisture for contaminant migration. Also, there is no evidence that such a release has yet occurred. Infiltration from solid waste burial grounds is acknowledged in Figure 3-5 by depicting the pathway with dashed lines. A more significant release mechanism for burial grounds would be from the loss of the mechanical means by which contaminants are confined within the burial trenches, i.e., broken drums or decayed cardboard boxes.

The secondary release mechanisms are biotic intrusion, fugitive dust, and infiltration. Due to the routine surveillance and stabilization programs for burial grounds, biotic intrusion into a burial ground would most likely be limited to burrowing animals. Burrowing animals would also be the most plausible cause of fugitive dust. Biotic intrusion and fugitive dust are weighted evenly in potential significance. Infiltration could be more significant, however, it may be limited to sanitary sewage and ash pit wastes. Sanitary sewage and ash pit sites received wastes in conjunction with large amounts of water, much more than would naturally occur through precipitation.

3.3.1.3 Environmental Transport Media. In developing the preliminary conceptual model the follow were identified as transport media. Contaminants in the soil can be transported to the surface by burrowing animals or possibly plant root uptake. Contamination could then migrate through wind transport dispersion. Biota could also be a transport medium through ingestion, absorption or carrying contamination lodged in fur. Contaminants can infiltrate the soil column and eventually reach the groundwater, which in turn, transports the contaminants to the Columbia River. Ground water and surface water transport within the 100-HR-2 operable unit are considered negligible because of minimal driving precipitation.

Preliminary results of ongoing ecological studies in the 100 areas involving the sampling of ant mounds and small mammal burrows indicate that heavy metal levels are very low or undetectable in ant mounds; small mammal burrows exhibit higher levels of aluminum and chromium. All levels reported are substantially below those considered to be of environmental concern.

The concentrations of cesium-137 and strontium-90 were very low or undetectable in both ant mounds and small mammal burrows. Only one sample, from a small mammal burrow, collected in the 100-N Area exceeded 1 pCi/g strontium-90. Radionuclide levels at small mammal burrows and ant mounds are generally comparible to or lower than levels reported for soils in the 100 Areas through the routine monitoring program. The evidence to date indicates that ants and small mammals do not bring contaminants to the surface where wind transport occurs.

3.3.1.4 Exposure Routes. Receptors can be exposed to contaminants through the following routes:

- Uptake of soil contaminants (for plants) or ingestion of contaminated materials and biota (for animals and humans)
- Inhalation of contaminants in the ambient atmosphere
- Direct contact with contaminated media, including dermal and/or external exposure to radionuclides

3.3.1.5 Receptors. Receptors are organisms that have the potential for exposure to the released contaminants. Figure 3-5 divides this component of the pathway into humans and biota.

Due to access controls, the most likely potential for current human exposure to the 100-HR-2 operable unit contaminants is to onsite workers. Most, if not essentially all, of the contamination is now buried beneath the ground surface; therefore the workers with the greatest potential for exposure are those who will be involved in conducting remedial activities for this project. The principles of ALARA (As Low As Reasonably Achievable) will be applicable to conducting activities in areas where there is a potential for human exposure.

The most likely point of exposure for terrestrial animals (especially burrowing animals) is exposure by direct contact, inhalation, and ingestion of contaminated soil, water, plants, and animals. Terrestrial plants may be exposed in the root zone, where they could absorb buried contaminants or reach contaminated groundwater in the riparian zone. The likely exposure points in the aquatic environment are covered in Section 3.3.1 of the 100-HR-3 operable unit work plan.

3.3.2 Assessment of Need for ERAs

ERAs are either removal actions under the DOE authority of the Atomic Energy Act, removal actions under CERCLA 40 CFR 300.415, or interim measures under RCRA proposed 40 CFR 264.540. In deciding whether an ERA is appropriate, both technical engineering judgement, and an evaluation of potential threat to human health and the environment are considered. The decision to conduct an ERA is based on the immediacy and magnitude of the potential threat to human health and the environment, the nature of appropriate corrective action, and the implications of deferring the corrective action. Basically, ERAs are conducted when an unacceptable health or environmental risk and a short-time frame available to mitigate the problem exist. During work plan scoping, it was determined that ERAs are not currently warranted in the 100-HR-2 operable unit.

The following discussion briefly reviews the assessment of the need for ERAs, which was based on the current understanding of site conditions. The conclusions in this section will be subject to refinement as data is collected throughout the RFI process.

3.3.2.1 Human Health. Based on the existing environmental data discussed in Section 3.1, and the exposure pathways discussed in Section 3.3.1, the 100-HR-2 operable unit does not appear at this time to pose an immediate danger to human health. The conceptual exposure pathway model indicates that on site workers are currently the most significant potential human receptor population. Essentially all of the contamination is below the ground surface, and on site controls are sufficient to prevent contact with contaminants. No intrusive field activities will be performed within the boundaries of the 100-HR-2 operable unit as part of this RFI. The general considerations, requirements, procedures and plans set forth in the Health and Safety Plan developed for remedial investigation activities at the 100-HR-1 operable unit (DOE-RL 1992c, Appendix B) will adequately cover the surface investigations being done at the 100-HR-2 operable unit. The plan specifies site control and personnel monitoring procedures that will ensure the health and safety of those involved with the field portions of the project.

3.3.2.2 The Environment. Existing information and ongoing Hanford Site monitoring, as well as site access restrictions, and the exposure pathways discussed in Section 3.3.1, indicate that imminent and substantial endangerment to the environment does not exist within the 100-HR-2 operable unit. Essentially all of the contamination is below the ground surface, and as such is inaccessible to most animals. Preliminary results from studies of burrowing animals in the 100 Area indicate that concentrations of potential contaminants are at or below background or nondetectable. Herbicides are routinely applied to prevent the establishment of deep-rooted plants and subsequent uptake of radionuclides. Detailed findings of ongoing environmental monitoring studies will be reported and documented in the RFI report.

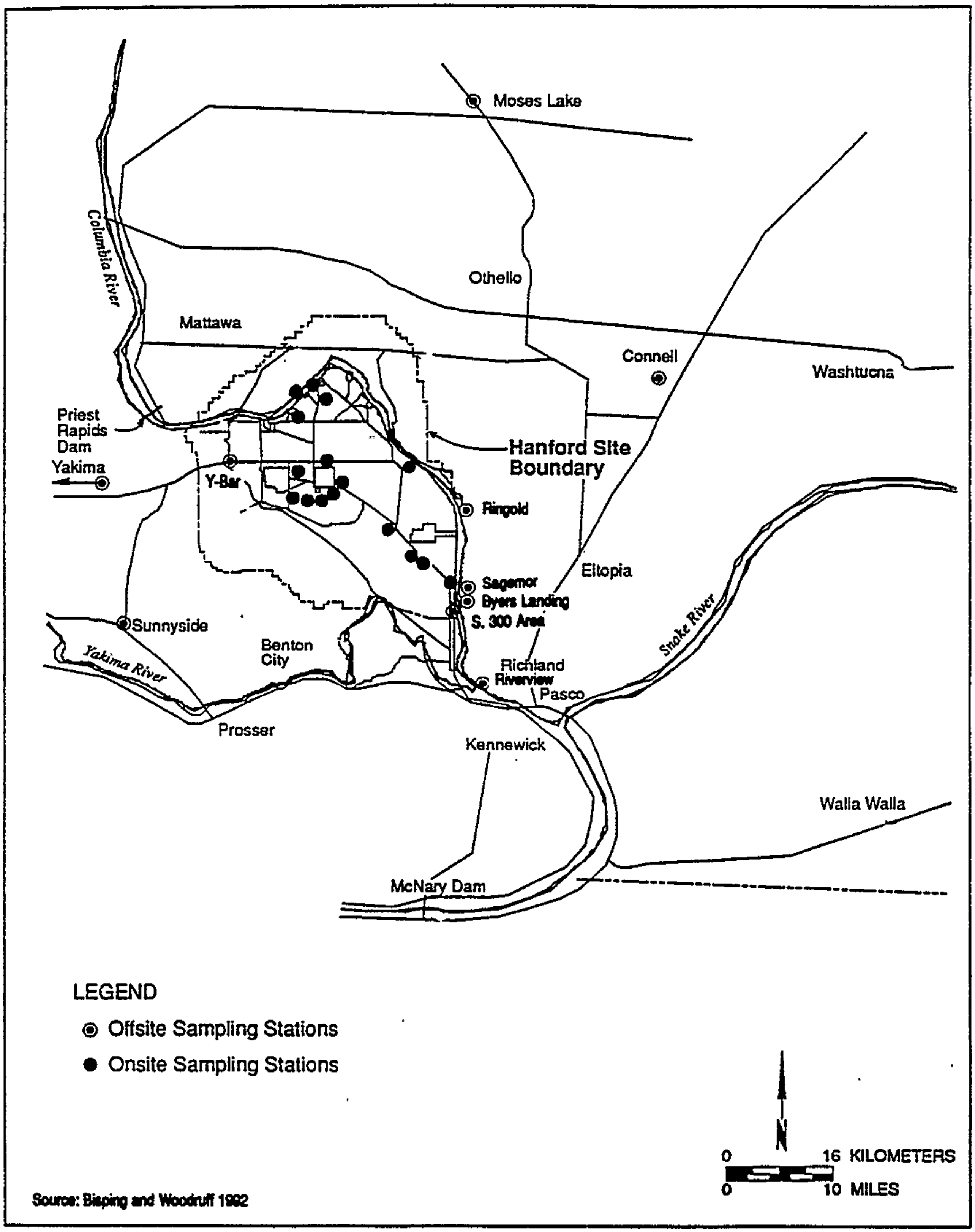
3.4 PRELIMINARY CORRECTIVE ACTION OBJECTIVES AND CORRECTIVE ACTION ALTERNATIVES

This section develops preliminary corrective action objectives, general response actions, remedial technologies and process options, and a range of preliminary corrective action alternatives for the 100-HR-2 operable unit. Corrective action objectives may change or be refined as additional site data are gathered and evaluated during the LFI and implementation of the IRMs. In addition, the observational approach is described and incorporated throughout this work plan with a bias towards action through implementation of IRMs. This approach and the *Hanford Site Past-Practice Strategy* (DOE-RL 1991a) are used to limit the range of corrective action alternatives which will be evaluated in the focused feasibility study, if necessary.

The preliminary corrective action objectives and range of preliminary corrective action alternatives for facilities within the 100-HR-2 operable unit are similar to those presented in the 100-HR-1 work plan. General response actions are identified and represent broad classes of corrective actions that may be appropriate to achieve the corrective action objectives.

Figure 3-6 identifies the interim corrective action objectives, the general interim response actions, the interim remedial technologies, and the process options. A detailed discussion of objectives and alternatives can be found in the 100-HR-1 operable unit work plan (DOE-RL 1992c) since the considerations are of a general nature.

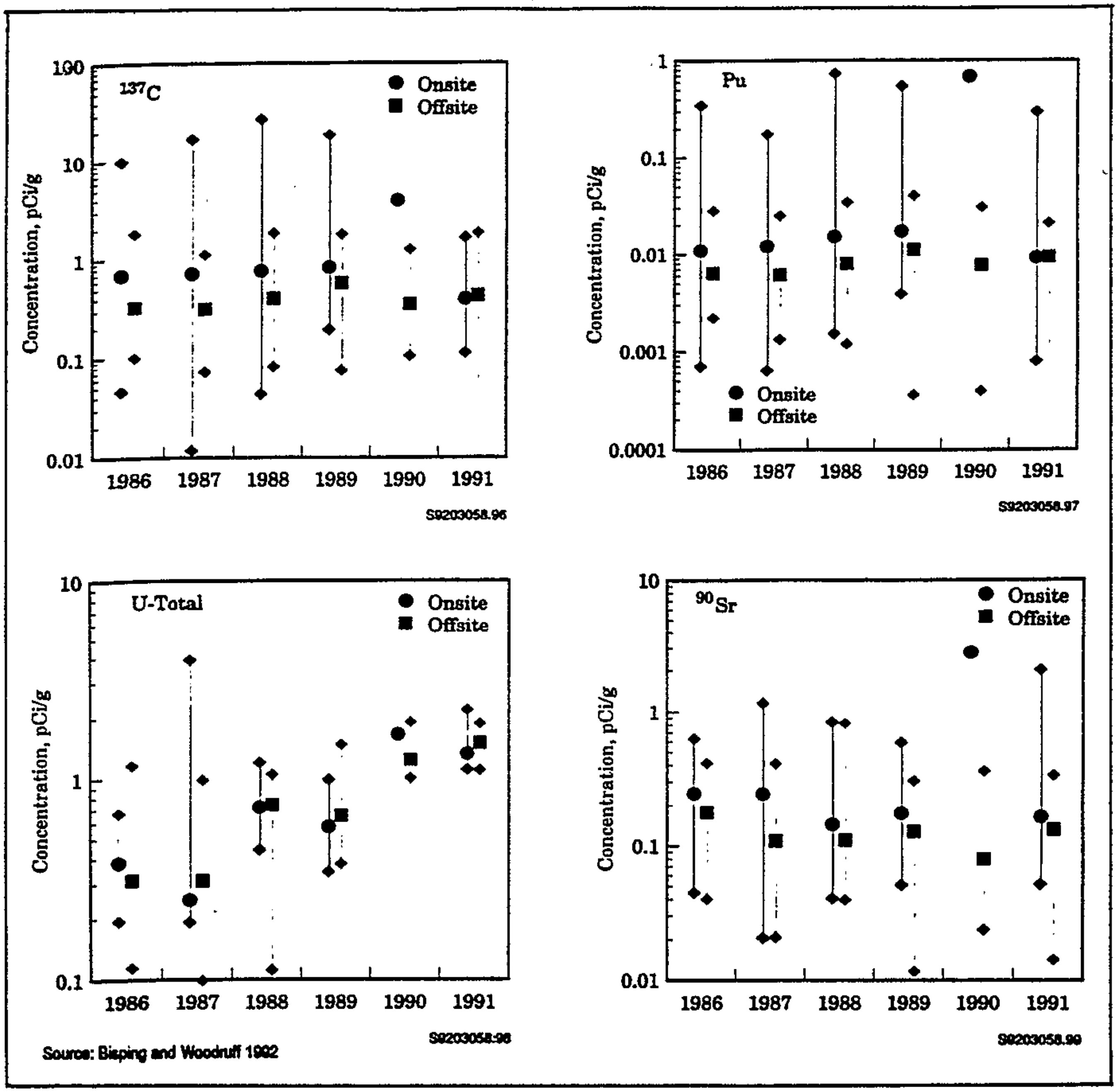
Figure 3-1. Environmental Monitoring Stations for Soil and Vegetation.



903 1272/26461/8-4-92

9312575.0061

Figure 3-2. Median, Maximum, and Minimum Strontium-90 (^{90}Sr), Cesium-137 (^{137}Cs), Plutonium-239,240 ($^{239,240}Pu$), and Uranium Concentrations Measured in Soil On and Off the Hanford Site, 1986 through 1991. Units are pCi/g (dry weight).



Source: Bisping and Woodruff 1992

Figure 3-3. Hanford Soil Background Study Inorganic Sampling Sites.

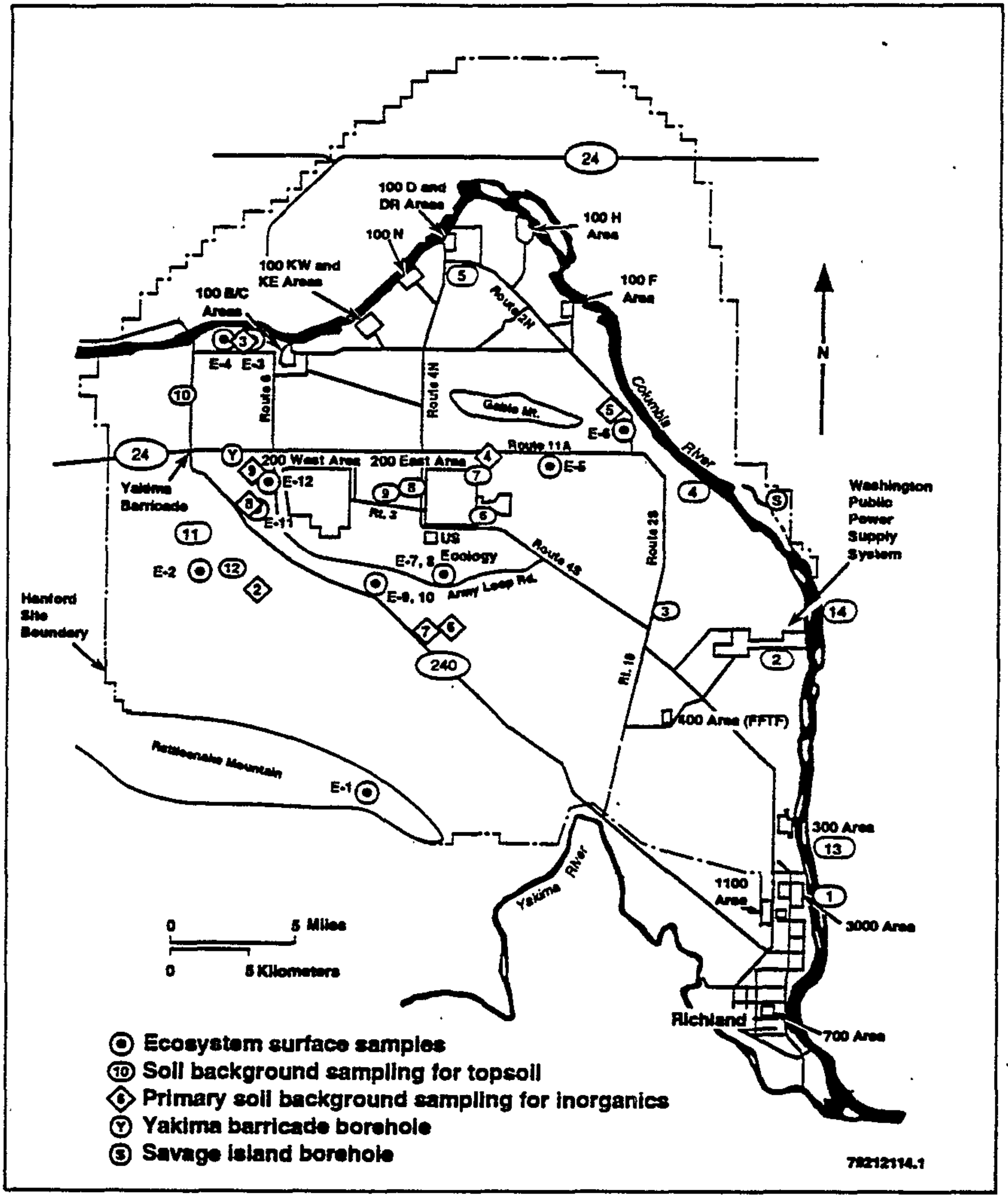
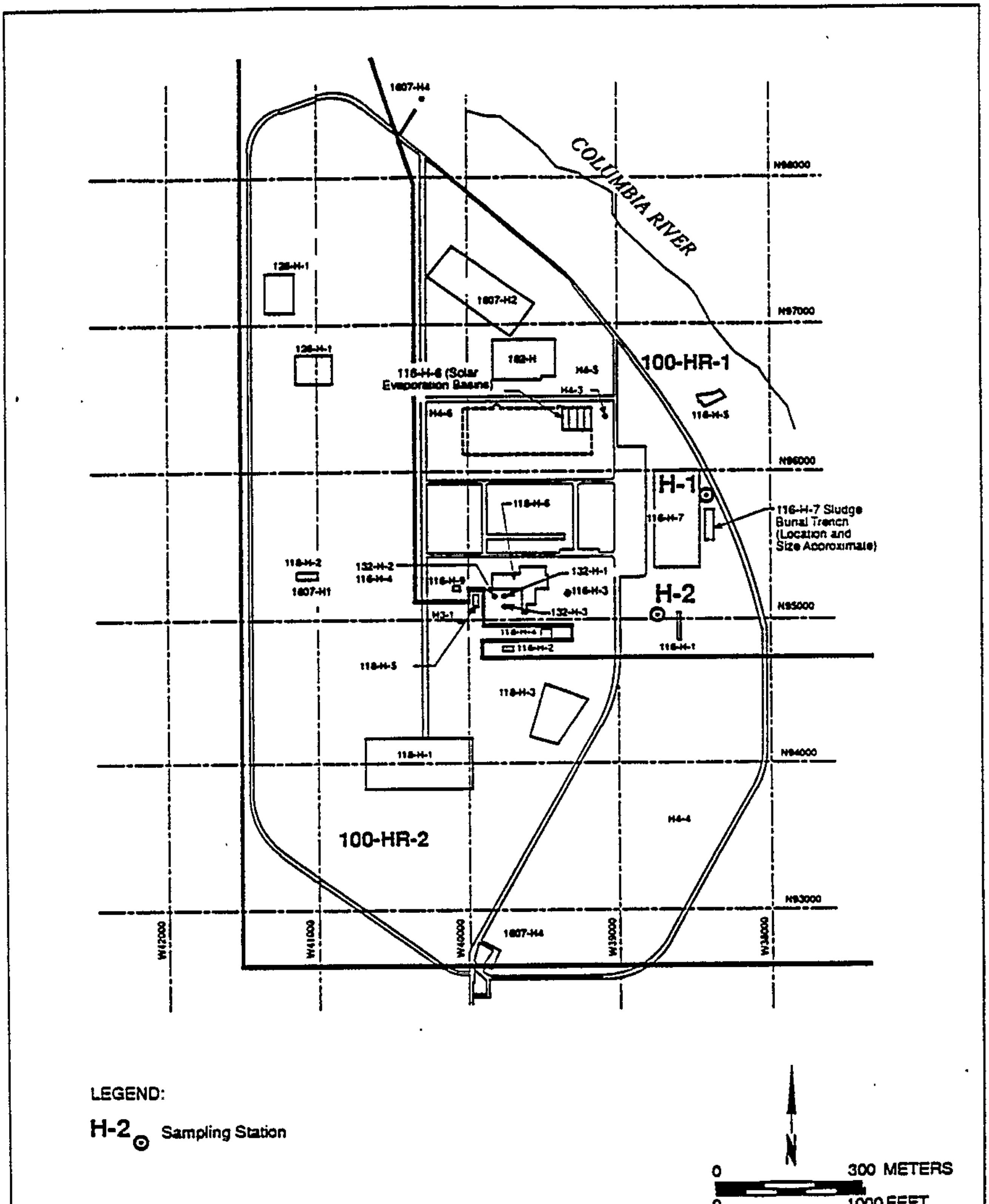


Figure 3-4. The 100-H Area Soil and Vegetation Sampling Stations.



Source: Adapted from Jacques 1987.

903 1272/36273/8-4-92

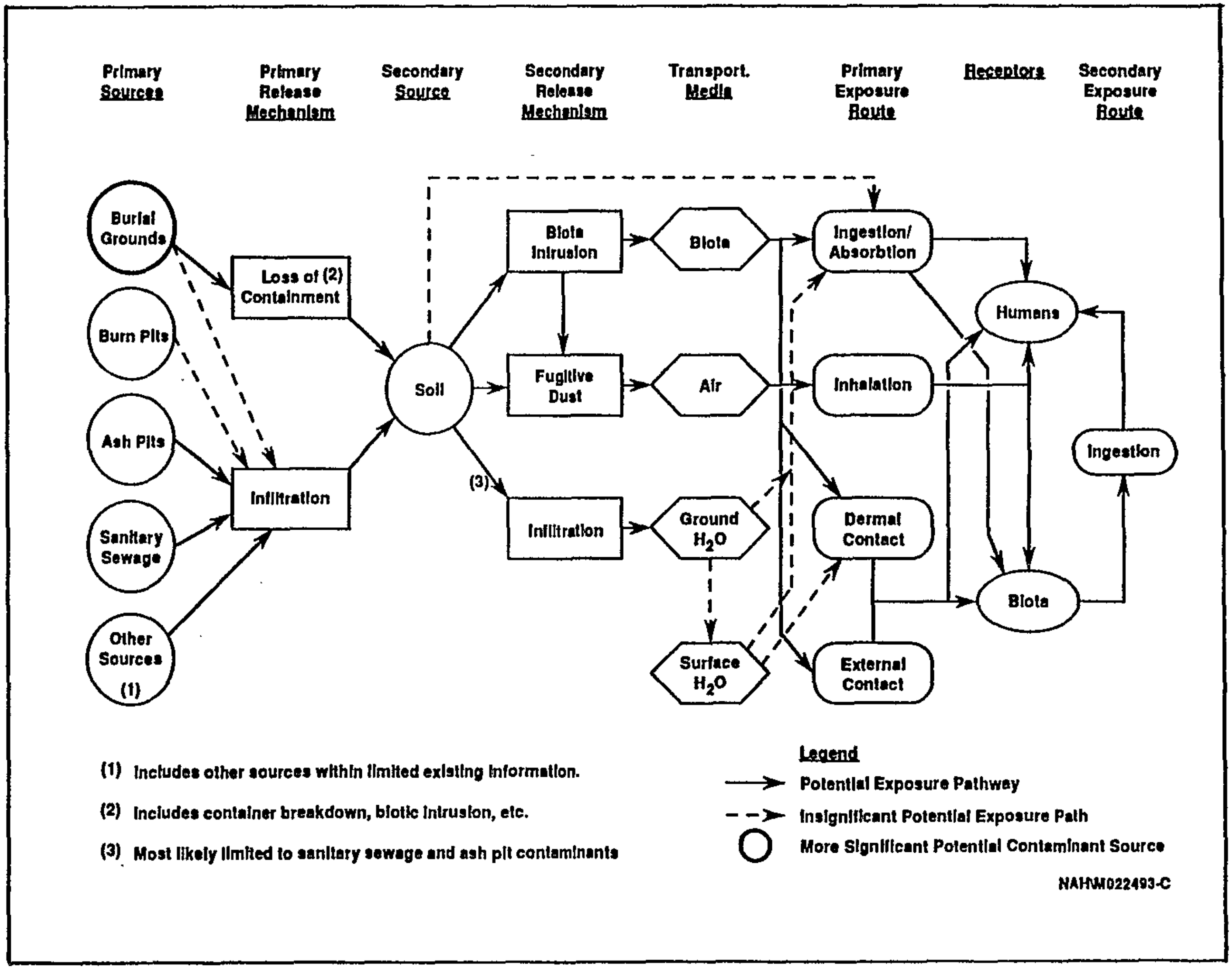
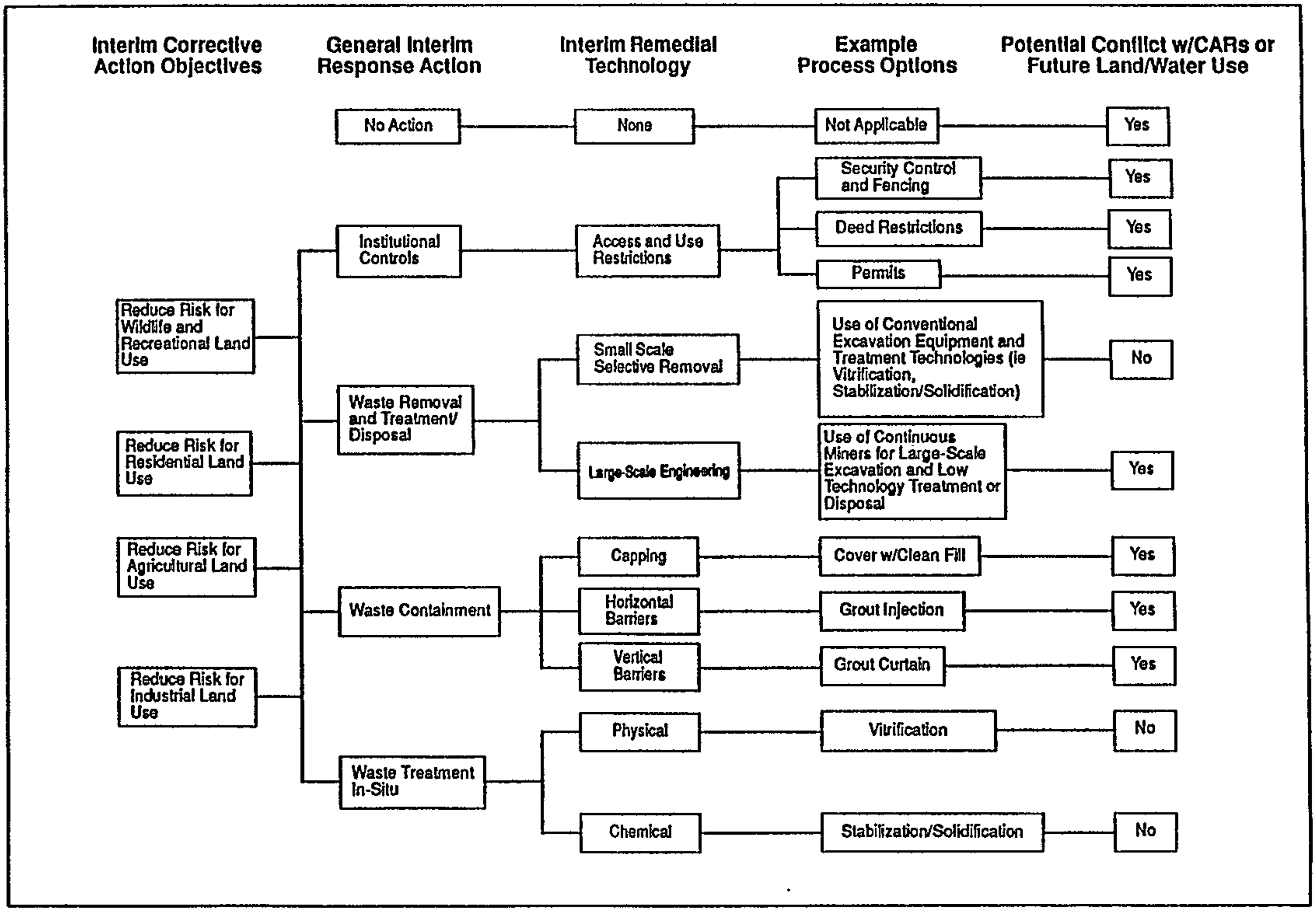


Figure 3-5. Conceptual Contaminant Exposure Pathway Model for the 100-HR-2 Operable Unit.



903 1272/26385/8-4-92

Figure 3-6. A Matrix of Preliminary Interim Response Actions, Technologies and Process Options Available.

Table 3-1. Preliminary List of Potential Contaminants of Concern for the 100-HR-2 Operable Unit.

Burial Grounds	Low Priority Sites
Cadmium	Polychlorinated Biphenyls (PCBs)
Lead	Asbestos
Mercury[a]	Volatiles
Hydrogen-3	
Carbon-14	
Cobalt-60	
Nickel-63	
Strontium-90	
Cesium-137	
Europium-152	
Europium-154	
Asbestos	

[a]Undocumented reports include accounts of mercury disposal into some solid waste burial grounds.

Table 3-2. 1991 Data from On-Site and Off-Site Soil Sampling, Hanford Environmental Monitoring Program.

	On-Site[a] Average pCi/g (dry weight)[b]	Off-Site[a] Average pCi/g (dry weight)[b]
^{90}Sr	0.299 ± 0.299	0.133 ± 0.055
^{137}Cs	0.540 ± 0.192	0.542 ± 0.317
$^{239/240}Pu$	0.0279 ± 0.0691	0.00993 ± 0.00481
U	1.44 ± 0.147	1.463 ± 0.169

[a] On-site and off-site are as shown in Figure 3-1; number of on-site samples = 16; number of off-site samples = 10.

[b] The values given after ± sign are two standard errors of calculated mean.

Source: Bisping and Woodruff 1992.

Table 3-3. Provisional Hanford Site Soil Background Threshold Values.

Constituent[a]	Concentration Threshold[b] (95/95) ppm	Maximum Value (nugget effect[c]) ppm
Aluminum	16,573	
Arsenic	4	8.1
Barium	169	229
Beryllium	2	
Cadmium	8	
Calcium	11,210	14,000
Chromium	20	48.3
Cobalt	16	
Copper	21	
Iron	29,781	
Potassium	2,740	
Magnesium	6,480	6,910
Manganese	424	533
Nickel	18	25.3
Lead	10	12.7
Strontium	43	
Vanadium	82	
Zinc	50	112
Ammonium	3	
Chloride	38	
Nitrate	< detection limit	
Sulfate	40	
Fluoride	5	

a Analytes for RCRA analysis per SW-846 6010 plus selected anions.

b Threshold statistically falls in the upper 95[th] percent confidence band at the 95[th] percentile level of the data.

c "nugget effect": specific constituents may occasionally exceed the threshold as a result of a natural anomaly or naturally occurring spike in which case exceeding the threshold would not indicate levels above background.

(Adapted from Hoover and LeGore 1991)

Table 3-4. Radionuclide Concentrations (pCi/g, dry weight) Detected in Surface Soil at 100-H Area.

Location*	^{60}Co	^{90}Sr	^{137}Cs	^{238}Pu	$^{239/240}Pu$
H1	< 0.038	0.048	0.25	0.00053	0.0049
H1R	0.16	0.049	0.34	0.00036	0.0081
H2	< 0.040	0.080	0.55	< 0.00029	0.0071

* Sampling stations shown on Figure 3-4.
R = Replicate sample.
Source: Perkins 1990.

9312975.0070

Table 3-5. Air Quality Data for Eastern Washington and the Hanford Site.

Sampling Parameter	Concentrations in air (pCi/m^3)[a]			
	Four 100 area stations	Number of samples	Six distant communities	Number of samples
Gross beta	0.0180 ± 0.0024	76	0.0170 ± 0.0014	156
Gross alpha	0.00041 ± 0.00014	24	0.00035 ± 0.00008	52
^{3}H	1.0 ± 0.3	25	0.8 ± 0.3	26
^{14}C	1.40 ± 0.34	7	1.40 ± 0.10	14
^{90}Sr	0.000024 ± 0.000033	4	-0.000002 ± 9.000008	15
^{131}I	-0.0001 ± 0.0005	50	-0.0001 ± 0.0005	51
^{137}Cs	-0.0001 ± 0.0002	12	0.0001 ± 0.0002	48

[a] Average values ±2 standard error of the calculated mean. Negative values are commonly encountered in environmental radiological testing because of the need to subtract instrument background from the measured values.
Source: Jaquish and Bryce 1990.

Table 3-6. Terrestrial Flora Radionuclide Concentrations for the 100-H Area.

Sample	Concentrations (pCi/g)						
	^{60}Co	^{90}Sr	^{137}Cs	^{238}Pu	$^{239/240}Pu$	^{152}Eu	^{154}Eu
H-1	0.12	0.11	0.98	<0.00013	0.000088	<0.16	<0.35
H-2	0.31	0.96	1.6	<0.00013	ND	<0.30	<0.32

Source: Jacques 1987 (100-H Area data)

Table 3-7. Results of Wildlife Monitoring in the 100 Area in 1989.

Radionuclide Concentrations in Muscle Tissue of Pheasant					
^{60}Co, pCi/g, Wet Weight			^{137}Cs, pCi/g, Wet Weight		
No. of Samples	Maximum	Average	No. of Samples	Maximum	Average
10	0.010 ± 0.011	0.001 ± 0.004	10	2.0 ± 0.1	0.20 ± 0.39
Radionuclide Concentrations in Bone and Muscle Tissue of Cottontail Rabbits					
^{90}Sr (Bone), pCi/g, Wet Weight			^{137}Cs (Muscle), pCi/g, Wet Weight		
No. of Samples	Maximum	Average	No. of Samples	Maximum	Average
4	160 ± 3	80 ± 91	4	0.15 ± 0.05	0.04 ± 0.07

Maximum values ±2 sigma counting error. Averages ± standard error of the calculated mean.

Source: Jaquish and Bryce 1990.

4.0 RATIONALE AND APPROACH

The rationale for conducting the RFI is established by identifying data quality objectives (DQO) and specific data needs. These are based, in part, on the Hanford Site Past-Practice Strategy (DOE-RL 1991a). This strategy and the scoping efforts of the DOE, EPA and Ecology in July, 1991 emphasize a bias for action, by quickly and efficiently implementing ERAs and IRMs, to achieve cleanup actions at priority candidate sites. During scoping efforts the three parties did not identify any sites within the 100-HR-2 operable unit for conducting an ERA. Several sites within the 100-HR-2 operable unit have been identified as potential candidates for conducting an IRM. Several low priority sites were identified which are to be dealt with as part of the final remedy selection process. Based upon agreements reached during the 100-DR-1 operable unit discussions these include sites such as septic systems, ash disposal basins, electric facilities, and support facilities where no waste is suspected.

The three parties also recognize the need to more closely integrate source and groundwater operable unit investigation and remediation, and acknowledge that some environmental media should be investigated on an aggregate-area basis using information from similar or analogous facilities to the extent practicable. Investigations from source and groundwater operable units, as well as aggregate-area studies, will be integrated with existing historical information and available information from analogous facilities to satisfy the data needs for the 100-HR-2 operable unit.

To implement this strategy, data are needed for specific waste sources, groundwater plumes, and contamination of other environmental media to refine existing conceptual models and to conduct a qualitative risk assessment. The data must be adequate to determine whether concentrations of contaminants pose an unacceptable risk that should be remediated through an IRM.

Data are also needed to complete a quantitative baseline risk assessment and select a final remedy for the overall operable unit and for the 100 Area NPL site. Some of these data will be collected during the 100-HR-1 and 100-HR-3 LFIs, other data can be collected as needed when implementing the IRM or preparing the final CMS. Section 4.1 of the 100-HR-1 operable unit work plan describes the general DQO process (DOE-RL 1992c). An operable unit-specific discussion of DQOs and data needs related to the 100-HR-2 investigations is given below.

4.1 RATIONALE

The central rationale for undertaking an RFI at the 100-HR-2 operable unit is to develop data needed for an initial IRM determination and eventually for completing the CMS. The amount and quality of available information, while not yet adequate to quantify the risk posed by the operable unit due to the size of the operable unit, the complexity of past operations, the number of waste management units, and the limited quantitative information on the nature and extent of contamination from these units. The data may be sufficient to conduct qualitative risk assessments and initiate IRMs.

The rationale for the technical approach presented in this RFI/CMS work plan is based on two concepts. First, every activity should be justified by producing data for one or more of the following purposes:

- Confirm, or revise the conceptual models for specific waste sites and/or areas of contaminated environmental media for the operable unit and aggregate area
- Support a qualitative risk assessment
- Support development and evaluation of IRMs for individual waste sites, groups of sites, or areas of environmental contamination
- Support the quantitative baseline risk assessment for the operable unit
- Support the corrective action requirements (CAR) evaluation
- Support development, evaluation, and selection of a final corrective measure alternative.

Second, a streamlined approach with a bias for action will be followed. This approach will focus on obtaining data sufficient to implement the IRM(s) and will use the observational approach during the implementation of the remedy to reduce the amount of data required before beginning cleanup. The emphasis in this work plan is on describing those data that will be obtained through detailed record search at solid waste burial grounds to determine whether to implement an IRM. However, general data needs for the quantitative baseline risk assessment and final remedy selection will also be addressed. Other secondary data include health and safety planning and environmental monitoring during implementation of the IRM.

The methods used to identify data uses and needs can be found in the EPA's data quality objectives (DQO) process (CDM Federal Programs Corporation 1987). The three elements of the DQO process are (1) decision types identification, (2) data uses and needs identification, and (3) data collection program design.

4.1.1 Data Quality Objectives Process

The primary users will be decision makers identified in the *Hanford Federal Facility Agreement and Consent Order* (Ecology et al. 1990a). These are the DOE, EPA, and Ecology. Additional primary data users will be an technical lead organization responsible for the RFI/CMS tasks as directed by the DOE, EPA, and Ecology. Secondary data users include the support groups within the technical lead organization who may utilize the data for activities not necessarily associated with this investigation (i.e., Geosciences for site-wide modeling). Other potential data users include technical support groups who provide input through the review process described in the *Environmental Investigations and Site Characterization Manual* (WHC 1991a).

4.1.2 Identification of Data Uses and Needs

The second element of the DQO process is the identification of data uses and needs. The determination of data uses and needs is supported by evaluation of available data and development of an operable unit conceptual model. This information is presented in Chapters 2 and 3 of this work plan. The data that have been reviewed are the basis for the investigation described in this work plan which leads to a decision of whether an IRM is necessary. The data were discussed at scoping meetings with the DOE, EPA, and Ecology to develop the final strategy for each site. The information has also been used to help to determine what additional data must be obtained.

The data types needed to support the decision making process are:

- Location, disposal history, and construction of all identified and newly discovered contaminant sources

- Quantity and nature of the material disposed to the facilities

- Quantity, nature, and extent of contamination in surface soils, the vadose zone, and aquifer matrix

- Geochemical, geological, and physical characteristics of the vadose zone, especially in relation to the fate and transport of contaminants from waste sites to the groundwater and also to support the evaluation of remedial action alternatives

- Information on the nature and extent of contamination in the terrestrial, riparian, and aquatic biota adjacent to and in the vicinity of the 100-H Area

- Information on the potential airborne contamination from fugitive dust.

Table 4-1 is a summary of the data needs for the 100-HR-2 operable unit. Existing data are sufficient to identify sites for conducting IRMs and for determining low priority sites. If additional data are needed at the completion of the investigation to evaluate IRMs, additional data may be collected as part of the focused FS.

The nature of the investigation to be completed for the 100-HR-2 operable unit makes defining the quality and quantity of the data to be collected difficult. Studies to be completed are record searches and review of the records. The goal is to obtain sufficient data to identify the burial ground locations, types, quantities, and contamination levels. The quantity of data to be obtained is dependent on the credibility of the data sources.

The DQO specific to the 100-HR-2 operable unit burial grounds are shown in Table 4-2. This table was developed by adapting the DQO development methods in Data Quality Objectives for Remedial Response Activities (CDM Federal Programs Corporation 1987). The DQO development methods are focused toward DQO for a intrusive field investigation effort. This work plan will not require any intrusive field investigations, but, will utilize archived documents, drawings, photographs, analogous site information from other 100-Area operable units, and interviews with former 100-Area workers to meet the DQO. Therefore, defining the data quality and quantity is subjective in nature. Data quality will be judged by credibility of the data source with burial site-specific reports, disposal logs, drawings, and photographs having the greatest credibility. Lesser credibility will be assigned to other information as identified in Table 4-2. Data quantity requirements will be based on the individual source quality. Secondary, tertiary and quaternary quality data will require verification from additional sources.

4.1.2.1 Refining the Conceptual Waste Site and Operable Unit Model. Data will be collected to test and refine the conceptual models for individual waste sites and the operable unit. In addition, data collected for individual waste sites will be important in establishing the interaction between the sites and the groundwater. Therefore, it will be important to coordinate data-gathering activities and share data with the 100-HR-3 groundwater operable unit and the 100-HR-1 source operable unit RFIs. Refinement of the conceptual models will require data collection for each of the data types shown on Table 4-1, including source, geologic, vadose zone, groundwater, surface water, air, ecological, and cultural resource data. Some of these data will be obtained during implementation of this work plan, some through the 100-HR-3 groundwater operable unit work plan, some through implementation of other work plans addressing analogous facilities, and some through the 100 Area aggregate investigations. A summary of some of these data needs and the plan(s) that describe the data collection activities includes:

- Location, disposal history, and construction of all identified and newly discovered contaminant sources (100-HR-2 operable unit)
- Geochemical, geologic, and physical characteristics of the vadose zone, especially in relation to the fate and transport of contaminants from waste sites to the groundwater (100 Area source operable units and 100 Area aggregate investigations)
- Quantity, nature, and extent of contaminants in the groundwater system (100-HR-3 groundwater operable unit)
- An understanding of the relationship between water-table fluctuations (especially related to fluctuations in levels in the Columbia River) and release and transport of contaminants from the lower vadose zone and capillary fringe to groundwater (100-HR-3 groundwater operable unit and 100 Area aggregate investigations)
- The nature and geometry of the hydrogeologic system, including the thickness, areal extent, and intrinsic properties (e.g., hydraulic conductivity) of the various hydrostratigraphic units (100-HR-3 groundwater operable unit and 100 Area aggregate investigations)
- Horizontal and vertical gradients in contaminated hydrostratigraphic units (100-HR-3 groundwater operable unit)

- Information on the nature of contamination in water emanating from seeps and springs along the shoreline of the Columbia River in the 100 Area, and the nature and extent of contamination in seep and spring sediments and adjacent river water (Surface Water/Sediment Investigation for the 100 Area, Appendix D-1 of the 100-HR-3 operable unit work plan)

- Information on the nature and extent of contamination in the terrestrial, riparian, and aquatic biota adjacent to and in the vicinity of the 100-H Area (100 Area aggregate investigations)

- Information on the potential for airborne contamination from fugitive dust (100-HR-2 operable unit)

- Information on the groundwater recharge and discharge, and contaminant transport from off-site sources to the 100-H Area (100-HR-3 groundwater operable unit and 100 Area aggregate investigation.

- The impact of fluctuations in river stage on shallow groundwater flow (100-HR-3 groundwater operable unit).

4.1.2.2 Qualitative Risk Assessment. A qualitative risk assessment is performed as part of the process to determine the need for an IRM. This assessment provides a semi-quantitative assessment of risk, and is focused on the principal risk drivers in the operable unit. The results of this assessment are used to help determine the need for an IRM. The qualitative risk assessment will be conducted using the HSBRAM (DOE-RL 1992d) as a guide.

4.1.2.3 Development and Evaluation of Interim Corrective Measures. Data needs for developing and evaluating the interim measures can be reduced by focusing only on a limited range of probable IRMs, as described in Section 3.4, and by employing the observational approach. For example, a detailed understanding of the lateral extent of contamination at solid waste burial grounds may not be needed if excavation is the preferred remedy and the volume of contaminated materials is not critical to selection of this remedy. On the basis of existing data and judgement, the lateral extent of contamination below solid waste burial grounds is expected to be limited to the size of the facility. Field screening could be used during implementation of the remedy to determine where and how much to excavate, and sampling conducted for laboratory analysis could verify completion of the cleanup. Preliminary data needed for developing and evaluating IRMs, developing the IRM ROD, and the plan(s) that describe the data collection activities include:

- Nature and composition of solid wastes (100-HR-2 source operable unit)

- Information on the location, design, construction, and uses of the waste disposal units (100-HR-2 source operable unit)

- Hydrogeologic properties of the aquifer (100-HR-3 groundwater operable unit)

- Nature and extent of groundwater contamination discharging to the Columbia River (100-HR-3 groundwater operable unit)

- Nature and extent of contamination of surface water, sediment and biota (100 Area aggregate investigation)

- Treatability study information relevant to the limited range of interim actions that may be considered (100 Area aggregate FS and 100 Area Treatability Studies).

If additional data are needed to evaluate interim remedial alternatives, additional data will be identified and collected during the focused corrective measure study.

4.1.2.4 Baseline Risk Assessment. Data collected to conduct the quantitative baseline risk assessment will include input parameters for fate and transport models, vadose zone characteristics, and contaminant information required to evaluate the threats to human and environmental receptors posed by releases of contaminants. The baseline risk assessment will require input of data from the source, geologic, vadose zone, groundwater, surface water, air, terrestrial biota, and ecological data types, as shown in Table 4-1.

Specific computer programs for describing the flow of contaminants in the vadose zone will be identified and used following the evaluation of the above data. It is anticipated that PORFLOW (Runchal and Sagar 1993), or other programs mandated by DOE, with consultation with EPA and Ecology, will be used in evaluating mass flux in the vadose zone.

Many of the input parameters to the vadose zone and air transport modeling will be ranges of values, based on the results of recent studies at the Hanford Site, drilling and sampling in the 100-H Area, and laboratory testing of selected samples from this RFI. The need to further refine these parameters will be assessed based on the findings and results of the RFI, and any IRMs that are implemented. Specific data and information requirements to support the baseline risk assessment, and the plan(s) that describe the data collection activities include the following:

- Information on the nature of contamination from specific waste sites (100-HR-2 operable unit)

- Nature and extent of contamination in the surface soil (including airborne particulates) and shallow vadose zone are needed to evaluate current and future potential risk from external radiation, direct contact, and soil ingestion or inhalation pathways of exposure (100-HR-2 operable unit)

- Nature and extent of vadose zone contamination are needed to predict flux of contaminants to the groundwater (100-HR-2 operable unit)

- Soil geochemical, physical and hydrogeologic properties are needed as input parameters to fate and transport models (100 area source operable units and aggregate investigation)

- Physical characteristics of site contaminants are needed as input parameters to fate and transport models (100 area source operable units)

- Nature and extent of contaminants in the groundwater system (100-HR-3 groundwater operable unit)

- Information on the nature and extent of soils contaminated by seeps at the river edge and the human and environmental risks posed by this soil (100 Area aggregate investigations)

- Information on the nature and extent of contamination in the surface water and river sediments adjacent to the 100 Areas (100 Area aggregate investigations)

- Information on the nature and extent of contamination in the terrestrial, aquatic and riparian biota adjacent to the 100 Areas (100 Area aggregate investigations)

- The nature of contamination associated with airborne particulates (100-HR-2 source operable unit).

4.1.2.5 Corrective Action Requirements Assessment. Identification of potential CARs will assist in identifying corrective measure alternatives. The CARs assessment will require data from the source, geologic, vadose zone, groundwater, surface water, air, ecological, and cultural resources data types, as shown on Table 4-1. Specific information needed to assess CARS includes:

- Nature and extent of contamination in the various environmental media to determine contaminant-specific CARs (solid waste burial ground, source, groundwater and 100 Area aggregate area studies)

- Determination of the presence of threatened or endangered species or the presence of critical habitats within the operable unit (100 Area aggregate investigations)

- Determination of the presence of any archaeological or historic resources that may be considered eligible for inclusion on the National Registry of Historic Places (100 Area aggregate investigations).

4.1.2.6 Developing and Analyzing Final Corrective Measure Alternatives. Information needed to develop and analyze corrective measure alternatives during the final CMS includes operable unit characteristics and engineering data required for the development, screening, and detailed analysis of such alternatives. Sufficient information is needed at this time only for feasibility-level conceptual designs and order-of-magnitude cost estimates. The final CMS will require input of the same data types identified in Section 4.1.2.3 for IRMs. These data needs are also shown in Table 4-1. It is anticipated that much of the data for completing the final CMS will be provided during concurrent characterization conducted while implementing IRMs. In addition, since many of the reactor areas have similar or analogous facilities, information provided from investigations and interim actions at other operable units will be evaluated when selecting final corrective measure alternatives for this operable unit.

Detailed design information generally is not collected until the final corrective measure alternative(s) are selected. The RFI will not emphasize collecting design-level information. However, results of treatability studies and technology demonstration testing that may be conducted will be used, as appropriate, to design the full-scale corrective measures alternative.

4.1.2.7 Other Data Uses. Although not the primary objective, data collected for the previously described project purposes (Sections 4.1.2.1 through 4.1.2.6) will also be used for health and safety planning, design of alternatives, and environmental monitoring during the implementation of the corrective action.

The RFI/CMS data can be used to establish a pre-implementation baseline data set. Environmental monitoring, after implementation of the selected corrective action, can be performed to allow for comparison of the selected interim and final corrective actions with the baseline data to evaluate the effectiveness of the corrective measure alternative. The RFI/CMS data can also be used to determine the needs and best methods for any post-implementation monitoring that may be required. If the selected corrective measure alternative has the potential to cause adverse environmental impacts during the construction or operations phases, monitoring will be essential. Sufficient information will be generated to establish contaminant-specific action levels on which corrective measure monitoring efforts can be focused.

4.2 APPROACH

The overall approach to the 100-HR-2 operable unit investigation is based on the *Hanford Site Past-Practice Strategy* (DOE-RL 1991a). In particular, this strategy recognizes that to expedite the ultimate goal of cleanup, much more emphasis needs to be placed on initiating and completing waste site cleanup through interim measures.

4.2.1 Basic Concepts of Approach

The basic concept of the approach used in this work plan are the *Hanford Site Past-Practice Strategy* (DOE-RL 1991a) and the investigation strategy for the 100-HR-2 operable unit.

4.2.1.1 Hanford Site Past-Practice Strategy. The three parties have agreed to a streamlined approach to past-practice work at the 100-Area that is intended to maximize efficiency, maintain project schedules, and achieve earlier remedial action. Figure 4-1 is a decision flow chart that shows the streamlined Hanford Site RI/FS (RFI/CMS) process.

Following the agreement on the past-practice strategy, the three parties rescoped the initial 100 Area work plans with a bias toward interim remedial action, and with the initial focus of the limited intrusive investigations placed on the highest-priority waste sites within each operable unit. The collective knowledge and judgment of the three parties and the information contained in the existing work plans were used to identify the high-priority waste sites and the paths to be followed to implement the new, streamlined strategy.

The 100-HR-2 operable unit work plan approach described below focuses on the IRM path at waste sites where existing data are considered sufficient to indicate that the site poses a risk through one or more pathways.

4.2.1.2 Investigation Strategy for the 100-HR-2 Operable Unit. This work plan describes the approach for implementing the past-practice strategy for currently identified solid waste burial grounds and contaminant sources at the 100-HR-2 operable unit. Investigations at low-priority sites will be deferred for long-term action for the final remedy selection process (see Figure 4-1), as deemed necessary.

Table 4-3 lists the 100-HR-2 facilities to be addressed by the past-practice investigation strategy and facilities to be deferred to the final remedy selection. The table also describes those facilities where the three parties have determined that data are sufficient to determine that an IRM is appropriate without further field investigations. At these sites, further characterization will be performed concurrently with remediation, using the observational approach.

Options for contingencies have also been developed as part of the past-practice strategy, which include the option for:

- Performing treatability studies or technology demonstrations at selected facilities and using data from analogous 100 Area facilities; the decision as to which solid waste burial grounds will ultimately be selected as candidates for these studies must be agreed upon by the three parties at future unit managers' meetings

- Collecting additional data during a focused feasibility study

- Deferring a waste site to the final remedy selection process.

Details on facilities within the 100-HR-2 operable unit and proposed actions are listed in Table 4-3. Proposed actions shown in Table 4-3 may require modification as data are collected and evaluated from other 100 Area analogous sites. Changes of scope to the investigative strategy and limited field investigations described in this work plan will be documented by minutes to the monthly unit managers' meetings.

4.2.1.2.1 Investigations at Solid Waste Burial Grounds. The IRM path, as shown in a logic diagram in Figure 4-2, is proposed at the following solid waste burial grounds in the 100-HR-2 operable unit:

- 118-H-1 Burial Ground #1
- 118-H-2 Burial Ground #2
- 118-H-3 Construction Burial Ground
- 118-H-4 Ball 3x Burial Ground
- 118-H-5 Thimble Pit
- 105-H Rod Cave
- Buried Thimble.

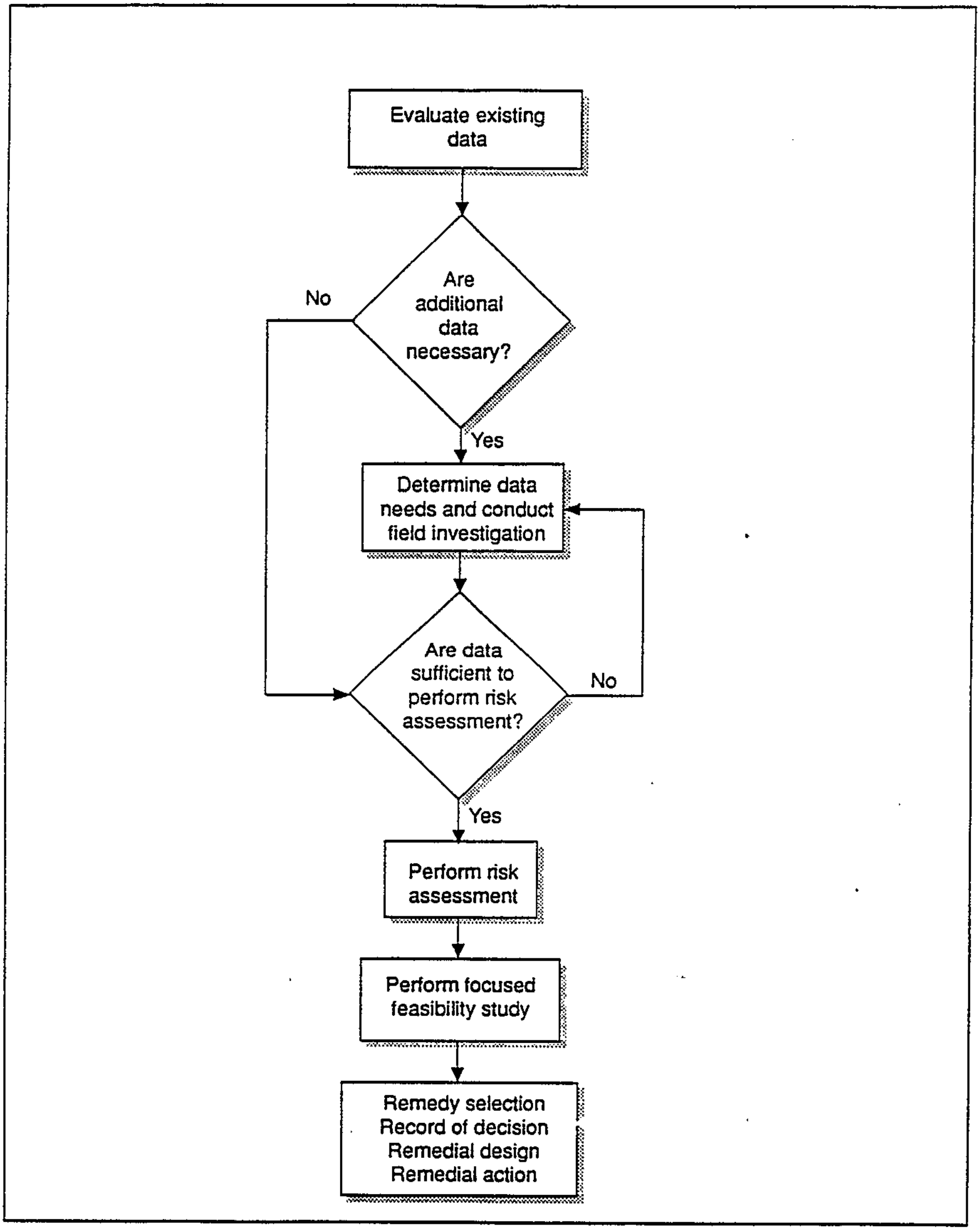
No field activities are required to collect information for the IRM at this time, although some surface geophysics may be conducted to verify historical data on burial ground locations. The primary investigative activity is to be a review of historic records to further document the actual use of the burial grounds.

4.2.1.2.2 Investigations at Decommissioned Facilities. Data will be reviewed at facilities already demolished by decommissioning, as shown in a logic diagram in Figure 4-3, to determine if further investigation is needed.

4.2.1.2.3 Investigations at Existing Facilities. Investigations are not planned at the 1713-H warehouse because it is still in use.

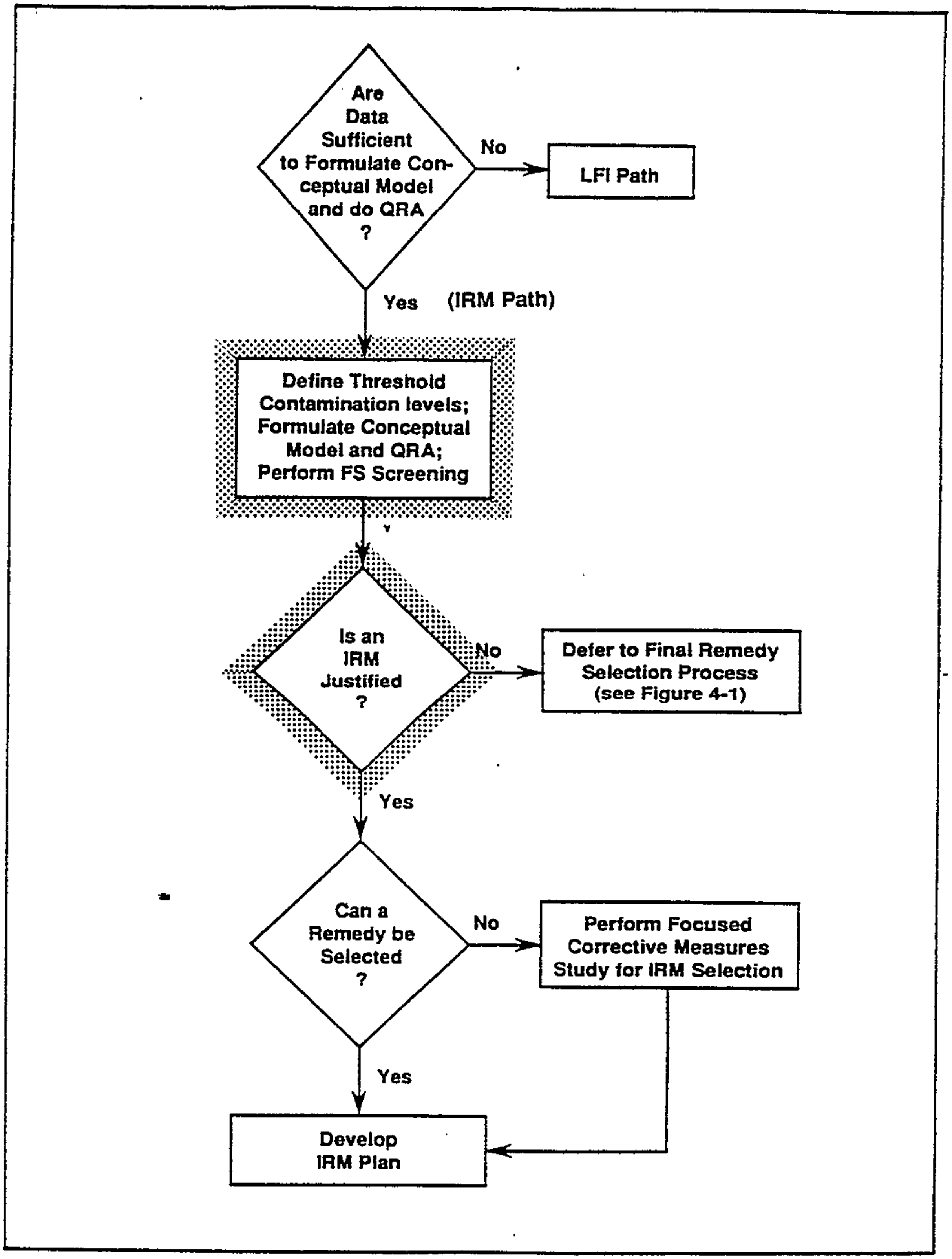
4.2.1.2.4 Investigations at Low-Priority Facilities. Low-priority facilities include ash pits, burn pits, septic systems, electrical facilities, and support facilities where waste is currently not suspected. Investigations proposed in this work plan under the past-practice strategy preliminary investigation will, in general, be limited to evaluation of existing data and a site walkover. Some selected low-priority sites may have scoping activities, such as soil gas sampling and surface geophysics, conducted prior to the issuance of the work plan. Any intrusive field activities for low-priority sites will be deferred until the final remedy selection phase for the operable unit (see Figure 4-1). Future sampling of inactive septic system and placing a minimum of one shallow borehole or trench in each active or inactive tile field is recommended at the septic systems. The need for long-term investigations at electrical facilities will be determined by reviewing records for historic PCB equipment locations and associated possible PCB contamination. PCB sampling conducted as a part of the 100-HR-1 LFI will also be reviewed. Limited surface soil sampling is recommended for some of the burn pits. Further investigation at support facilities where waste is not suspected will be dependent upon the results of the site walkover and data compilation.

Figure 4-1. Final Remedy Selection Process.



903 1272/26349/8-4-92

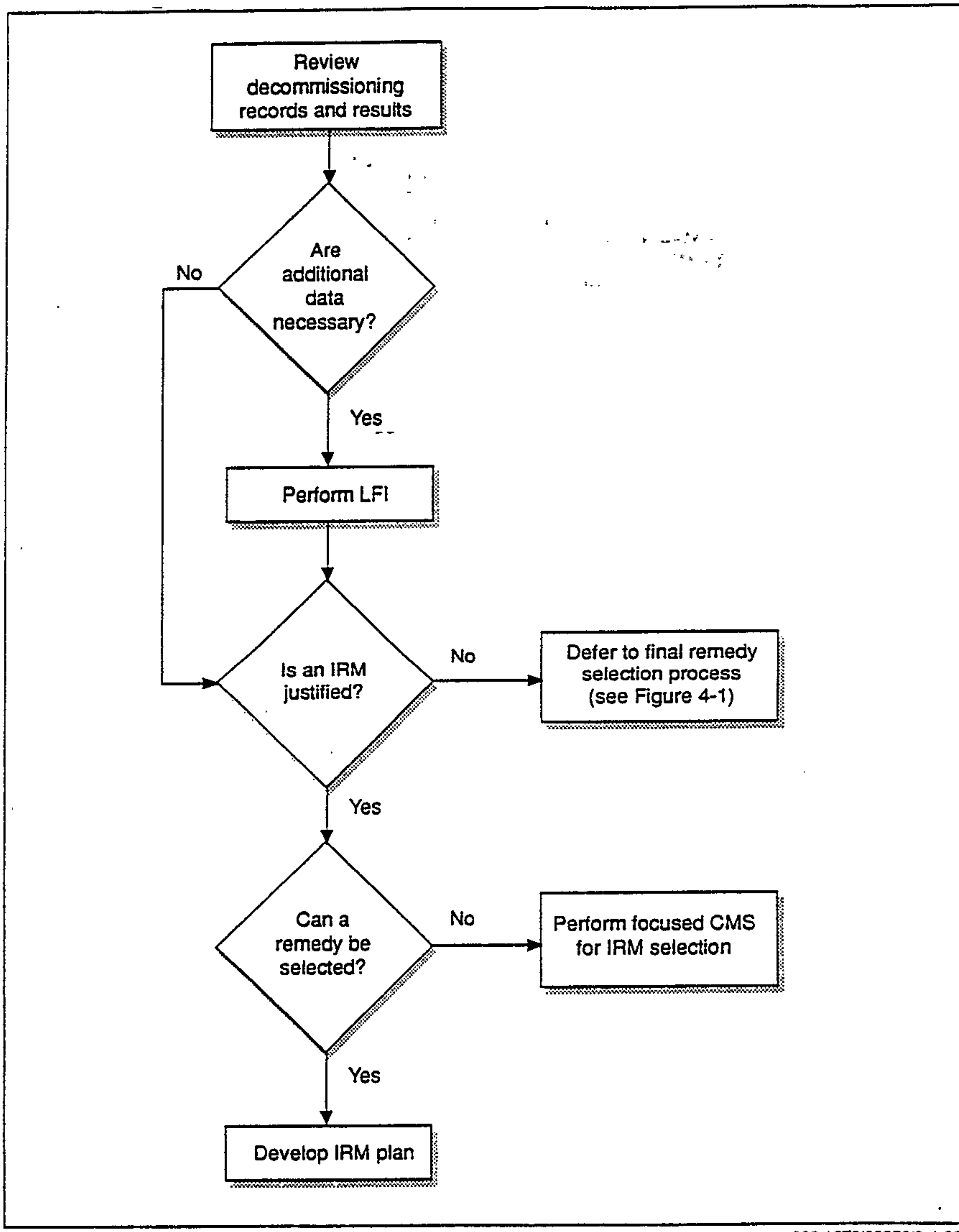
Figure 4-2. Interim Remedial Measures Selection Process.



NAH\M022593-A

9312975.0025

Figure 4-3. Investigations at Facilities that have been Decommissioned.



903 1272/26352/8-4-92

THIS PAGE INTENTIONALLY
LEFT BLANK

Table 4-1. Data Needs Summary. (1 of 4)

Data needs	Purpose of Data							
	Refine conceptual operable unit model	Conduct baseline quantitative risk assessment	Conduct qualitative risk assessment	Evaluate CARs	Conduct focused feasibility study for IRM	Conduct final feasibility study for operable unit	Plan IRM	Perform remedial design
Solid Waste Burial Ground:								
• Locations and dimensions of all burial grounds	W	W	W	W	W	W	W	W
• Types, quantities, and concentrations of solid wastes	W	W	W	W	W	W	W	W
• Waste chemical and physical properties	W	W	W	W	W	W	W	W
Source Data:								
• Locations and dimensions of all contaminant sources	W	W	W	W	W	W	W	W
• Types, quantities, and concentrations of contaminant sources	W	W	W	W	W	W	W	W
• Waste chemical and physical properties	W	W		W		W	W	W
Geologic Data:								
• Geological unit thickness and areal extent	S,G	S,G		S,G		S,G	S,G	S,G
• Soil mineralogy		H			H	H	H	H
• Stratigraphic features	S,G	S,G		S,G		S,G	S,G	S,G
Vadose Zone Data:								
• Soil/sediment types (classification)	S,G	S,G		S,G		S,G	S,G	S,G
• Saturated and unsaturated hydraulic conductivity[a]	S,G	S,G		S,G		S,G	S,G	S,G
• Moisture content	S,G	S,G				S,G	S,G	S,G
• Physical properties (grain-size distribution and bulk density)	S,G	S,G				S,G	S,G	S,G
• Soil chemistry and pH	S,G	S,G		S,G		S,G	S,G	S,G
• Contaminant concentrations and extent	S,G	S,G	S,G	S,G	S,G	S,G	S,G	S,G

Table 4-1. Data Needs Summary. (2 of 4)

Data needs	Purpose of Data							
	Refine conceptual operable unit model	Conduct baseline quantitative risk assessment	Conduct qualitative risk assessment	Evaluate CARs	Conduct focused feasibility study for IRM	Conduct final feasibility study for operable unit	Plan IRM	Perform remedial design
Vadose Zone Data (cont.):								
• Soil/sediment lithology	S,G					S,G		S,G
• Depth to water table/thickness of vadose zone	S,G	S,G			G	S,G	S,G	S,G
• Infiltration[b]	H	H				H	H	H
Groundwater Data:								
• Nature and extent of contaminants in groundwater system	G	G	G	G	G	G	G	G
• River/aquifer interactions	A	A			A	A	A	A
• Hydraulic head in selected stratigraphic units	G	G			G	G	G	G
• Hydraulic properties	A,G,S	A,G,S			A,G,S	A,G,S	A,G,S	A,G,S
Surface Water and Sediment Data:								
• Nature and extent of contaminants in riverbank seeps, Columbia River and river sediments	A	A	A	A	A	A	A	A
Air Data:								
• Precipitation (annual and monthly averages and extremes; 1-hr and 24-hr max.; PMP)	H	H		H		H	H	H
• Temperature (annual and monthly averages and extremes; days per year below freezing)	H	H		H		H	H	H
• Wind velocity and direction (monthly/ seasonal averages and extremes)	A	A		A		A	A	A

Table 4-1. Data Needs Summary. (3 of 4)

Data needs	Purpose of Data							
	Refine conceptual operable unit model	Conduct baseline quantitative risk assessment	Conduct qualitative risk assessment	Evaluate CARs	Conduct focused feasibility study for IRM	Conduct final feasibility study for operable unit	Plan IRM	Perform remedial design
Air Data (cont.):								
• Barometric pressure	H	H				H	H	H
• Relative humidity	H	H				H	H	H
• Evaporation rate (monthly average)	H	H				H	H	H
• Atmospheric stratification and inversions (duration and frequency)	H	H				H	H	H
• Magnitude and frequencies of extreme weather events	H	H				H	H	H
• Air quality	S[c]	S[c]	S[c]	S[c]		S[c]	S[c]	S[c]
Ecological Data:								
• Terrestrial vegetation and wildlife potentially affected by source or groundwater contamination	A	A	A	A	A	A	A	A
• Presence of critical habitats	A	A	A	A	A	A	A	A
• Biocontamination	A	A	A	A	A	A	A	A
• Receptor demographics	A	A	A	A	A	A	A	A
• Land use characteristics; existing and potential future uses	A	A	A	A	A	A	A	A
• Water use characteristics; existing and potential future uses	A	A	A	A	A	A	A	A

Table 4-1. Data Needs Summary. (4 of 4)

Data needs	Purpose of Data							
	Refine conceptual operable unit model	Conduct baseline quantitative risk assessment	Conduct qualitative risk assessment	Evaluate CARs	Conduct focused feasibility study for IRM	Conduct final feasibility study for operable unit	Plan IRM	Perform remedial design
Cultural Resource Data:								
• Location of surficial archaeological sites	A			A		A		A
• Presence of historic or archaeological sites that may be eligible for the National Register of Historic Places	A			A		A		A

[a] A range of unsaturated hydraulic conductivity values will be developed bounded by the saturated hydraulic conductivity and laboratory values of unsaturated hydraulic conductivity from tests on selected vadose zone samples.

[b] A range of infiltration values will be developed using current Hanford literature, studies such as the Hanford Protective Barrier Program, and actual site surface conditions.

[c] No field activities other than routine health and safety monitoring are planned.

Notes:
CAR = Corrective action requirement
PMP = Probable Maximum Precipitation
S = Source operable unit investigation
W = Solid waste burial ground operable unit investigation
G = Groundwater operable unit investigation
H = Hanford Site-wide studies
A = Aggregate area studies

Table 4-2. Data Quality Objectives for the 100-HR-2 Operable Unit Burial Grounds.

Specific Needs	Requirements
Objectives	Determine location, types, concentrations, and volume of wastes.
Prioritized Data Uses	Determine threshold contamination levels for refinement of conceptual model to support qualitative risk assessment; perform FS screening; determine IRM action; plan IRM: perform remedial design.
Data Type	Waste site location, waste type, volumes concentrations, waste component characteristics.
Data Quality	Primary source - Disposal documents, photo, drawings. Secondary source - Nonspecific reference in documents. Tertiary source - Analogous site information. Quaternary source - Former worker interview.
Data Quantity	Primary source - One document, photo, drawing for each data type. Secondary source - One plus backup. Tertiary source - One plus one backup. Quarternary source - Two or more.
Data Sources	Disposal logs, logbook, photos, drawings, primary historical documents, secondary historical documents, analogous waste sites at other operable units, former worker interviews.

THIS PAGE INTENTIONALLY
LEFT BLANK

Table 4-3. 100-HR-2 Investigation. (1 of 2)

Current Designation (aliases)	Facility Type	Wastes Received or Handled	Strategy	Proposed Boreholes
118-H-1 (100-H Burial Ground #1, 100-H-1)	Burial Ground 700 x 350 ft 20 ft deep	The site received an estimated 10,000 cubic meters of waste consisting of: activated components - dummy elements, process tubing and horiz. control rods; misc. surface contaminated materials - broken hand tools, rags, sweeping compound, light bulbs, sheets of plastic and paper from zones, etc. Misc. wastes were sealed in boxes and placed in different trenches than the activated wastes.	IRM Pathway	0
118-H-2 (100-H Burial Ground #2, H-1 Loop Burial Ground)	Burial Ground 140 x 50 ft 15 ft deep	The site received an estimated 2 cubic meters of waste. The east vault received one stainless steel double-tube with associated hardware (cleaning solutions and misc. capsule components). The west vault was used for disposal of contaminated pipe.	IRM Pathway	0
118-H-3 (Construction Burial Ground)	Burial Ground 100 x 375 x 313 x 400 20 ft deep	The site received an estimated 3,000 cubic meters of waste consisting of sections of contaminated 16-inch pipe used as chutes for removal of thimbles from 105-H, reactor hardware, and components from reactor modification programs.	IRM Pathway	0
118-H-4 (Ball 3X Burial Ground)	Burial Ground 150 x 30 ft 20 ft deep	The site received an estimated 20 cubic meters of irradiated materials, such as vertical safety rod thimbles and guides, from 105-H during the Ball 3X Program.	IRM Pathway	0
118-H-5 (105-H Thimble Pit)	Burial Ground 30 x 2 ft 10 ft deep	The site received an estimated 30 cubic meters of waste. A thimble assembly from the B Experimental Hole from the 105-H X-Level. In 1960 the 105-H Pluto Crib was excavated and placed in this burial ground.	IRM Pathway	0
105-H Rod Cave	Burial Ground 40 x 25 ft	The site is suspected to contain contaminated horizontal control rods and possibly other miscellaneous reactor facility components.	IRM Pathway	0
Buried Thimble	Burial Ground 40 ft long	The site is suspected to contain a verticle safety rod thimble.	IRM Pathway	0
126-H-1 (184-H Powerhouse Ash Pit, 188-H Ash Disposal Area)	Ash Pit	Unknown amounts of coal ash were sluiced to this pit with raw river water. The ash has been analyzed using the EP Toxicity Test in accordance with WAC 173-303, no hazardous materials were found.	defer to final remedy selection process	0
128-H-1 (100-H Burning Pit No. 1)	Burning Pit 100 x 100 ft 10 ft deep	An estimated waste volume is 10,000 cubic meters of wastes. Nonradioactive, combustible materials, such as paint wastes, office wastes and chemical solvents.	defer to final remedy selection process	0

Table 4-3. 100-HR-2 Investigation. (2 of 2)

Current Designation (aliases)	Facility Type	Wastes Received or Handled	Strategy	Proposed Boreholes
128-H-2 (100-H Burning Pit No. 2)	Burning Pit 120 x 80 ft	Unknown amounts of nonradioactive, combustible materials such as vegetation, paint waste, office waste and chemical solvents.	defer to final remedy selection process	0
128-H-3	Burning Pit	Suspected wastes are combustible materials, amounts are unknown.	defer to final remedy selection process	0
1607-H1	Sanitary Septic System tank: 15 x 6 ft field: 56 x 50 ft	An unknown amount of sanitary sewage.	defer to final remedy selection process	0
1607-H3	Sanitary Septic System tank: 19 x 7 ft field: 100 x 50 ft	An unknown amount of sanitary sewage.	defer to final remedy selection process	0
151-H	Electrical Substation	Potential PCB contamination in soils where oil-filled equipment was located.	defer to final remedy selection process	0

5.0 RCRA FACILITY INVESTIGATION/CORRECTIVE MEASURES STUDY PROCESS

This chapter describes the RFI/CMS process through the final RFI and final CMS for the operable unit. Section 5.1 outlines the tasks to be implemented during the LFI and the 100 Area aggregate and Hanford Site studies, and during the final RFI. Tasks are designed to provide information needed to meet the DQOs identified in Chapter 4. The detailed information needed to carry out these tasks for field activities, if needed, will be presented in Descriptions of Work (DOW) for the operable unit (see Subtask 1e). Environmental monitoring requirements for protecting the health and safety of onsite investigators are described in the 100-HR-1 Health and Safety Plan (HSP) (See Appendix B).

The feasibility and corrective measures studies that will be conducted in support of remedy selection during the RFI/CMS process are described in Section 5.2. A detailed analysis of remedial alternatives for IRMs will be conducted as part of the focused FS, and an analysis for operable unit corrective actions will be conducted as part of the final CMS. Both the focused FS and final CMS will use information provided by the analysis of generic remedial alternatives completed as part of the 100 Area FS.

5.1 RCRA FACILITY REMEDIAL INVESTIGATION PROCESS

5.1.1 Limited Field Investigation and the 100 Area Aggregate and Hanford Site Studies

To satisfy the data needs and DQOs specified in Chapter 4.0, the following tasks will be addressed during the LFI:

- Task 1--Project Management
- Task 2--Source Investigation
- Task 3--Geological Investigation
- Task 4--Surface Water and Sediments Investigation
- Task 5--Vadose Zone Investigation
- Task 6--Groundwater Investigation
- Task 7--Air Investigation
- Task 8--Ecological Investigation
- Task 9--Other Tasks
- Task 10--Data Evaluation
- Task 11--Risk Assessment
- Task 12--Verification of CARs
- Task 13--LFI Report.

The tasks and their component subtasks and activities are outlined in the following sections. Information is provided on each task to allow estimation of the project schedule (see Section 6.0) and costs.

5.1.1.1 Task 1--Project Management. The project management objectives throughout the course of the 100-HR-2 operable unit RFI/CMS are to direct and document project activities so that the data and evaluations generated meet the goals and objectives of the work plan, and to ensure that the project is kept within budget and schedule. The initial project management activity will be to assign individuals to roles established in Chapter 7.0. Specific subtasks that will occur throughout the LFI/Focused FS and RFI/CMS include the following:

- Subtask 1a--General Management
- Subtask 1b--Meetings
- Subtask 1c--Cost Control
- Subtask 1d--Schedule Control
- Subtask 1e--Work Control
- Subtask 1f--Records Management
- Subtask 1g--Progress and Final Reports
- Subtask 1h--Quality Assurance
- Subtask 1i--Health and Safety
- Subtask 1j--Community Relations.

Each of these subtasks is described in Section 5.1.1.1 of the 100-HR-1 Operable Unit Work Plan. There is no notable difference, with the exception of Subtask 1e-Work Control and 1h-Quality Assurance. The references to the QAPjP are not relevant to this work plan. The 100-HR-2 operable unit work plan does not require a QAPjP because no intrusive field activities are planned for the solid waste burial grounds. Further detail on schedule control, cost control, meetings, and reporting can be found in the DOE-RL (1989) Environmental Restoration Field Office Management Plan and the Action Plan in the Tri-Party Agreement (Ecology et al. 1990a).

5.1.1.2 Task 2--Source Investigation. The source investigation for the LFI at the 100-HR-2 operable unit is composed of five subtasks and their component activities:

- Subtask 2a--Source Data Compilation and Review

- Subtask 2b--Geodetic Control

- Subtask 2c--Field Activities
  - Activity 2c-1--Site Walkover
  - Activity 2c-2--Source Sampling

- Subtask 2d--Laboratory Analysis and Data Validation

- Subtask 2e--Source Data Evaluation.

These subtasks will be conducted to identify sources, locations, and potential contamination associated with each solid waste burial ground and identified low priority sites as agreed to by the three parties. As described in the following subtasks, not all activities will be conducted at each facility.

The source investigation performed as part of the 100-HR-2 operable unit investigation will be integrated with and rely on similar investigations performed as part of the 100-HR-3 groundwater operable unit investigation to avoid duplication of effort and maximize use of the data obtained.

5.1.1.2.1 Subtask 2a--Source Data Compilation and Review. An initial search for 100-HR-2 operable unit documents, photographs, and drawings was completed as part of the 100-HR-3 activity. Review of this material was used to provide additional information about burial grounds, source units, or potential source areas. The current source data compilation subtask consists of reviewing the existing information to more accurately and completely characterize the potential sources of contamination within the operable unit. The information obtained in this subtask will be evaluated and subsequently used to refine the 100-HR-2 operable unit conceptual model, and support the Qualitative Risk Assessment (QRA).

Any data gathered during LFIs at analogous facilities within the other 100 Area operable units will be compiled. These data will be evaluated to determine its applicability to facilities in the 100-HR-2 operable unit.

5.1.1.2.2 Subtask 2b--Geodetic Control. The objectives of this activity are to provide horizontal and vertical control for sampling points and to document all sample-point locational data on an operable-unit-wide basis. A topographic base map for the operable unit has been developed using computer aided design at a scale of 1:2,000 that shows elevation contours at 0.5-m (1.5 ft) intervals. Horizontal control will be provided for sampling points established for completing the sampling of low priority sites. The topographic base map will provide adequate horizontal and vertical control for source samples. Subtask 2b, geodetic control, will continue throughout the field program.

5.1.1.2.3 Subtask 2c--Field Activities. Surface geophysics studies using GPR and EMI and soil vapor surveys were used in the scoping studies and may be used as appropriate as part of the LFI of the burial grounds. Two field activities are planned for the 100-HR-2 operable unit. These activities are:

Activity 2c-1--Site Walkover. The objectives of this activity are to identify and locate additional sources and areas of disturbed and/or unnatural appearance, to locate known (but mislocated) sources, and to obtain a general understanding of the site with emphasis on those facilities deferred to the long-term final remedy selection process. The entire operable unit will be walked, and areas of disturbance, monuments, old foundations, and so forth, will be mapped. The walkover will be extended outside the operable unit boundary if it is determined that previously unidentified source units are present near the operable unit. Available aerial photographs will be used by the crew performing the walkover. The crew will note areas of potential interest on the photographs and will ground-truth unusual areas noted on the photographs. All areas of potential interest will be flagged and surveyed as part of Subtask 2b--Surveying.

Activity 2c-2--Source Sampling. At the 100-HR-2 operable unit this activity will be conducted under the final remedy selection process at low-priority sites. Sampling is proposed to be conducted for sludges and surface soils 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 extent of any contamination found. Location and numbers of source samples will be plotted on the topographic base map. Specific sampling locations and procedures for sampling will be documented in the DOW. The following facilities have been deferred to the final remedy selection process and may be sampled along with any unplanned releases identified during the source data compilation:

- Sludge from inactive septic tanks
- Soils from the septic tank tile fields
- Surface soils where PCBs are possible
- Soils from burn pits.

Septic Systems. This activity will sample the sludge found in the bottom of the inactive 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 contaminants, a tank removal plan may be developed and implemented. Access to the sludge in the septic tanks will be conducted through the cleanout ports. In active tile fields one shallow hand-held auger boring will be drilled close to the inlet of the field. In inactive tile fields, samples will be collected from test pits. Samples will be analyzed for radionuclides and a reduced analyte list using SW-846 methods. If necessary, geophysics will be used to locate the boring to ensure that the tiles are not penetrated by the boring. Further borings will be emplaced as necessary, pending the sampling results in the first boring.

Electrical Facilities. Available data on the presence and history of PCB transformers and other PCB electrical equipment will be reviewed in Subtask 2a. Surface soils around the areas where PCB transformers, switches, and capacitors were stored or operated and locations with possible PCB contamination will be visually examined for evidence of leaks. Soil samples will be collected from areas with visible soil staining and analyzed for PCBs.

5.1.1.2.4 Subtask 2d--Source Sample Laboratory Analysis and Data Validation. When source sampling of low-priority sites occurs, samples collected for analysis will be analyzed for a reduced list of analytes, derived from historical sampling and process knowledge. Chemical and radiological samples will be analyzed in accordance with SW-846 methods (EPA 1986) and standard methods, respectively. Analytical methods, routinely analytical detection and quantification limits, and precision and accuracy specified for the methods will be addressed in the QAPjP (see Appendix A). Sample parameters selected for laboratory analysis for specific source units will be documented in the DOW.

5.1.1.2.5 Subtask 2e--Source Data Evaluation. Additional existing information compiled under Subtask 2a, Source Data Compilation, will be evaluated, and any necessary changes to the planned work will be made. This compilation will include descriptions of each source with levels and types of contamination in the source. The information collected during Subtask 2c, Field Activities, will be compiled and evaluated.

5.1.1.3 Task 3--Geologic Investigation. The purpose of the geologic investigation is to further characterize the geology of the operable unit. Because geological data needs overlap with those of the 100-HR-3 operable unit vadose zone investigations and the 100-HR-3 groundwater operable unit investigation, the geological investigation will require an integrated compilation of geologic information from both the source and groundwater operable units. For this reason, the geologic investigation for the 100-HR-2 operable unit will be performed as part the 100-HR-3 groundwater operable unit investigation.

5.1.1.4 Task 4--Surface Water and Sediments Investigation. Surface water and recent water based sediments are included within the boundaries of the 100-HR-3 operable unit. The subtasks for the surface water and sediments investigation for the 100-HR-2 operable unit were performed as part of an aggregate area investigation for the 100 Area, and are discussed in Appendix D-1, Surface Water and Sediment Investigation, of the 100-HR-3 operable unit work plan.

5.1.1.5 Task 5--Vadose Zone Investigation. The objective of this task is to define the nature and vertical extent of contamination related to waste disposal facilities at the 100-HR-2 operable unit, to define relevant migration paths between the solid waste burial grounds and potentially contaminated media, especially groundwater, and to support the selection of IRMs. On the basis of existing data and judgement, the lateral extent of the contamination below waste facilities is expected to be limited to the size of the facility. As described in Section 4.2.1.2, collection of additional field data is not currently planned. Historic and analogous facility data will be used for the following purposes:

- Refining the conceptual model
- Supporting a qualitative risk assessment to determine cleanup levels for implementing IRMs
- Supporting a focused feasibility study for developing and evaluating IRM alternatives.

5.1.1.6 Task 6--Groundwater Investigation. The groundwater investigation is being performed as part of the 100-HR-3 operable unit RFI, and is described in that work plan (DOE-RL 1992a).

5.1.1.7 Task 7--Air Investigation. Although the proposed 100-HR-2 low-priority field sampling activities include actions that may expose waste and potentially contaminated soil to the atmosphere, it is expected that there will be minimal disturbance of significant volumes of contaminated materials during these activities. Because air is therefore not anticipated to be a significant contaminant transport medium for the 100-HR-2 operable unit, no field activities are planned for the air investigations. However, if the need for air investigation becomes apparent during the course of the project or because of experience at other projects, air investigations will be performed as required.

5.1.1.8 Task 8--Ecological Investigation. The ecological investigation will determine the potential biocontamination transport pathways through the environment, the critical habitat for major species, and conceptual models of human and environmental risk. The ecological investigation will provide information necessary to complete the risk assessment and to develop and evaluate a full range of remediation alternatives. These tasks were performed as part of an aggregate area investigation for the 100 Area, in accordance with the activities addressed in Appendix D-2, Ecological Investigations, of the 100-HR-3 operable unit work plan.

5.1.1.9 Task 9--Other Tasks. This task has been reserved in the event that additional tasks are identified during the course of the project. Currently, one subtask has been identified: Subtask 9a--Cultural Resources Investigation.

5.1.1.9.1 Subtask 9a--Cultural Resource Investigation. The cultural resource investigation will deal with the entire 100 Area and the 600 Area north of the Gable Mountain and south of the Columbia River, rather than individual operable units. Details of this investigation are presented in Appendix D-3, Cultural Resource Investigation, of the 100-HR-3 groundwater operable unit work plan. The task will include review of available existing data on historic land uses by local Indian tribes as well as early 20th century land use by pioneer farmers and settlers. A field survey will be conducted by a qualified archaeologist following the review of existing data.

5.1.1.10 Task 10--Data Evaluation. Data generated during these tasks will be integrated and 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 made available to project management personnel to keep project staff informed of progress being made. The interpretations developed under this task will be used in Task 11--Risk Assessment, which will evaluate the overall risk to human health and the environment posed by the 100-HR-2 operable unit.

5.1.1.11 Task 11--Risk Assessment. Both qualitative and baseline risk assessments will be conducted during the course of the RFI/CMS process for the 100 Area. Qualitative risk assessments based on available site data will be used to support IRMs following the initial data evaluation and LFIs. Baseline risk assessments will be conducted after evaluation of data from ERA, IRM, and LFI paths, the corrective measures and feasibility studies, and when necessary, the completion of additional field investigations.

The 100-HR-2 operable unit risk assessment process will determine the magnitude and probability of potential harm to human health and the environment by the threatened or actual release of hazardous substances from the 100-HR-2 operable unit in the absence of an action-oriented corrective measure. Both the qualitative and baseline risk assessments will be developed in accordance with HSBRAM (DOE-RL 1992d) when finalized. This methodology addresses both human health and environmental assessments in accordance with appropriate federal and state guidance, including the *Risk Assessment Guidance for Superfund, Volume 1: Human Health Evaluation Manual, Part A* (EPA 1989a), *Risk Assessment Guidance for Superfund, Volume II: Environmental Evaluation Manual* (EPA 1989b), *EPA-Region 10 Supplemental Guidance for Risk Assessment* (EPA 1991), and MTCACR (WAC 173-340).

The risk assessment task will be divided into two subtasks:

- Subtask 11a--Human Health Evaluation
- Subtask 11b--Environmental Evaluation.

The subtasks are more fully described in the 100-HR-1 work plan (DOE-RL 1992c).

5.1.1.12 Task 12--Verification of Contaminant- and Location-Specific CARs. The formulation of operable-unit-specific CARs is an ongoing process throughout the RFI/CMS. Preliminary CARs were identified and discussed in Section 3.2 of the 100-HR-1 operable unit work plan (DOE-RL 1992c). In addition, potential ARARs for the 100 Area are currently being developed. Following the evaluation of analytical data under Task 10, contaminant-specific and location-specific CARs will be reviewed and identified, based upon the new knowledge of contamination at the site and the site setting. Once the potential CARs for the 100-HR-2 operable unit have been properly identified, EPA and Ecology will be asked to verify the contaminant- and location-specific CARs. 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 the 100-HR-2 operable unit.

5.1.1.13 Task 13--Limited Field Investigation Report. An interim report will be prepared upon completion of the limited field investigation. This report will consist of a preliminary summary of the characterization activities described in Tasks 1 through 12. Information pertinent to the operable unit conceptual model will be refined, as necessary. The report will include the results of the historical investigation, identify the contaminant- and location-specific CARS, and provide an assessment of whether contaminant concentrations pose an unacceptable risk that warrants action through IRMs. The report will include a determination of whether or not sufficient information exists to recommend continuing the waste sites as IRM candidates.

5.1.2 Final RCRA Facility Investigation

The final RFI provides any additional data and characterization needed to support selection, design, and implementation of a final corrective action for the operable unit. The final RFI is performed at remaining low-priority sites where existing data are considered insufficient by the unit managers, and at any remaining high-priority sites where final cleanup criteria were not achieved during the IRM. The final RFI may consist of data compilation, non-intrusive investigations, intrusive investigations, and data evaluation. Analyses conducted during the final RFI will use data collected during the LFI, during IRM implementation, and in previous investigations.

A baseline risk assessment is performed as part of the final RFI. This assessment provides a quantitative evaluation of residual risk at the operable unit after completion of the IRMs, and is conducted according to HSBRAM (DOE-RL 1992d). The results of this assessment are used to help determine the need for corrective actions, to select the corrective action, and to determine risk-based cleanup levels for the corrective action.

The final RFI is conducted in parallel with the final CMS, permitting the collection of any additional data that may be identified when conducting the final CMS. The final RFI and the baseline risk assessment are documented in the final RFI report, which is a secondary document.

5.2 CORRECTIVE MEASURES STUDY PROCESS

In accordance with the *Hanford Federal Facility Agreement and Consent Order Change Packages* (Ecology et al. 1991), the FS and CMS process for the 100 Area will be conducted on both an aggregate area and operable unit basis. The EPA published *Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA* (EPA 1988a) will be used as the guidance document for the content and approach to each of the feasibility and corrective measures studies performed. This process includes preparation of a 100 Area FS completed on an aggregate basis, a focused FS, and a final CMS completed on an operable unit basis. The IRM process takes place between the focused FS and final CMS. A description of the IRM process and each of the corrective measures and feasibility studies is also provided in the 100-HR-1 work plan. The emphasis in this work plan is placed on the focused FS. If a final CMS is necessary, the tasks outlined for the focused FS would be repeated. This process is intended to reduce the level of effort required for any one individual study and allow initiation of corrective action activities based on known data and previously tested/demonstrated technologies.

6.0 SCHEDULE

An operable unit schedule, which supports the Tri-Party Agreement Action Plan work schedule, has been prepared that details the work described in Chapter 5 of this work plan. This schedule (Figure 6-1) is the baseline that will be used to measure progress in implementing this work plan. The approval of this work plan is for the work associated with the 100-HR-2 operable unit and is not binding for any other work plans.

The integrated schedule, the operable unit schedule, and the 100 Area-wide activity schedule (Figs. 6-2, 6-3, and 6-4) from the 100-HR-1 Operable Unit Work Plan (DOE-RL, 1992c) are incorporated by reference. They include interim milestones established to track and help ensure progress of the various tasks. A formal change control process has been established in the Tri-Party Agreement Action Plan, and will be used, if necessary, to modify milestones shown in the schedules.

THIS PAGE INTENTIONALLY
LEFT BLANK

9312975.0103

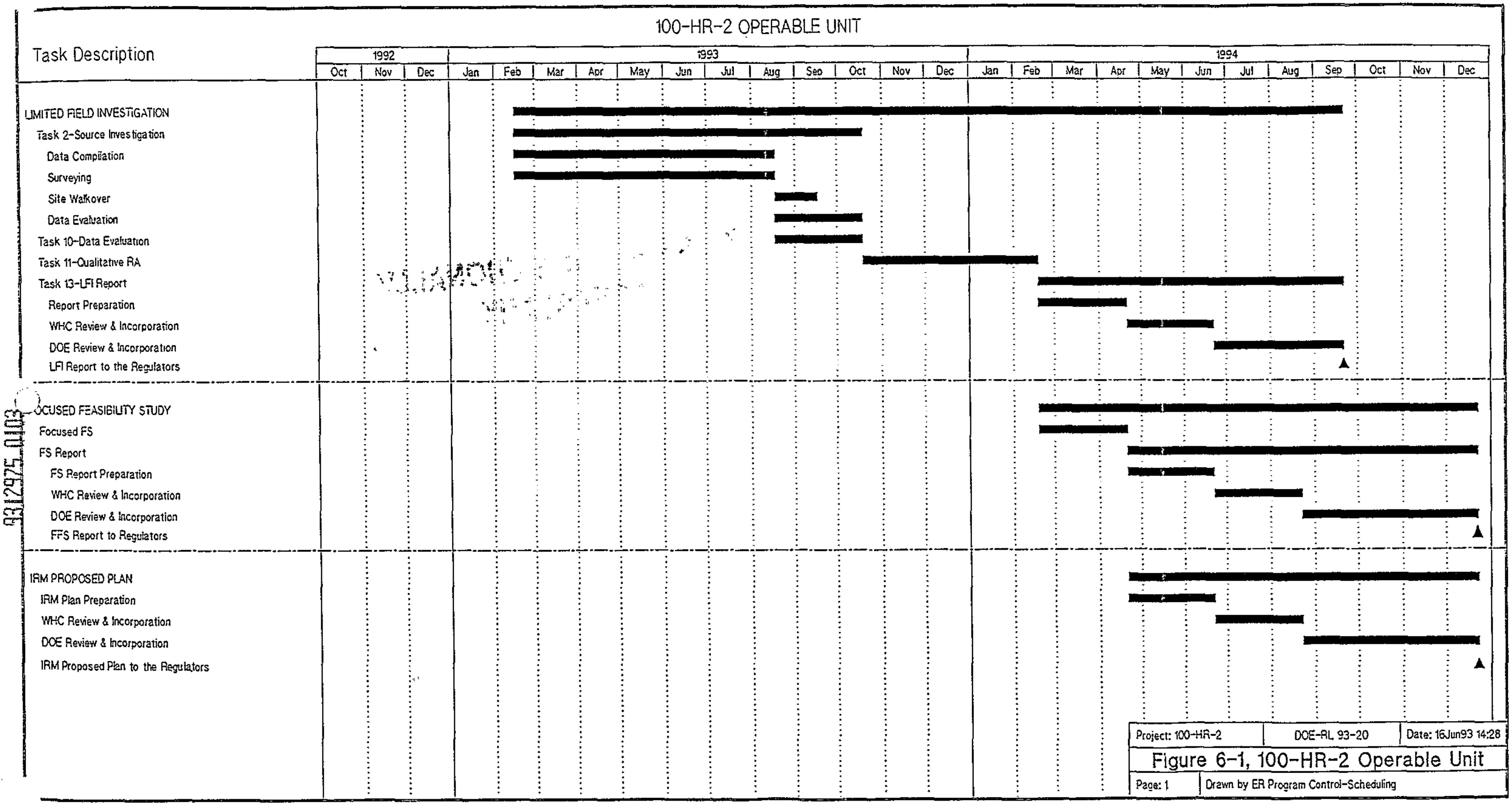


Figure 6-1. 100-HR-2 Operable Unit

THIS PAGE INTENTIONALLY
LEFT BLANK

7.0 PROJECT MANAGEMENT

This chapter defines the administrative and institutional tasks necessary to support the RFI/CMS for the 100-HR-2 operable unit at the Hanford Site. Also, this chapter defines the responsibilities of the various participants, the organizational structure, and the project tracking and reporting procedures. This chapter is in accordance with the provisions of the Tri-Party Agreement Action Plan dated August 1990. Any revisions to the Tri-Party Agreement Action Plan that would result in changes to the project management requirements would supersede the provisions of this chapter.

The Project Management activities included in the 100-HR-1 work plan (DOE-RL 1992c) cover all of the activities which are a part of the 100-HR-2 work plan. Therefore, the 100-HR-1 work plan, Chapter 7.0, Project Management, shall be used for 100-HR-2, by reference.

THIS PAGE INTENTIONALLY LEFT BLANK

8.0 REFERENCES

Backman, G.E., P.C. Jerman, R.E. Roberts, J.W. Vanderbeek, 1963, *Burial of Hanford Radioactive Wastes*, HW-77274, General Electric, Hanford Atomic Products Operation, Richland Washington.

Bisping, L.E. and R.K. Woodruff, 1992, *Hanford Site Environmental Data for Calendar Year, 1991 - Surface and Columbia River*, PNL-8149, Pacific Northwest Laboratory, Richland, Washington.

CDM Federal Programs Corporation, 1987, *Data Quality Objectives for Remedial Response Activities: Volume 1, Development Process*, EPA-540/G-87/003A, U.S. Environmental Protection Agency, Office of Emergency and Remedial Response and Office of Solid Waste and Emergency Response, Washington, D.C.

Delaney, C.D., K.A. Lindsey, and S.P. Reidel, 1991, *Geology and Hydrology of the Hanford Site: A standardized Test for Use in Westinghouse Hanford Company Documents and Reports*, WHC-SD-ER-TI-003, Westinghouse Hanford Company, Richland, Washington.

DOE, 1987a, *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, 1988a, *Site Characterization Plan, Reference Repository Location, Hanford Site, Washington; Consultation Draft*, DOE/RW-0164, U.S. Department of Energy, Office of Civilian Radioactive Waste Management, Washington, D.C.

DOE-RL, 1982, *Site Characterization Report for the Basalt Waste Isolation Project*, DOE/RL 82-3, Rockwell Hanford Operations, Richland, Washington.

DOE-RL, 1989, *Environmental Restoration Field Office Management Plan*, DOE/RL 89-29, U.S. Department of Energy, Richland Field Office, Richland, Washington.

DOE-RL, 1991a, *Hanford Site Past-Practice Strategy*, DOE/RL-91-40, Draft A, U.S. Department of Energy, Richland Field Office, Richland, Washington.

DOE-RL, 1992a, *RCRA Facility Investigation/Corrective Measures Study Work Plan for the 100-HR-3 Operable Unit, Hanford Site, Richland, Washington*, DOE/RL 88-36, Rev 0, U.S. Department of Energy, Richland Field Office, Richland, Washington.

DOE-RL, 1992b, *RCRA Facility Investigation/Corrective Measures Study Work Plan for the 100-DR-1 Operable Unit, Hanford Site, Richland, Washington*, DOE/RL 89-09, Rev 0, U.S. Department of Energy, Richland Field Office, Richland, Washington.

DOE-RL, 1992c, *RCRA Facility Investigation/Corrective Measures Study Work Plan for the 100-HR-1 Operable Unit, Hanford Site, Richland, Washington*, DOE/RL 88-35, Rev. 0, U.S. Department of Energy, Richland Field Office, Richland, Washington.

DOE-RL, 1992d, *Hanford Site Baseline Risk Assessment Methodology,* Revision 2, DOE/RL 91-45, U.S. Department of Energy, Richland Field Office, Richland, Washington.

DOE-RL, 1992e, *Hanford Site Soil Background,* DOE/RL-92-24, U.S. Department of Energy, Richland Field Office, Richland, Washington.

Dorian, J.J., and V.R. Richards, 1978, *Radiological Characterization of the Retired 100 Areas*, UNI-946, United Nuclear Industries, Richland, Washington.

Dworzak, W.R., 1983, *Assessment of Hanford Coal Ash Resources and Recovery Techniques*, Internal Letter #65455-83-047 to H.H. Hopkins, Rockwell Hanford Operations.

Ecology, EPA, and DOE, 1990a, *Hanford Federal Facility Agreement and Consent Order*, First amendment, Two volumes, 89-10 Rev.1, Washington Department of Ecology, U.S. Environmental Protection Agency, and U.S. Department of Energy, Richland Field Office, Richland, Washington.

Ecology, EPA, and DOE-RL, 1991, *Hanford Federal Facility Agreement and Consent Order Change Packages*, May 16, 1991, Washington State Department of Ecology, U.S. Environmental Protection Agency, and U.S. Department of Energy, Richland Field Office, Richland, Washington.

EPA, 1988a, *Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA; Interim Final*, EPA-540/G-89/004, U.S. Environmental Protection Agency, Office of Emergency and Remedial Response, Washington, D.C.

EPA, 1988b, *Superfund Exposure Assessment Manual*, EPA-540/1-88/001, U.S. Environmental Protection Agency, Washington, D.C.

EPA, 1989a, *Risk Assessment Guidance for Superfund: Volume 1, Human Health Evaluation Manual; Interim Final*, EPA/540/1-89/002, U.S. Environmental Protection Agency, Washington, D.C.

EPA, 1989b, *Risk Assessment Guidance for Superfund: Volume II, Environmental Evaluation Manual; Interim Final*, EPA/540/1-89/001, U.S. Environmental Protection Agency, Washington, D.C.

EPA, 1991, *Supplemental Risk Assessment Guidance for Superfund*, U.S. Environmental Protection Agency, Region X, Seattle, Washington.

General Electric, 1963, *Hazards Summary Report: Volume 3 - Description of the 100-B, 100-C, 100-D, 100-DR, 100-F and 100-H Production Reactor Plants*, HW-74094, General Electric, Hanford Atomic Products Operation, Richland, Washington.

Hawley, K.A., R.A. Peloquin, R.D. Stenner, 1986, *Modified Hazard Ranking System for Sites with Mixed Radioactive and Hazardous Wastes--User Manual*, PNL-5841, Pacific Northwest Laboratory, Richland, Washington.

Heid, K.R., 1956, *Unconfined Underground Radioactive Waste and Contamination -- 100 Areas*, HW-46715, General Electric, Hanford Atomic Products Operation, Richland, Washington.

Herman, G., Jr., 1965, *Underground Radioactive Materials in 100-H and F Plants*, RL-REA-2514, General Electric, Hanford Atomic Products Operation, Richland, Washington.

Hoover, J.D. and T. LeGore, 1991, *Characterization and Use of Soil and Groundwater Background for the Hanford Site*, WHC-MR-0246, Westinghouse Hanford Company, Richland, Washington.

Jacques, I.D., 1987, *UNC Environmental Surveillance Report for the 100 Areas - FY 1986*, UNC-4065, UNC Nuclear Industries, Richland, Washington.

Lindsey, K.A., 1991, *Revised Stratigraphy for the Ringold Formation, Hanford Site, South Central Washington*, WHC-SD-EN-EE-004, Westinghouse Hanford Company, Richland, Washington.

Lindsey, K.A. and G.K. Jaeger, 1993, *Geologic Setting of the 100-HR-3 Operable Unit, Hanford Site, South-Central Washington,* WHC-SD-EN-TI-132, March 1993, Westinghouse Hanford Company, Richland, Washington.

Perkins, C.J., 1990, *Westinghouse Hanford Company Environmental Surveillance annual Report - 100 Areas, Calendar Year 1990*, WHC-EP-0258-2, Westinghouse Hanford Company, Richland, Washington.

Rasmussen, O.R. and R.A. Carlson, 1987, *Design Specifications for the Semiworks (201-C) Site Engineered Barrier,* SD-DD-TI-004, Westinghouse Hanford Company, Richland, Washington.

Runchal, A.K. and B. Sagar, 1993, *PORFLOW: A Multifluid, Multiphase Model for Simulating Flow, Heat Transfer, and Mass Transport in Fractured Porous Media: User's Manual, Version 2.41*, NUREG/CR-5991/CNMRA 92-003.

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, Pacific Northwest Laboratory, Richland, Washington.

Stone, W.A., J.M. Thorpe, O.P. Gifford, and D.J. Hoitink, 1983, *Climatological Summary for the Hanford Area*, PNL-4622, Pacific Northwest Laboratory, Richland, Washington.

USGS, 1986, *Locke Island, Washington, 7.5 Minute Topographic Quadrangle*, Scale 1:24,000, U.S. Geological Survey, Denver, Colorado.

WHC, 1988a, *Final Status Post-Closure Permit Application: 183-H Solar Evaporation Basins*, DOE/RL 88-09, Westinghouse Hanford Company for U.S. Department of Energy, Richland Field Office, Richland, Washington.

WHC, 1991a, *Environmental Investigations and Site Characterization Manual*, WHC-CM-7-7, Westinghouse Hanford Company, Richland, Washington.

WHC, 1991b, *Environmental Compliance Manual*, WHC-CM-7-5, Westinghouse Hanford Company, Richland, Washington.

WHC, 1991c, *WIDS Database Field Descriptions and Data*, WHC-MR-0056 Rev. 1, Westinghouse Hanford Company, Richland, Washington.

WHC, 1992, *Data Validation Report for 100-HR-1 Operable Unit Electrical Facilities*, WHC-SD-EN-TI-079 Rev. 0, Westinghouse Hanford Company, Richland, Washington.

Woodruff, R.K. and R.W. Hanf, 1992, *Hanford Site Environmental Report for Calendar Year 1991*, PNL-8148, Pacific Northwest Laboratory, Richland, Washington.

APPENDIX A

QUALITY ASSURANCE PROJECT PLAN (QAPjP)

A quality assurance project plan (QAPjP) applies specifically to the field activities and laboratory analyses performed as part of a Limited Field Investigation (LFI). Inasmuch as no field and laboratory analyses are to be performed as part of the 100-HR-2 LFI, a QAPjP is not required. For purposes of this work plan, the QAPjP in the 100-BC-2 Work Plan can be consulted for relevant information. The 100-BC-2 QAPjP has incorporated the aspects of analyzing to a reduced analyte list in conjunction with SW-846 methods, as has been presented in this work plan. The 100-BC-2 QAPjP will be used as a guide should future circumstances require such field activities. Changes (including the addition of a QAPjP) shall be documented, reviewed and approved as required by Section 6.6 EII 1.9 "Work Plan Review" (WHC 1991b) and shall be documented in monthly unit managers' meeting minutes.

Reference

WHC, 1991b, *Environmental Investigations and Site Characterization Manual*, WHC-CM-7-7, Westinghouse Hanford Company, Richland, Washington.

APPENDIX B

HEALTH AND SAFETY PLAN (HSP)

The purpose of the Health and Safety Plan (HSP) is to establish standard health and safety procedures for Westinghouse Hanford Company employees and contractors engaged in remedial investigation activities in the 100-HR-2 operable unit. These activities are similar to 100-HR-1 activities and may include site walkovers, surface geophysics and soil gas sampling. No invasive sampling is planned. Inasmuch as the activities and sites conditions are similar for 100-HR-2 and 100-HR-1, no HSP is prepared for the 100-HR-2 work plan. The 100-HR-1 HSP (DOE-RL 1992c) is incorporated by reference.

APPENDIX C

INFORMATION MANAGEMENT OVERVIEW

The Information Management Overview provides an overview of the information, data, and records related activity at the operable unit level. It identifies the source type and quantity of data to be collected and references the procedures which control the collection and handling of data and records. Inasmuch as this overview is the same for all of the operable units, it will not be repeated here, the Information Management Overview Appendix C, from the 100-HR-1 work plan (DOE-RL 1992c) is included by reference. Table C-1 is the 100-HR-2 specific information needed to supplement the 100-HR-1 Information Management Overview.

THIS PAGE INTENTIONALLY
LEFT BLANK

Table C-1. Estimated 100-HR-2 Operable Unit Data Quantities. (1 of 2)

Work plan task	Types of data	Documents/ articles	Sample locations	Total samples	Analyses per sample	Total data points
Task 1--Project management						
Task 2--Source investigations						
--Data compilation	Historic:					
	Engineering plans, reports	1				
	Memoranda/ minutes	3				
--Topographic maps	Aerial photos	1				
	Logbook	1				
	Magnetic media and supporting documentation	1				
	Map	1				
--Soil gas analysis	Logbooks	1				
	Chain of	1				
	custody					
	forms	1				
	QA/QC		2	20		
	Validated					
	sample	1				
	analyses					
	Magnetic media and supporting documentation					
--Electromagnetic induction survey	Logbooks	1				
	Magnetic media and supporting documentation	1				
	Chart recordings	unknown				
--Ground penetrating radar survey	Logbooks	1				
	Magnetic media and supporting documentation	1				
	Chart recordings	unknown				
Task 3--Geologic investigations	Not included in this plan					

Table C-1. Estimated 100-HR-2 Operable Unit Data Quantities. (2 of 2)

Work plan task	Types of data	Documents/ articles	Sample locations	Total samples	Analyses per sample	Total data points
Task 4--Surface-water and sediment investigations	Not included in this plan					
Task 5--Vadose zone investigations	None planned					
Task 6--Groundwater investigation	Not included in this work plan					
Task 7--Air investigations	None planned					
Task 8--Ecological investigations	Not included in this work plan					
Task 9--Other investigations	Technical memo	1				
Task 10--Data evaluation	Technical memo	1				
Task 11--Risk assessment	Technical memo	1				
Task 12--Verification of CARs	Report	1				
Task 13--LFI report	Report	1				

9312975.0113