DOE/RL-96-07
Revision 4

200-ZP-1 Interim Remedial Measure Remedial Design Report

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

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

DOE/RL-96-07
Revision 4

200-ZP-1 Interim Remedial Measure Remedial Design Report

Date Published
June 2008

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

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

J. D. Aardal 07/03/2008
Release Approval Date

Approved for Public Release;
Further Dissemination Unlimited

Printed in the United States of America

TABLE OF CONTENTS

APPENDICES

FIGURES

TABLES

LIST OF TERMS

ARAR	applicable or relevant and appropriate requirement
ASAP	as soon as possible
BTU	British thermal unit
CERCLA	*Comprehensive Environmental Response, Compensation, and Liability Act of 1980*
CFR	*Code of Federal Regulations*
COC	contaminant of concern
COPC	contaminant of potential concern
DOE	U.S. Department of Energy
DWS	drinking water standard
EPA	U.S. Environmental Protection Agency
ERDF	Environmental Restoration Disposal Facility
ETF	Effluent Treatment Facility
FY	fiscal year
GAC	granular activated carbon
gpm	gallons per minute
HEIS	Hanford Environmental Information System
IRM	interim remedial measure
LDR	land disposal restriction
LERF	Liquid Effluent Retention Facility
MCL	maximum contaminant level
N/A	not applicable
OU	operable unit
PFP	Plutonium Finishing Plant
ppb	parts per billion
ppbv	parts per billion by volume
ppm	parts per million
ppmv	parts per million by volume
PRF	Plutonium Reclamation Facility
QA	quality assurance
QC	quality control
RAA	remedial action assessment
RAO	remedial action objective
RCRA	*Resource Conservation and Recovery Act of 1976*
RDL	required detection limit
RECUPLEX	Reclamation of Uranium and Plutonium by Extraction
RI/FS	remedial investigation/feasibility study
ROD	Record of Decision
RPD	relative percent difference
S&GRP	Soil and Groundwater Remediation Project
SAP	sampling and analysis plan
SDWA	*Safe Drinking Water Act*
SVE	soil vapor extraction

TCE	trichloroethylene
Tri-Party Agreement	*Hanford Federal Facility Agreement and Consent Order*
USB	universal serial bus
VOC	volatile organic compound
WAC	*Washington Administrative Code*

METRIC CONVERSION CHART

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

This page intentionally left blank.

1.0 INTRODUCTION

This remedial design report presents the objectives and rationale developed for design and implementation of the selected interim remedial measure (IRM) for the 200-ZP-1 Operable Unit (OU), located in the 200 West Area of the Hanford Site.

The IRM was chosen in accordance with the *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* (CERCLA), as amended by the *Superfund Amendments and Reauthorization Act of 1986*, the *Hanford Federal Facility Agreement and Consent Order* (Tri-Party Agreement) (Ecology et al. 2003), and the "National Oil and Hazardous Substances Pollution Contingency Plan" (40 *Code of Federal Regulations* [CFR] 300).

1.1 PURPOSE AND SCOPE

This remedial design report addresses the design of a groundwater pump-and-treat system. The goal is to reduce further migration of carbon tetrachloride, chloroform, and trichloroethylene (TCE) in the groundwater of the 200 West Area. The system is designed to hydraulically contain and reduce the contaminant mass in the high-concentration portion (i.e., the 2,000 to 3,000 parts per billion [ppb] contour) of the carbon tetrachloride plume. Groundwater and extraction well monitoring data from the 200-ZP-1 pump-and-treat system have improved the understanding of effectiveness of the remedial measure.

1.2 BACKGROUND

The 216-Z-9 Trench received organic and aqueous waste from the Reclamation of Uranium and Plutonium by Extraction (RECUPLEX) process at the Plutonium Finishing Plant (PFP) between 1955 and 1962. RECUPLEX was a solvent extraction process used to recover plutonium from plutonium metal and compound scraps. Tributyl phosphate mixed 15% to 20% by volume with carbon tetrachloride removed plutonium in the exchange process from an inorganic acid feed. The plutonium was then removed from the tributyl phosphate/carbon tetrachloride organic solution and converted to plutonium nitrate, which became part of the feed for the plutonium-refining process at the PFP. The tributyl phosphate/carbon tetrachloride solution was treated and then discharged to the soil column at the 216-Z-9 Trench (*Fiscal Year 2004 Annual Report for 200-UP-1 and 200-ZP-1 Pump-and-Treat Operations* [DOE/RL-2004-72]).

Scrap reprocessing was performed at the 236-Z Plutonium Reclamation Facility (PRF) between 1964 and 1987. Wastes were sent to the soil column at the 216-Z-1A tile field between 1964 and 1969 and to the 216-Z-18 Crib between 1969 and 1973. After 1973, organic mixtures containing carbon tetrachloride wastes were used but were no longer discharged to the soil column (DOE/RL-2004-72).

The 242-Z Waste Treatment Facility (in service between 1963 and 1976) was involved with the recovery of americium-241 and plutonium in an ion-exchange batch process using 30% dibutyl butyl phosphonate and 70% carbon tetrachloride between 1964 and 1970 (DOE/RL-2004-72).

From the above sources, carbon tetrachloride was discharged to the ground during operations at the PFP between 1955 and 1973. Estimated quantities of carbon tetrachloride discharged to the waste sites vary between 363,000 to 580,000 L (95,900 to 153,200 gal, or 577,000 to 922,000 kg) of liquid carbon tetrachloride. The waste was discharged primarily to three sites: 216-Z-1A (268,000 kg/168,600 L), 216-Z-9 (471,000 kg/296,300 L), and 216-Z-18 (173,800 kg/

109,300 L) between 1955 and 1973 (*Waste Site Grouping for 200 Areas Soil Investigations* [DOE/RL-96-81]). Three other sites (the 216-T-19 and 216-Z-12 Cribs and the 216-Z-19 Ditch) are also known or suspected to have received quantities of carbon tetrachloride and were active between 1959 and 1981.

Carbon tetrachloride was first detected in groundwater samples from several wells in 1986 (*Environmental Monitoring at Hanford for 1986* [PNL-6120]) and was recognized as a broad plume beneath the 200 West Area in 1987. The *200 West Area Groundwater Aggregate Area Management Study Report* (DOE/RL-92-16) discussed the groundwater carbon tetrachloride plume and recommended it for expedited response action. It became the target of an expedited response action when regulatory agencies requested that the U.S. Department of Energy (DOE) assess groundwater contamination and evaluate alternatives for carbon tetrachloride remediation in the 200 West Area. The *Treatability Test Plan for the 200-ZP-1 Operable Unit* (DOE/RL-94-12) proposed and implemented a treatment system, which later became Phase I of the 200-ZP-1 pump-and-treat system.

In a separate and preceding action, the regulatory agencies requested that DOE assess carbon tetrachloride in the vadose zone (200-ZP-2, currently 200-PW-1) and evaluate alternatives to treat the contaminant. This led to preparation of the *Expedited Response Action Proposal (EE/CA & EA) for 200 West Carbon Tetrachloride Plume* (DOE/RL-91-32). Soil vapor extraction (SVE) was recommended and implemented at the 216-Z-9 Trench, 216-Z-1A tile field, and 216-Z-18 Crib. Initially, one system was built and operated at each of the three waste sites. Operations are currently conducted between April 1 and September 30 each year. Passive SVE systems have also been installed at eight boreholes around the 216-Z-18 Crib. The *Performance Evaluation Report for Soil Vapor Extraction Operations at the 200-PW-1 Carbon Tetrachloride Site, Fiscal Year 2004* (WMP-26178) reports on SVE site operations and vadose zone conditions.

The *Interim Remedial Measure Proposed Plan for the 200-ZP-1 Operable Unit* (DOE/RL-93-68) provides an overview and comparative analysis of the remedial measure alternatives. The preferred alternative (Alternative 2 – Groundwater Pump-and-Treat) was chosen for the following reasons:

- It would accelerate cleanup of the 200-ZP-1 Groundwater OU due to expedient implementation.
- It would provide a reduction in potential risk to human health and the environment by removing contaminant mass and limiting contaminant spread at the area of greatest contamination.
- It relies on best available technology that can be optimized to allow the pump-and-treat interim action to be implemented in a timely manner.
- It would remove and treat contaminants without limiting future options for containment and remediation of the 200-ZP-1 Groundwater OU.

1.3 PUMP-AND-TREAT PHASES OF OPERATION

The 200-ZP-1 OU pump-and-treat system was implemented in a three-phased approach. Phase I operations consisted of the pilot-scale treatability test between August 29, 1994, and July 19, 1996, around the 216-Z-12 Crib. During this phase, contaminated groundwater was removed through a single extraction well (299-W18-1) at a rate of approximately 151 L/min [40 gallons per minute (gpm)], was treated using granular activated carbon (GAC), and was then returned to the aquifer through an injection well (299-W18-4). For more detailed information on operations during the treatability test, refer to the *200-ZP-1 Operable Unit Treatability Test Report* (DOE/RL-95-30).

Concurrent with Phase I operations, the *Declaration of the Interim Record of Decision for the 200-ZP-1 Operable Unit* (EPA et al. 1995) was issued in June 1995. The selected remedy was to use groundwater pump-and-treat technology to minimize further migration of carbon tetrachloride, chloroform, and TCE in the groundwater and to remove the contaminant mass.

Phase II operations commenced August 5, 1996, in accordance with the interim action Record of Decision (ROD) (EPA et al. 1995) and Tri-Party Agreement Milestone M-16-04A. The 1996 groundwater plume was the basis for the interim action ROD. Initial Phase I wells (299-W18-1 and 299-W18-4) were converted to monitoring wells. The well field configuration during Phase II operations consisted of three extraction wells (299-W15-33, 299-W15-34, and 299-W15-35) pumping at a combined rate of approximately 567.8 L/min (150 gpm) and a single injection well (299-W15-29). Groundwater was treated using an air stripper to release carbon tetrachloride into a vapor phase, and GAC was used to collect the vapor. For a detailed description of the treatment system setup and operation, refer to the *200-ZP-1 Phase Interim Remedial Measure Quarterly Report, October – December 1996* (BHI-00952-02). Phase II operations were terminated on August 8, 1997, to transition to Phase III operations.

Phase III operations began on August 29, 1997, satisfying Tri-Party Agreement Milestone M-16-04B. The well field for Phase III operations was expanded to include six extraction wells (existing three wells, plus wells 299-W15-32, 299-W15-36, and 299-W15-37) and five injection wells (299-W15-29, 299-W18-36, 299-W18-37, 299-W18-38, and 299-W18-39). The total pumping rate was increased to more than 800 L/min (+200 gpm) versus a total treatment system capacity of 1,893 L/min (500 gpm). The treatment process for the Phase III system uses the same air-stripping and GAC systems used in Phase II. Extraction wells were installed to contain the high-concentration portion of the carbon tetrachloride plume located near PFP, as required by the interim action ROD (EPA et al. 1995). The southernmost extraction well, 299-W15-37, was converted to a monitoring well in January 2001 because of its limited impact on hydraulic capture of the high-concentration portion of the plume (*Fiscal Year 2002 Annual Summary Report for the 200-UP-1 and 200-ZP-1 Pump-and-Treat Operations* [DOE/RL-2002-67]). In 2004, extraction wells 299-W15-45 and 299-W15-47 were brought on-line to replace extraction wells 299-W15-32 and 299-W15-33, which were no longer producing adequate flow. The reduction in flow from these two wells was predominately a result of dropping water levels. Since the screen in well 299-W15-33 is only 6.1 m (20 ft) in length, dropping water levels had a significant impact on production rates. Although well 299-W15-32 has a 12.2–m (40-ft)-long screen in it, the upper portion of the saturated zone showed higher production rates. As water levels dropped, the formation produced less water. Wells 299-W15-45 and 299-W15-47 have 15.2–m and 18.3-m (50-ft and 60-ft) screens in them, respectively.

Elevated carbon tetrachloride concentrations detected in well 299-W15-40 in the late 1990s was originally thought to be an isolated hotspot. However, the installation of monitoring wells 299-W15-41, 299-W15-43, 299-W15-44, and 299-W15-765 showed that 2,000 μg/L carbon tetrachloride known to be present in the vicinity of PFP also extends well to the north, just beyond the northern end of the 241-TX/TY Tank Farms. In fiscal year 2005 (FY05), four monitoring wells (299-W15-40, 299-W15-43, 299-W15-44, and 299-W15-765) were converted to extraction wells to capture this northern lobe of the 2,000 μg/L carbon tetrachloride plume.

The results from the modeling of groundwater flow from these four additional extraction wells shows that the northern lobe of the carbon tetrachloride plume will be fully captured. In FY06 an out-of-service monitoring well (299-W15-6) was converted to an extraction well, bringing the total number of extraction wells to 10. The combined total pumping rate from these 10 extraction wells was >1,135 L/min (>300 gpm). In FY08, four additional monitoring wells (299-W15-1, 299-W15-7, 299-W15-11, and 299-W15-46) were converted to extraction wells, bringing the number of extraction wells to 14, with a combined pumping rate of approximately 1,514 L/min (400 gpm).

A summary of the changes to the pump-and-treat system throughout its history is addressed in Table 1-1.

Table 1-1. Major Changes to the 200-ZP-1 Pump-and-Treat System.

1994 through 1995	Conducted Phase I operations using one extraction well (299-W18-1) and one injection well (299-W18-4).
1996 through 1997	Conducted Phase II operations using three extraction wells (299-W15-33, 299-W15-34, and 299-W15-35) and a single injection well (299-W15-29). Phase I wells 299-W18-1 (extraction) and 299-W18-4 (injection) were converted to monitoring wells.
1997 through 2001	Conducted Phase III operations. Operations started using the existing three wells, plus three more recent wells (299-W15-32, 299-W15-36, and 299-W15-37) and five injection wells (299-W15-29, 299-W18-36, 299-W18-37, 299-W18-38, and 299-W18-39).
2001	Well 299-W15-37 was converted to a monitoring well, reducing the number of extraction wells to five.
2004	Wells 299-W15-45 and 299-W15-47 were brought on-line to replace extraction wells 299-W15-32 and 299-W15-33.
2005	Wells 299-W15-40, 299-W15-43, 299-W15-44, and 299-W15-765 were converted to extraction wells, bringing the number of extraction wells to nine.
2006	Well 299-W15-6 was converted from an out-of-service monitoring well to an extraction well, bringing the number of extraction wells to 10.
2008	Monitoring wells 299-W15-1, 299-W15-7, 299-W15-11, and 299-W15-46 were converted to extraction wells, bringing the number of extraction wells to 14.

1.4 REMEDIAL ACTION OBJECTIVES

Performance criteria were developed as an initial step in evaluating effectiveness of the IRM based on the Remedial Action Objectives (RAOs) in the interim action ROD (EPA et al. 1995). The RAOs and the associated performance criteria are as follows:

- **RAO #1:** Prevent further movement of contaminants from the highest concentration area of the plume (i.e., containing contaminants inside the 2,000 to 3,000 ppb contour).

  Performance criterion #1: Establish an inward hydraulic gradient within the 2,000 to 3,000 ppb carbon tetrachloride contour (i.e., the containment perimeter).

- **RAO #2:** Reduce contamination in the area of highest concentrations of carbon tetrachloride.

Performance criterion #2: Operate an interim remedial treatment system that will remove carbon tetrachloride, TCE, and chloroform and measure the extracted contaminant mass.

- **RAO #3:** Provide information that will lead to development of a final remedy that will be protective of human health and the environment.

  Performance criterion #3: Evaluate aquifer and contaminant properties information that is collected during well installation and operation.

Performance criterion #1 is the primary standard for assessing effectiveness of the IRM. If an inward hydraulic gradient is established, groundwater will flow toward the extraction wells, thus allowing capture of the high-concentration portion of the plume, reducing contaminant mass (performance criterion #2), and providing additional information for selecting a final remedy. Performance criterion #3 is less directly measurable and consists of additional data-gathering and groundwater-modeling activities focused on development of the final remedy.

1.5 COLLECTION OF FINAL REMEDY INFORMATION

To provide information that will lead to development of a final remedy that will be protective of human health and the environment (RAO #3), various methods (e.g., tracer testing, vertical profiling, and treatability tests) have been implemented in the field to help refine the hydrogeologic system. A large percentage of characterization has been completed to date under the remedial investigation phase. However, in order to further refine the 200-ZP-1 hydrogeologic and hydrochemical system model and, thus, provide additional information that can be used to develop a final remedy, several other types of data are needed. For example, the vertical distribution of contamination needs further definition.

Vertical profile data suggest that dissolved contamination in some cases is deeper than 30 m (100 ft) below the water table. In addition to the evaluations of the water-level measurement data and data from the groundwater sampling network, other types of information that would be useful to determine the final remedy are discussed in the following subsections.

1.5.1 Tracer Testing

One effective method for determining the extent of the capture zone and the rate of remediation is tracer testing. Tracer tests are also useful for locating transmissive zones (i.e., preferential contaminant pathways), which can be used to identify and selectively sample intervals for evaluating the vertical distribution of volatile organics in the aquifer, and for providing hydrostratigraphic correlation data that may be useful for addressing performance criterion #3.

Two types of tracer tests may be useful: (1) a point-dilution tracer test to determine preferential pathways and, thereby, locate sampling or monitoring intervals; and (2) a well-to-well test to enhance performance monitoring, especially in areas where hydraulic control is considered least effective (*Methods for Monitoring Pump-and-Treat Performance* [EPA 1994]). With regard to the latter method, by placing a tracer in a monitoring well near one of the extraction wells and monitoring for arrival at the extraction well, the travel time, effectiveness of the capture zone, and hydraulic conductivity can be estimated. These data are useful for predicting remediation times and for confirming that the capture zone (inward hydraulic gradient) is established. Capture zones will be estimated using data collected during Phase III operations. If these data are inconclusive or could be enhanced, tracer testing could be used to refine definition of the capture zone.

Preferential contaminant pathways can also play a significant role in the rate of cleanup and contaminant migration. These pathways may be determined by performing point-dilution tracer tests in monitoring wells.

A tracer test plan would be prepared and approved before conducting any of these tracer tests. The plan would describe the test objectives, test process, and data evaluation techniques for the testing.

1.5.2 Vertical Profiling

Vertical profile data from wells 299-W11-25B, 299-W11-43, 299-W13-1, 299-W14-11, 299-W15-10, 299-W15-11, 299-W15-7, 299-W15-46, 299-W15-49, 299-W15-50, and 299-W18-16 indicate that dissolved-phase carbon tetrachloride is present more than 30 m (100 ft) below the water table. To assess whether carbon tetrachloride contamination can be successfully remediated requires, in part, knowledge of the vertical distribution of contamination. For this reason, additional vertical profile sampling will be performed in most new monitoring wells to continue to refine the vertical distribution of contamination within the aquifer.

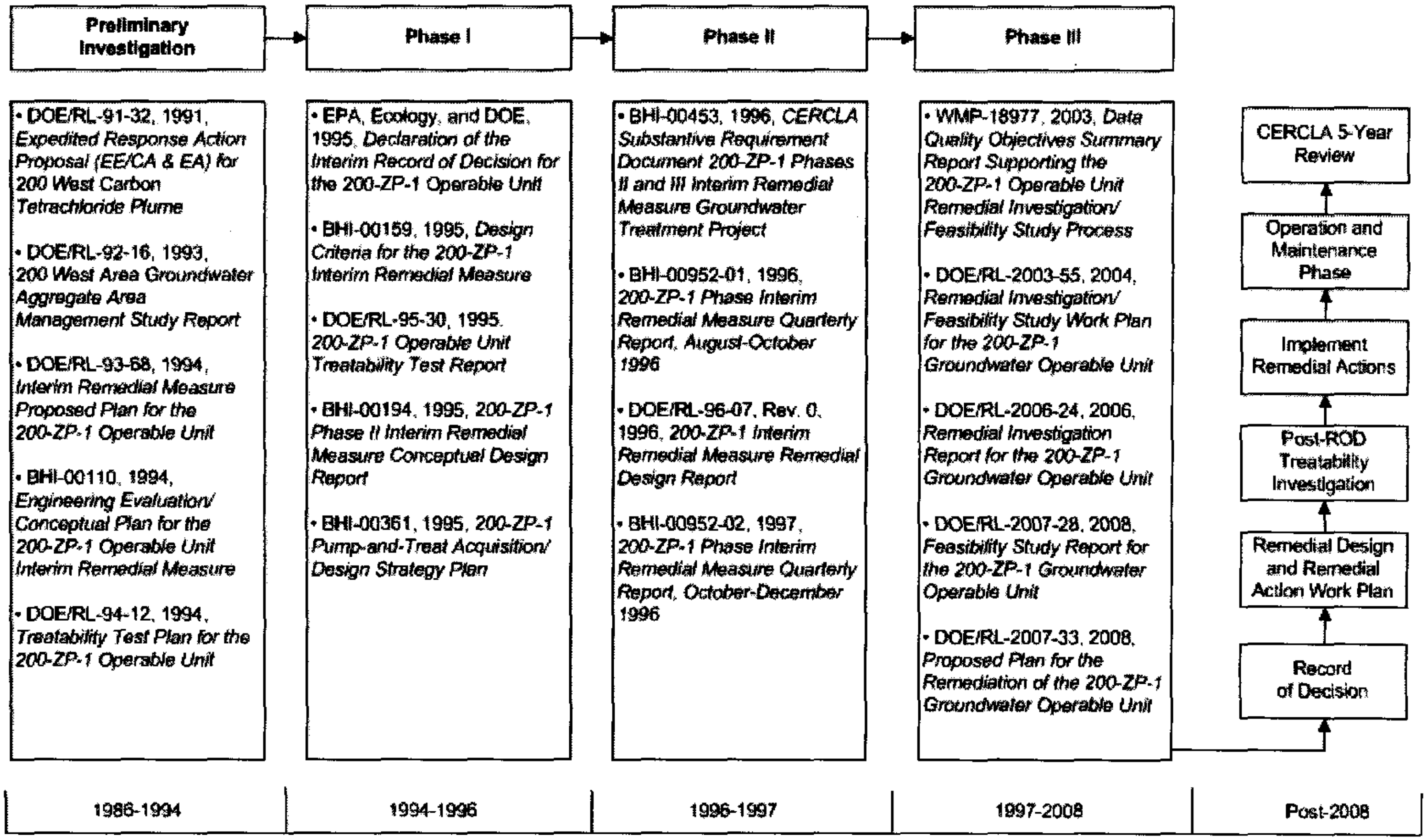
1.5.3 Treatability Tests

In order to evaluate long-term alternatives for the remediation of primary or secondary contaminants, it may be necessary to conduct treatability tests to evaluate potential remedial technologies such as air sparging, enhanced in situ reductive dechlorination, or other technologies as they mature. Treatability tests may be used to assess the capabilities of technologies to successfully treat either high-concentration groundwater or contaminants within the subsurface.

1.6 DESIGN INFORMATION

A timeline of reference documents supporting the engineering and design of the 200-ZP-1 pump-and-treat system is outlined in Figure 1-1, including those investigatory design concepts preliminary to Phases I, II, and III. A list of engineering drawings, as well as additional engineering and design references, is presented in Appendix A.

Figure 1-1. 200-ZP-1 Pump-and-Treat System Engineering and Design Reference Timeline.



This page intentionally left blank.

2.0 EXTENT OF CONTAMINATION

There are five organic (e.g., carbon tetrachloride, chloroform, methylene chloride, tetrachloroethylene, and TCE), four inorganic (e.g., total chromium, hexavalent chromium, nitrate, and total uranium), and three radiological (e.g., technetium-99, tritium, and iodine-129) contaminants of potential concern (COPCs) considered for the 200-ZP-1 OU.

Carbon tetrachloride, chloroform and TCE are the primary contaminants of concern (COCs) that are addressed in this report.

Data presented in this section are summarized from *Fiscal Year 2006 Annual Report for 200-UP-1 and 200-ZP-1 Pump-and-Treat Operations* (DOE/RL-2006-73) and the *Fiscal Year 2004 Annual Report for 200-UP-1 and 200-ZP-1 Pump-and-Treat Operations* (DOE/RL-2004-72). The latter document presents conditions and trends through the end of FY04.

Table 2-1 presents estimates of the baseline extent of carbon tetrachloride contamination in the 200-ZP-1 OU. Figures 2-1 through 2-3 and the plate map provided in Appendix B show the areal extent in the upper unconfined aquifer of the carbon tetrachloride, TCE, and chloroform plumes, respectively for FY2007.

The carbon tetrachloride contamination in the groundwater emanates from the highest concentration mound located beneath the 200 West Area. The "apparent" time-averaged rate of movement of the carbon tetrachloride plume is approximately 0.3 m/day (1 ft/day). As the slope of the water table flattens due to the cessation of groundwater discharges, the rate of movement in the future should be slower because of decreasing hydraulic gradients (DOE/RL-2004-72).

Table 2-1. Baseline Extent of Contamination in the 200-ZP-1 Groundwater Operable Unit.

Wastewater from plutonium refining operations discharged to the soil column between 1955 and 1973	12.9 million L (3.4 million gal)
Estimated mass of carbon tetrachloride discharged to the soil column between 1955 and 1973	577,000 to 922,000 kg (1 to 2 million lb)
Areal extent of carbon tetrachloride groundwater plume	10.9 km^2 (4.2 mi^2)
Estimated mass of dissolved carbon tetrachloride contained in the groundwater plume	4,400 kg (9,700 lb)
Areal extent of the trichloroethylene plume	0.65 km^2 (0.25 mi^2)
Estimated mass of trichloroethylene in the groundwater	0.14 kg (0.3 lb)
Areal extent of the chloroform plume	3.11 km^2 (1.2 mi^2)
Estimated mass of chloroform in the groundwater	30.6 kg (68 lb)

Source: *Hanford Sitewide Groundwater Remediation Strategy Supporting Technical Information* (BHI-00464).

Figure 2-1. Concentration Isopleths for the Carbon Tetrachloride Plume in the 200 West Area.

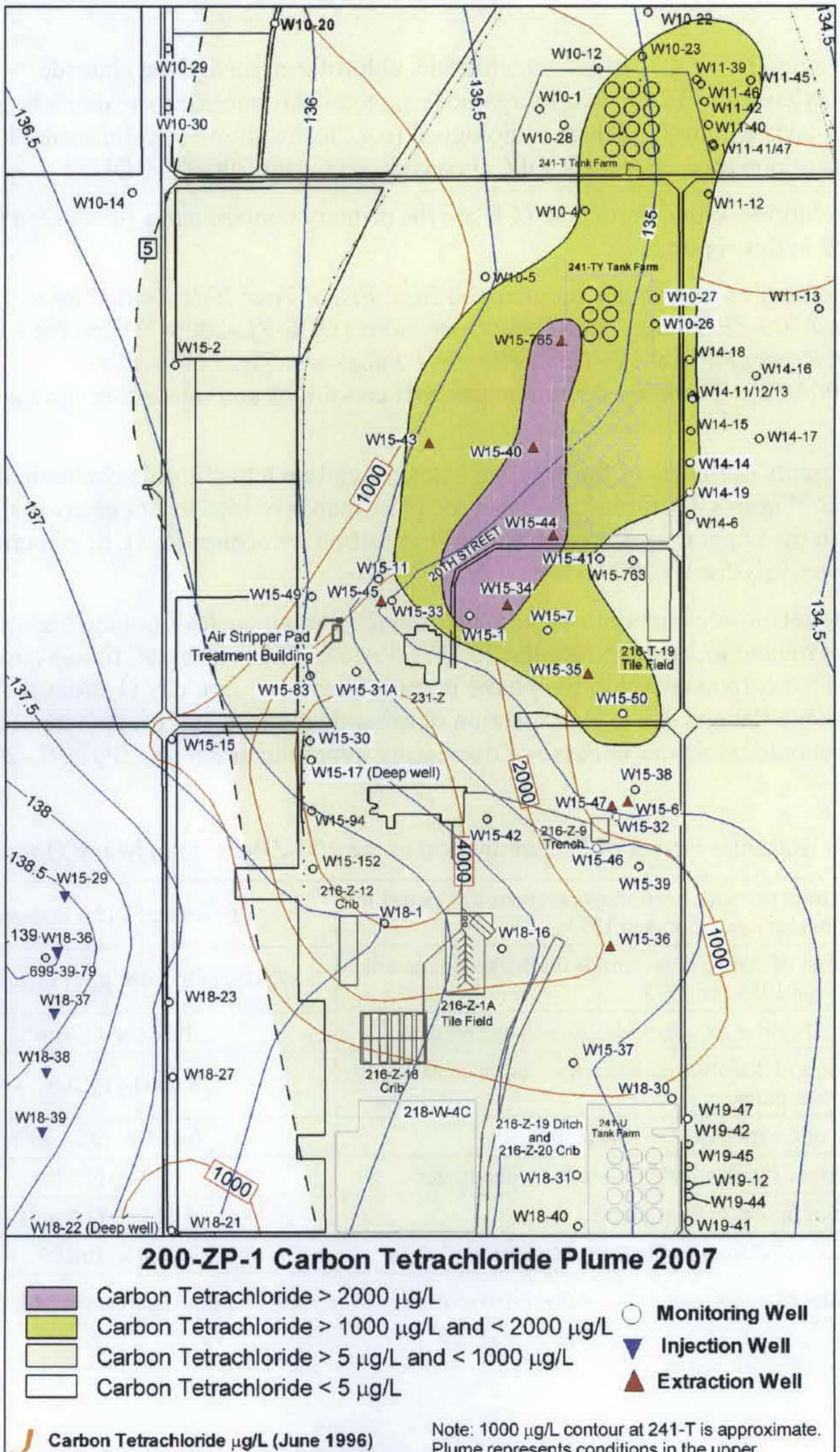


Figure 2-2. Concentration Isopleths for the Trichloroethylene Plume in the 200 West Area.

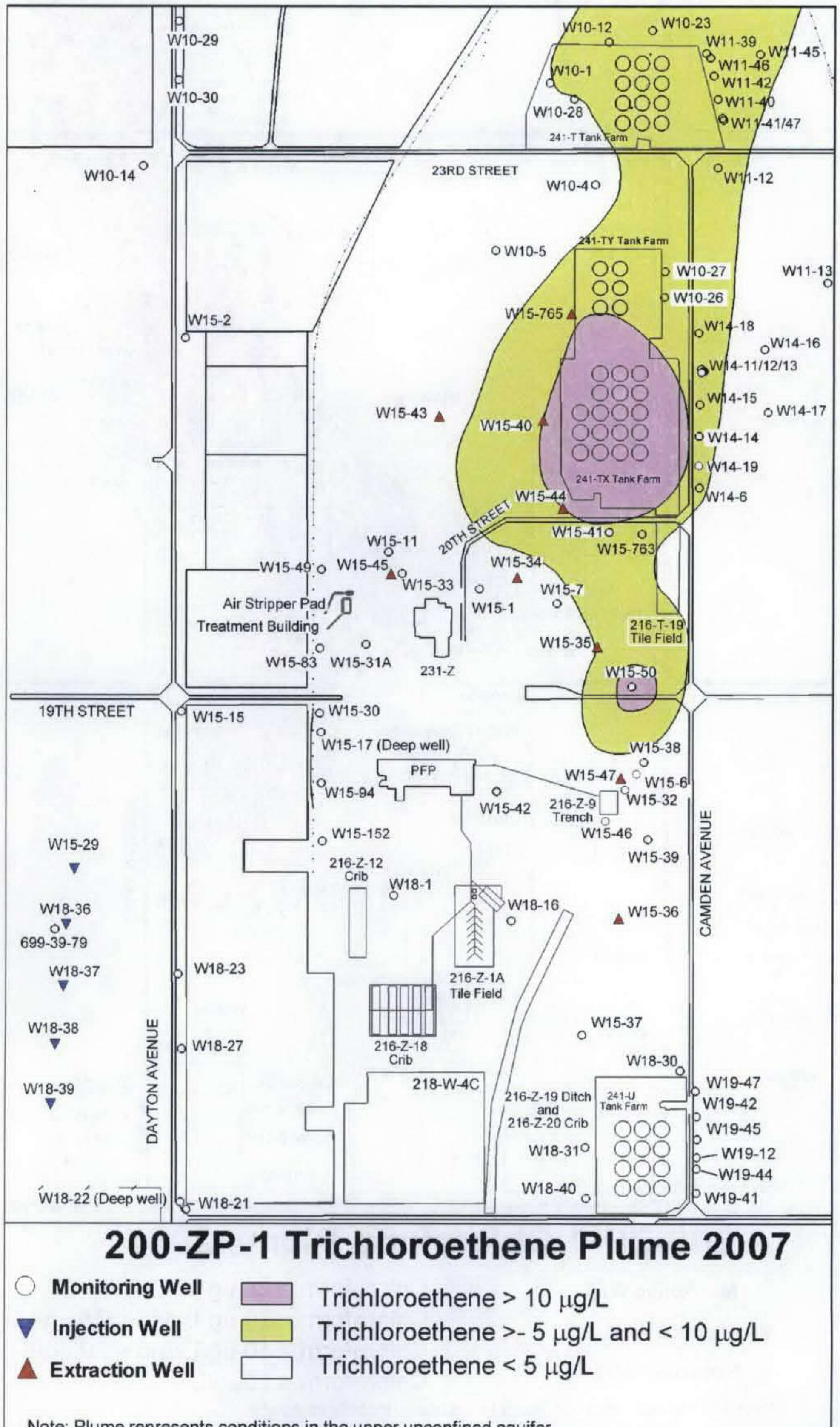
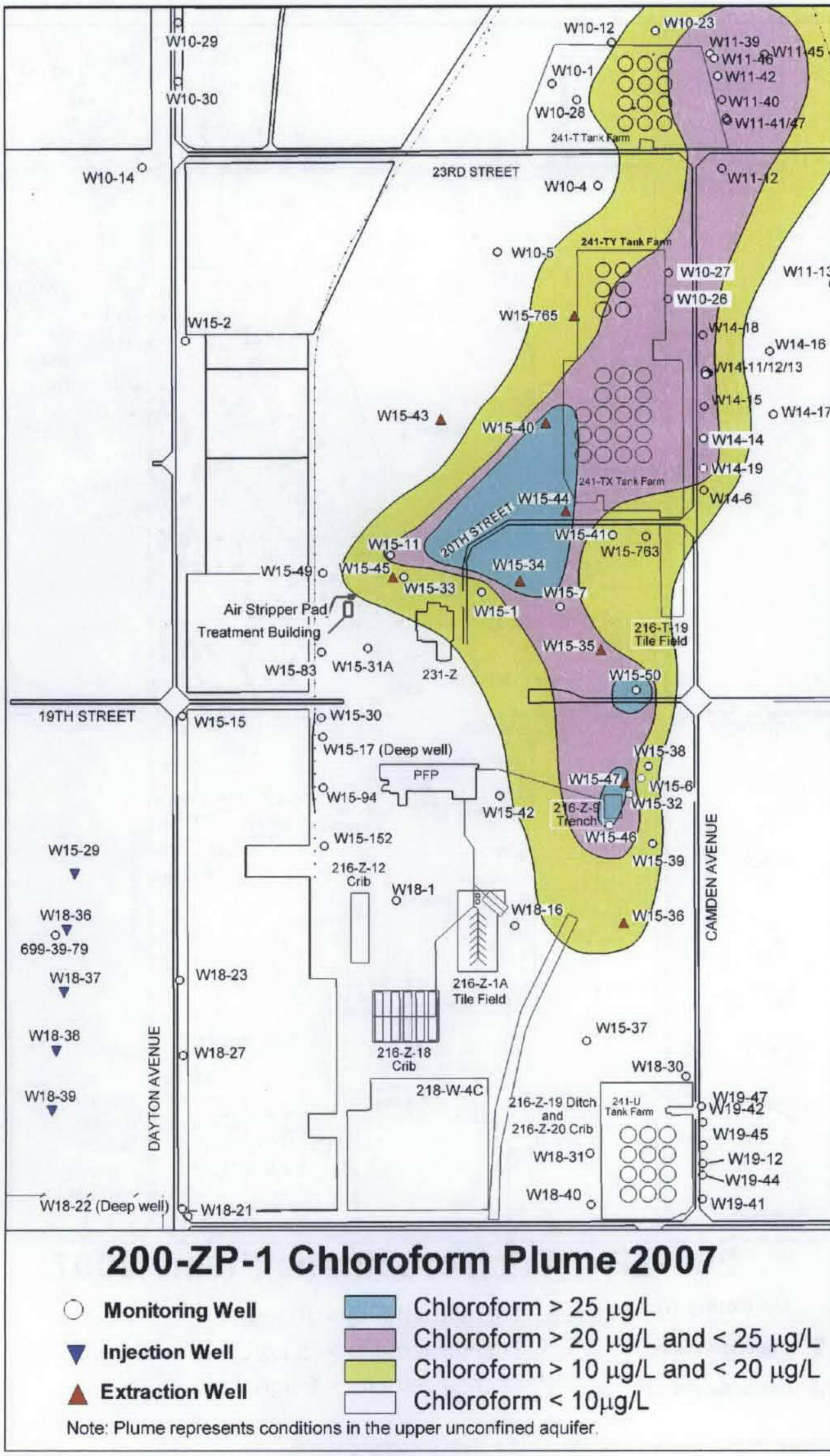


Figure 2-3. Concentration Isopleths for the Chloroform Plume in the 200 West Area.



Although very little site-specific data exist, there is some indication that carbon tetrachloride is slightly adsorbed by Hanford sediments (*1994 Conceptual Model of the Carbon Tetrachloride Contamination in the 200 West Area of the Hanford Site* [WHC-SD-EN-TI-248]; *Engineering Evaluation/Conceptual Plan for the 200-ZP-1 Operable Unit Interim Remedial Measure* [BHI-00110]). Interaction between carbon tetrachloride dissolved in the groundwater and the aquifer sediments may have an influence on the mobility of the contaminant in the aquifer and, consequently, the effort required to remediate the aquifer (DOE/RL-2004-72).

Monthly field sampling results in the FY06 annual report for the 200-ZP-1 OU (DOE/RL-2006-73) indicate that the average carbon tetrachloride concentration declined from FY05 to FY06 in five of the nine extraction wells, and the concentration was stable in the other four wells in the system. Monitoring wells 299-W15-1, 299-W15-7, 299-W15-11, and 299-W15-46 were converted to extraction wells in FY08 to capture more of the higher-concentration portion of the carbon tetrachloride plume.

Annual TCE concentrations were stable or decreasing in FY06 compared to FY05 values. The maximum concentration was 18 µg/L at well 299-W15-40. The TCE concentrations generally exceeded the applicable 5 µg/L maximum contaminant level (MCL) in the sampled extraction wells, except for wells 299-W15-36 and 299-W15-45. The TCE concentrations in wells 299-W15-40 and 299-W15-765 were above 5 µg/L for all samples. The TCE concentrations in wells 299-W15-34, 299-W15-35, and 299-W15-44 were above 5 µg/L in 75% or more of the samples.

Chloroform values in extracted groundwater did not exceed the 80 µg/L MCL in any well during FY06 or since Phase II operations began in August 1996. Maximum concentrations in the extraction wells ranged between 23 µg/L for well 299-W15-35 to 45 µg/L for well 299-W15-765. Average chloroform concentrations in the extraction wells decreased or were stable compared to FY05 annual averages (DOE/RL-2006-73). Contaminant concentrations at the treatment system's influent tank represent a composite of all extracted water that enters the system. Carbon tetrachloride, chloroform, and TCE averages for FY06 were 2,096 µg/L, 11 µg/L, and 6.3 µg/L, respectively. The FY06 carbon tetrachloride and chloroform concentrations were down from the FY05 annual average by approximately 3.5% and 33%, respectively. Chloroform increased 6.8% from FY05 to FY06.

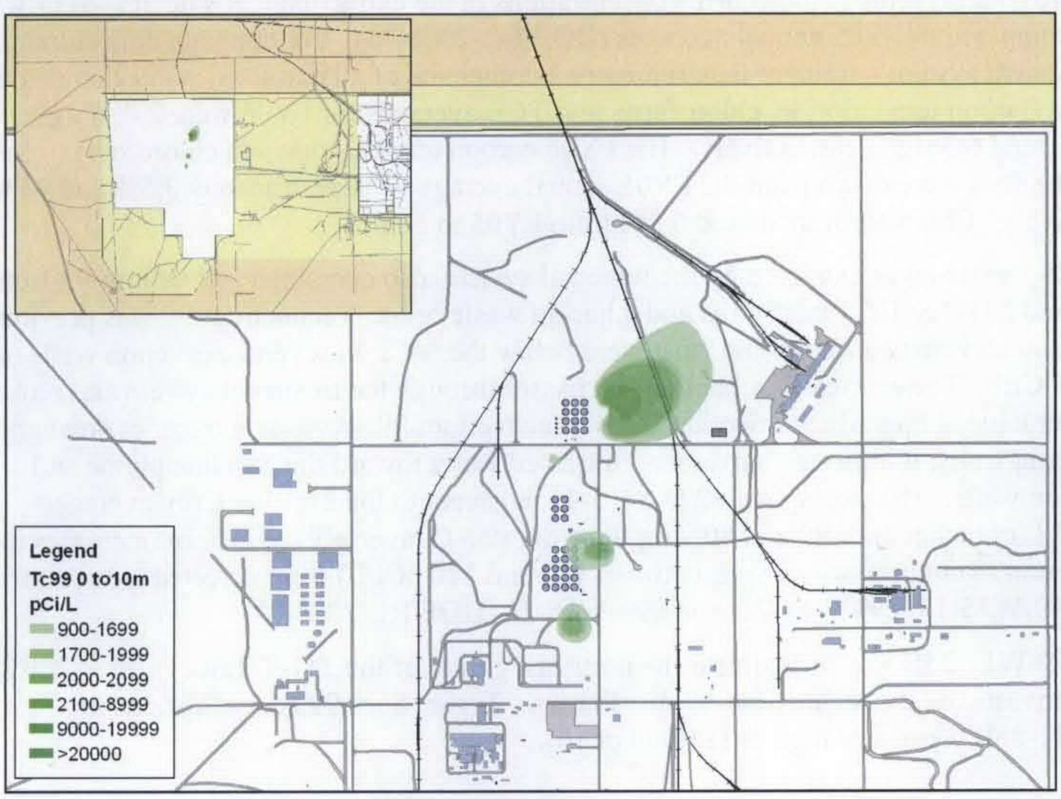
Groundwater that was extracted by the remedial system also contained technetium-99 from the 241-T and 241-TX/TY Tank Farms and adjacent waste cribs. Technetium-99 was previously detected at elevated concentrations that were below the MCL in several extraction wells near the 216-T-9 Crib. The extracted technetium-99 passes through the treatment system and returns to the water table at upgradient injection wells. Technetium-99 serves as a tracer at downgradient monitoring wells; it indicates movement of treated water toward the baseline plume and extraction wells. Monitoring well 299-W15-41, adjacent to the 216-T-9 Crib, averaged 377 pCi/L of technetium-99 and 80.9 mg/L of nitrate. Conversely, significant increases in technetium-99 concentrations (i.e., between 150 and 170 pCi/L) were detected in monitoring wells 299-W15-15, 299-W18-21, and 299-W18-23 (DOE/RL-2004-72).

Well 299-W11-25B was drilled near the northeast corner of the 241-T Tank Farm in 2005 to further investigate the technetium-99 distribution. Technetium-99 concentrations in 299-W11-25B were very high at 181,000 pCi/L.

In a DOE letter to Ecology and EPA (Plan for Action on the Single-Shell Tank Farm Waste Management Area and 200-ZP-01 Groundwater Operable Unit, [05-AMCP-0204, 2005], March 28, 2005), DOE committed to developing a schedule for a detailed characterization and remediation at Waste Management Area T and its associated groundwater. The schedule was to include characterization of the vertical and lateral extent of the technetium-99 groundwater plume and co-contaminants observed in the vicinity of the T Tank Farm. Subsequent groundwater monitoring efforts showed that technetium-99 concentrations steadily increased to 22,500 pCi/L in August 2006 around the 241-T Tank Farm.

Various monitoring wells have been converted to extraction wells in the 200-ZP-1 OU. From the start of extraction pumping, technetium-99 concentrations in well 299-W15-765 increased at faster-than-expected rates. Technetium-99 at well 299-W15-44 also increased rapidly. By August 2006, concentrations at wells 299-W15-44 and 299-W15-765 increased ten-fold, to 1,090 and 3,010 pCi/L, respectively. Extraction well 299-W15-40 exhibited a steady but much smaller increasing trend through FY06. After the technetium-99 trends at extraction and injection wells were identified, steps were taken to evaluate human health and the environment. Starting in mid-FY06, key extraction wells and the influent and effluent tanks of the treatment train were monitored monthly to track technetium-99 changes. Due to increasing technetium-99 activities, an ion-exchange treatability test was conducted in FY07 for technetium-99 remediation in two of the extraction wells (299-W15-44 and 299-W15-765). A report will be developed to describe the treatability test results. Figure 2-4 presents the concentration isopleths of technetium-99 contamination in the 200-ZP-1 OU. Nitrate is also transported through the treatment system and exhibits trends similar to technetium-99.

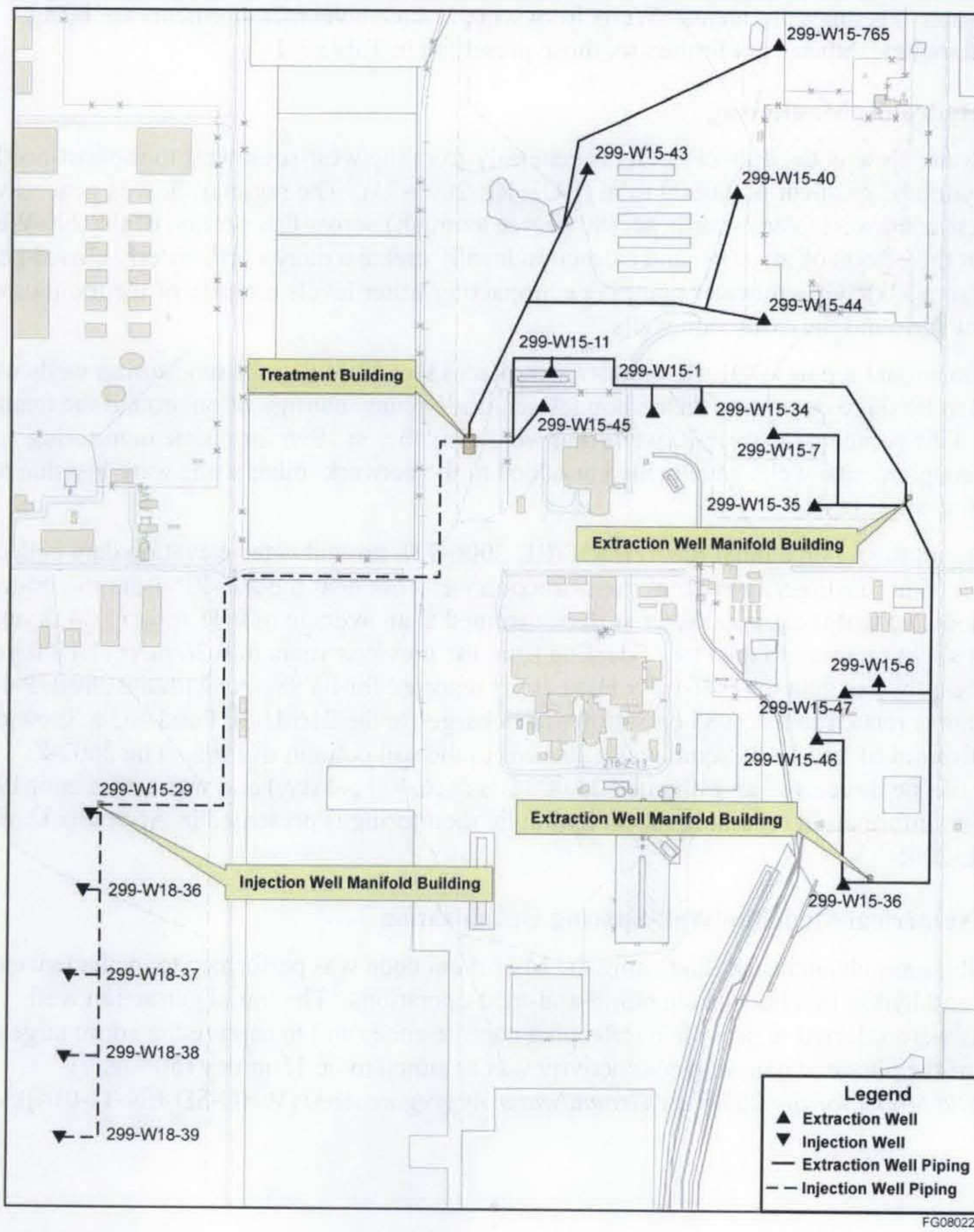
Figure 2-4. Concentration Isopleths for the Technetium-99 Plume in the 200 West Area.



3.0 PHASES II AND III WELL SELECTION AND LOCATION

This section discusses the process for selecting and locating the extraction and injection wells for Phase II and III operations. Section 7.0 discusses the overall groundwater monitoring network, including monitoring well locations, water-level measurements, and sample collection. Figure 3-1 shows the locations of the Phase II and III extraction wells, injection wells, and piping route locations.

Figure 3-1. 200-ZP-1 Pump-and-Treat, Related Wells, and Piping Route Locations.



3.1 IDENTIFICATION OF WELL LOCATIONS

The selection of extraction well locations was based on the requirement to contain the 2,000 to 3,000 ppb carbon tetrachloride contaminant contour. Per this requirement, the wells were generally located within or near these carbon tetrachloride contaminant isopleths. The locations for more recent wells were based on this constraint, numerical modeling, and other factors, as discussed below. Existing wells were considered for the following three potential uses: (1) as extraction wells, (2) as supplemental extraction wells to support overall production rates, and (3) as backup wells to ensure hydraulic containment of the 2,000 to 3,000 ppb carbon tetrachloride contour. Figure 3-2 and Appendix B present maps showing the location of some of the more frequently monitored wells in the 200-ZP-1 OU. Many of these wells are also used to collect water-level measurements. Wells from which water-level measurements are being collected include, but are not limited to, those presented in Table 3-1.

3.1.1 Hydraulic Monitoring

Groundwater flow in the 200-ZP-1 OU is generally from the west-southwest to the east-northeast with a hydraulic gradient of 0.0009 m/m (DOE/RL-2006-73). The regional flow is generally more west-southwest to east-northeast (80 degree azimuth) across this portion of the 200 West Area, but the effects of injection and extraction locally create a more northeasterly closed-cell flow (Figure 3-3). Groundwater pumping is impacting water levels in many of the monitoring wells that surround the extraction wells.

The FY06 annual report (DOE/RL-2006-73) indicates that more than 22 monitoring wells were sampled in FY06 to determine the carbon tetrachloride plume configuration around the treatment system. This compares to over 30 wells that were available in 1996 for plume monitoring. Several supplemental wells were drilled or added to the network; other wells were lost due to a declining water table.

According to the FY06 annual report (DOE/RL-2006-73), groundwater-elevation data collected during FY06 at locations away from the extraction wells but near the 200-ZP-1 pump-and-treat system indicate that the groundwater surface declined at an average of 0.41 m/yr (1.34 ft/yr). This is a slight increase to the rate of decline from the previous years of 0.36 m/yr (1.18 ft/yr) but is significantly less than the 0.46 m/yr (1.51 ft/yr) reported for FY98. As with the 200-UP-1 OU, the decline is related to the 1985 cessation of discharges to the 216-U-10 Pond and a Sitewide halt to disposal of low-level liquid waste streams to the soil column in 1995. The 2607-Z sanitary tile field received an estimated 23,000 L/day (6,000 gal/day) and was active until 1999. Additional information regarding recent hydraulic monitoring is presented in Appendix C of DOE/RL-2006-73.

3.1.2 Numerical Modeling/Well-Spacing Optimization

Originally, groundwater modeling using the MicroFem code was performed to evaluate well spacing and hydraulic effects from pump-and-treat operations. The initial extraction well locations were selected to provide overlapping capture zones and to capture the entire target portion of the plume. Hydraulic conductivity was assumed to be 15 m/day (50 ft/day) (*Hydraulic Model for the 200 West Groundwater Aggregate Area* [WHC-SD-EN-TI-014]).

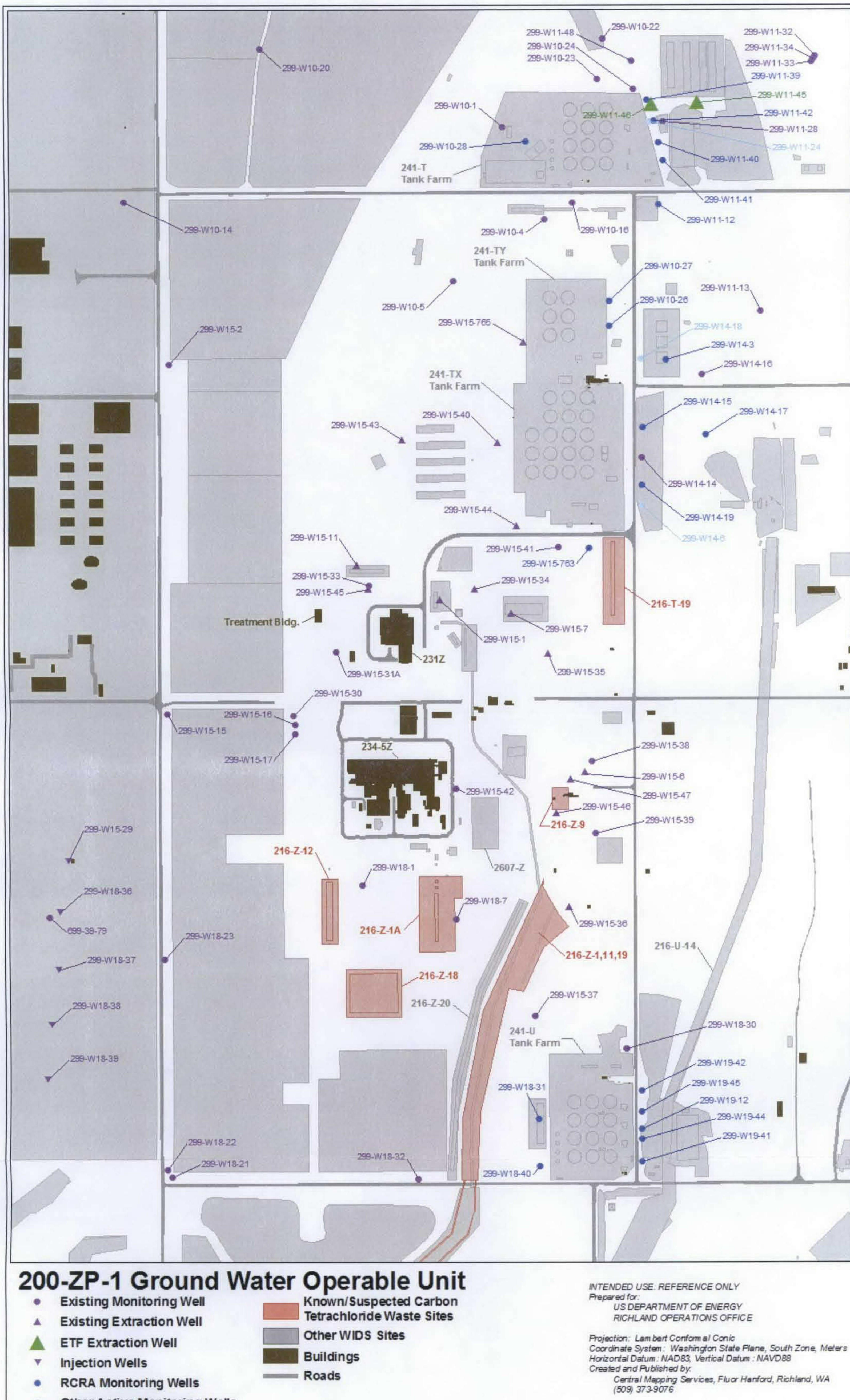
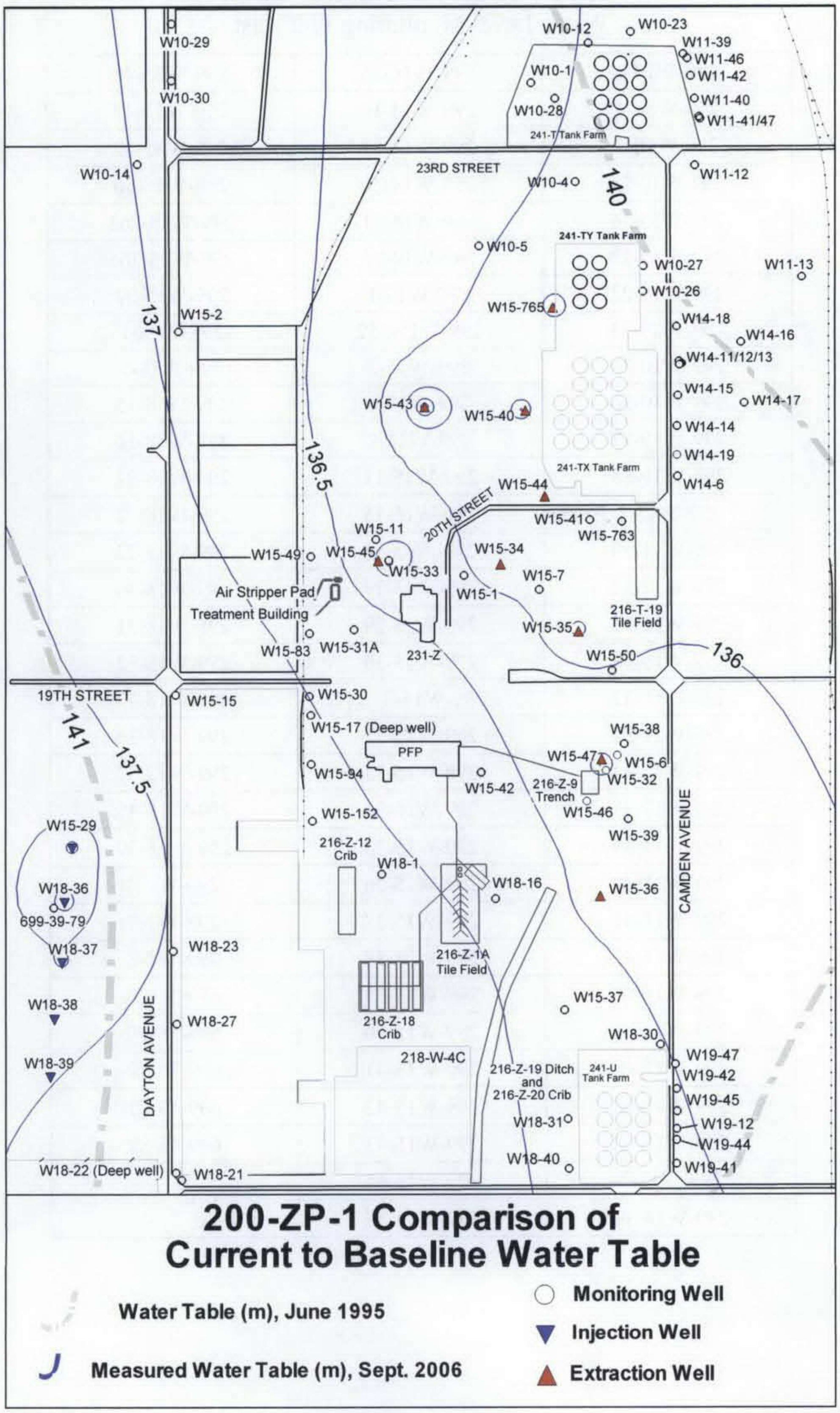


Figure 3-2. 200-ZP-1 Groundwater Monitoring Well Network.

Table 3-1. 200-ZP-1 Operable Unit
Water-Level Monitoring Well List.

299-W10-1	299-W14-15	299-W15-46
299-W10-4	299-W14-16	299-W15-47
299-W10-5	299-W14-17	299-W15-49
299-W10-14	299-W14-19	299-W15-50
299-W10-16	299-W14-71	299-W15-763
299-W10-20	299-W14-72	299-W15-765
299-W10-22	299-W15-1	299-W15-94
299-W10-23	299-W15-152	299-W18-1
299-W10-24	299-W15-2	299-W18-7
299-W10-26	299-W15-6	299-W18-15
299-W10-27	299-W15-7	299-W18-16
299-W10-28	299-W15-11	299-W18-21
299-W11-3	299-W15-15	299-W18-22
299-W11-10	299-W15-16	299-W18-23
299-W11-12	299-W15-17	299-W18-30
299-W11-13	299-W15-29	299-W18-31
299-W11-28	299-W15-30	299-W18-32
299-W11-32	299-W15-31A	299-W18-33
299-W11-33	299-W15-32	299-W18-36
299-W11-34	299-W15-33	299-W18-37
299-W11-37	299-W15-34	299-W18-38
299-W11-39	299-W15-35	299-W18-39
299-W11-40	299-W15-36	299-W6-2
299-W11-41	299-W15-37	299-W7-7
299-W11-42	299-W15-38	299-W7-8
299-W11-43	299-W15-39	699-34-88
299-W11-45	299-W15-40	699-38-70
299-W11-46	299-W15-41	699-39-79
299-W11-48	299-W15-42	699-43-83
299-W11-88	299-W15-43	699-43-89
299-W13-1	299-W15-44	
299-W14-14	299-W15-45	

Figure 3-3. 200-ZP-1 Operable Unit Water Table Map: Baseline June 1995 Water Table Versus September 2006 Water Table.



Simulations of hydraulic containment indicated that nine extraction wells would be required to capture the 2,000 µg/L carbon tetrachloride plume. These include extraction wells 299-W15-34, 299-W15-35, 299-W15-36, 299-W15-40, 299-W15-43, 299-W15-44, 299-W15-45, 299-W15-47, and 299-W15-765.

During FY07 and early FY08, a draft feasibility study (*Feasibility Study for the 200-ZP-1 Groundwater Operable Unit* [DOE/RL-2007-28, Draft B]) and proposed plan (*Proposed Plan for the Remediation of the 200-ZP-1 Groundwater Operable Unit* [DOE/RL-2007-33, Draft B]) were prepared by DOE and submitted for review. In preparation of the feasibility study and proposed plan, semi-analytical groundwater flow and particle-based, advective-dispersive transport modeling were completed to evaluate the likely comparative effectiveness of alternate groundwater pump-and-treat remedies. This evaluation included calculations of the approximate number and locations of extraction and injection wells required to contain and recover targeted contaminants. In support of these analyses, a comprehensive data set on aquifer properties, the extent of contaminants in groundwater, and the transport properties of the contaminants was compiled and documented in the appendices of the feasibility study.

The data set compiled for the feasibility study will be used to support the development of a three-dimensional groundwater flow and advective-dispersive-reactive contaminant transport model using public-domain, open-source versions of the flow simulator software called the "Modular Three-Dimensional Finite-Difference Groundwater Flow Model" (MODFLOW) (*MODFLOW-2000, the U.S. Geological Survey Modular Ground-Water Model – User Guide to Modularization Concepts and the Ground-Water Flow Process* [Harbaugh et al. 2000]). In addition, the Modular Three-Dimensional Multi-Species Transport Model for Simulation (MT3DMS) (*MT3DMS: A Modular Three-Dimensional Multi-Species Transport Model for Simulation of Advection, Dispersion, and Chemical Reactions of Contaminants in Groundwater Systems; Documentation and User's Guide* [Zheng and Wang 1999]) and associated particle-tracking software (*User's Guide for MODPATH/MODPATH-PLOT, Version 3: A Particle-Tracking Post-Processing Package for MODFLOW, the U.S. Geological Survey Finite-Difference Ground-Water Flow Model* [Pollock 1994]) will be used as well. This flow and transport model will encompass the 200-ZP-1 OU and will be used to estimate the likely concentrations of COCs in the proposed extraction wells in order to support the design and sizing of the necessary ex situ groundwater treatment system. Initial results from this modeling effort are expected late in FY08. Once modeling efforts are completed, the MODFLOW-based groundwater model will replace the MicroFem model in the evaluation of remedy performance, design, and optimization for the 200-ZP-1 OU.

Extraction wells 299-W15-47 and 299-W15-45 were installed in 2004 and replaced old extraction wells 299-W15-32 and 299-W15-33. These replacement wells were located very close to the old wells and have a much higher extraction rate. The extraction rates are approximately 151 to 170 L/min (40 to 45 gpm) for well 299-W15-45 and 208 to 227 L/min (55 to 60 gpm) for well 299-W15-47.

The FY06 annual report (DOE/RL-2006-73) concluded that extraction wells could be shut down for between 227 and 500 days before carbon tetrachloride concentrations at an extraction well would exit the capture zone. All of the monitoring wells show a decrease in carbon tetrachloride concentrations over the last 2 years.

3.1.3 Final Extraction/Injection Well Selection

Phase II operations commenced in 1996 and consisted of three extraction wells (299-W15-33 [replaced by 299-W15-45 in FY04], 299-W15-34, and 299-W15-35) and one injection well (299-W15-29). The extraction rate for Phase II was set at 568 L/min (150 gpm). The first set of extraction wells were constructed clockwise around the target plume, starting with well 299-W15-33 (replaced by 299-W15-45 in FY04). Constructing the extraction wells in this order provided the optimum input to the piping system design and results in the minimum pipeline length required to meet the initial groundwater supply requirement.

Phase III extraction wells include Phase II wells, plus 299-W15-32 (an existing well, later replaced in FY04 by 299-W15-47), 299-W15-36, 299-W15-765, 299-W15-43, 299-W15-40, and 299-W15-44. The latter five extraction wells target the northern components of the 2,000 to 4,000 μg/L carbon tetrachloride contours that are located west of the 241-TX/TY Tank Farms. Well 299-Wl5-37 was an extraction well for a period of time but was converted to a monitoring well in 2001. The extraction rate for Phase III operations started off at >1,140 L/min (>300 gpm). Capture of the carbon tetrachloride plume was further expanded when four additional extraction wells (299-W15-1, 299-W15-7, 299-W15-11, and 299-W15-46) were added during FY08.

Four additional injection wells (299-W18-36, 299-W18-37, 299-W18-38, and 299-W18-39) were added to existing injection well (299-W15-29) to accommodate eventual maximum pumping rates of 1,893 L/min 500 gpm.

4.0 PHASE II AND II HYDRAULIC SYSTEM DESIGN DESCRIPTION

This section provides a description of the Phase II and III treatment system.

4.1 PROCESS DESCRIPTION

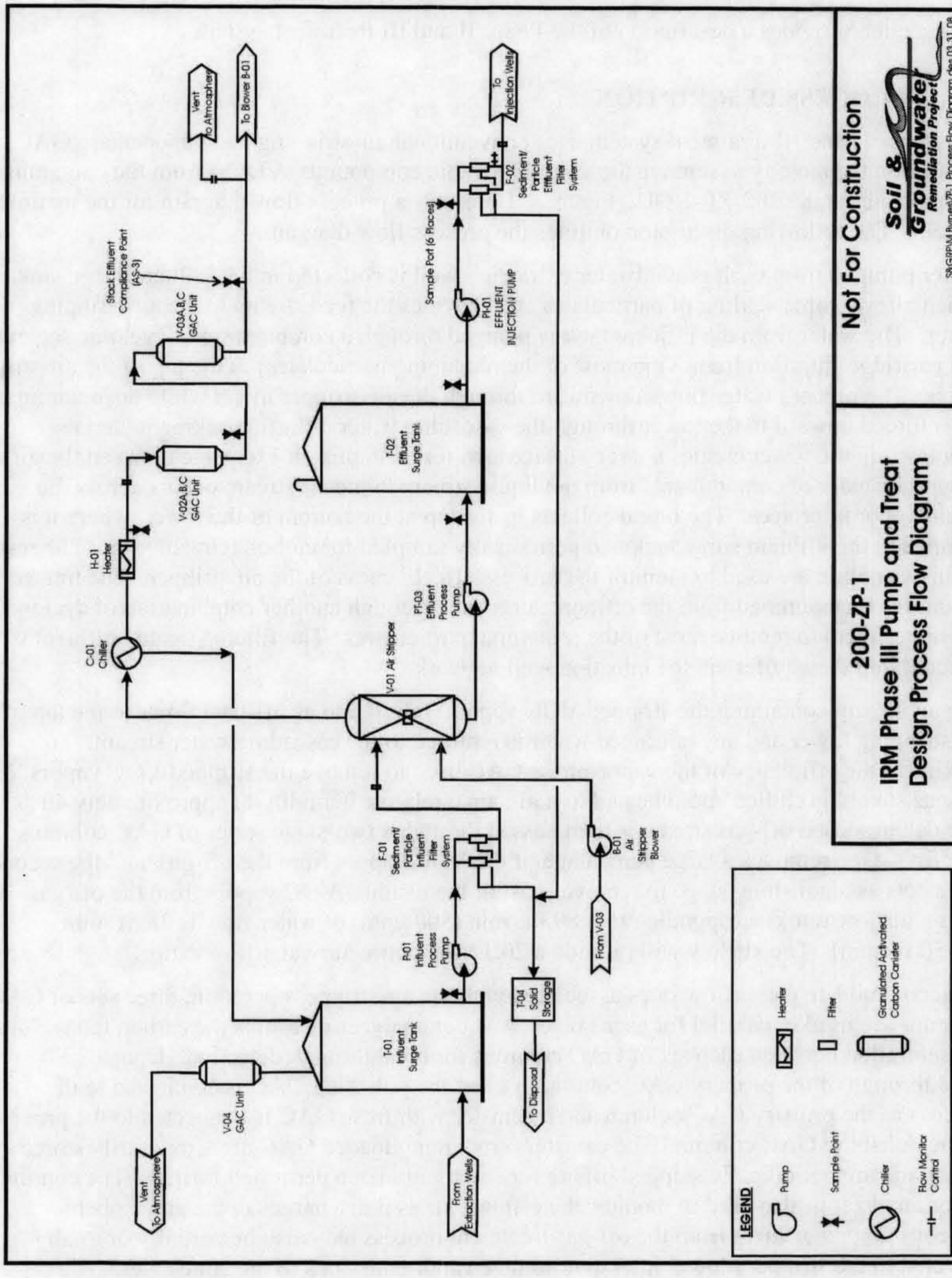
The Phase II and III treatment system uses conventional air-stripping and vapor-phase GAC adsorption technology to remove the volatile organic compounds (VOCs) from the contaminated groundwater at the 200-ZP-1 OU. Figure 4-1 presents a process flow diagram for the treatment system. The following discussion outlines the process flow diagram.

Water pumped from each groundwater extraction well is collected in the influent surge tank, which allows some settling of particulates and provides the feed stream to the air-stripping tower. The water from the influent tank is pumped through a combination of cyclonic separation and cartridge filtration (removing most of the remaining particulates) to the top of the air-stripper tower. The process water flows downward through the air-stripper tower while uncontaminated air is forced upward in the tower through the cascading water. Plastic packing material contained in the tower creates a large surface area for contaminant exchange between the air and water. Transfer of contaminants from the liquid stream to the air stream occurs across the liquid/vapor interfaces. The liquid collects in a sump at the bottom of the tower, where it is pumped to the effluent surge tank and periodically sampled for carbon tetrachloride. The results of this sampling are used to monitor the process effectiveness of the air stripper. The treated effluent is then pumped from the effluent surge tank through another combination of cyclone and cartridge filters to remove most of the remaining particulates. The filtered treated effluent is injected into the aquifer via the injection well network.

The air stream containing the stripped VOC vapors (referred to as off-gas) flows to the top of the air-stripping tower and any entrained water is returned to the cascading water stream. To maximize the efficiency of the vapor-phase GAC used to remove the stripped VOC vapors, the off-gas stream is chilled and reheated to maintain a relative humidity of approximately 40%. The dehumidified off-gas stream is then passed through a two-stage series of GAC columns. The first stage removes a large percentage of the VOC vapors from the off-gas, and the second stage acts as a polishing stage to remove most of the residual VOC vapors from the off-gas. The design airflow rate corresponding to 1,893 L/min (500 gpm) of water flow is 38 m^3/min (1,350 ft^3/min). The airflow will provide a 20:1 volumetric air/water flow ratio.

To accommodate the airflow rates associated with the air-stripper operation, three sets of GAC columns are used in parallel for each stage. A vapor analyzer measures the carbon tetrachloride concentration between each set of GAC columns for breakthrough detection. Upon breakthrough of the primary GAC column in a set, the polishing GAC is connected to the process as the primary GAC column and a canister with fresh GAC is connected to the process as the polishing GAC column. The canisters containing loaded GAC are temporarily stored onsite and are periodically shipped offsite for reactivation at a permitted facility. The continuous vapor analyzer is also used to monitor the effluent air as it discharges to the atmosphere. Gaseous treated effluent from the off-gas treatment process may also be partially or totally recycled to the stripper blower inlet to minimize vapor emissions to the atmosphere.

Figure 4-1. 200-ZP-1 Operable Unit Interim Remedial Operation Phase III Pump-and-Treat Design Process Flow Diagram.



The 200-ZP-1 air-stripping system is designed to treat groundwater containing a maximum influent concentration of 5,000 µg/L of carbon tetrachloride to achieve an effluent concentration of 4 µg/L of carbon tetrachloride. This goal of 4 µg/L was chosen conservatively to ensure compliance with the MCL of 5 µg/L mandated by the *Safe Drinking Water Act of 1974* (SDWA). Design flow rate for the treatment system is 1,893 L/min (500 gpm). The off-gas vapor-phase is designed to remove VOCs so the treated emissions from the treatment system are maintained below a maximum of 5 kg/yr (10 lb/yr) of carbon tetrachloride, as mandated by *Washington Administrative Code* (WAC) 173-460, "Controls for New Sources of Toxic Air Pollutants." Monitoring of carbon tetrachloride concentrations in the gaseous effluent is performed with an interlock set for system shutdown at 14 parts per million by volume (ppmv), which would indicate a system upset. The ambient air within the treatment system building is also monitored with an interlock to alarm and shut down the system at a concentration of 5 ppmv. Untreated off-gas is also monitored with an interlock to alarm and shut down the system at a concentration of 35 ppmv.

4.2 PROCESS CONTROL

Standard industrial controls and instrumentation are used throughout the Phase II and III treatment system. Main process control and data-logging functions are performed and coordinated via a programmable logic controller. Proportional control is performed via stand-alone industrial process controllers to provide maximum system flexibility and off-normal lineup capabilities.

Automatic control valves are provided with a combination of isolation valves and manually adjustable throttling valves to allow for adjustment to a wide range of process conditions and system configurations.

All instrumentation signals (including alarm annunciations, process variables, process controller outputs, position switch status, and programmable logic controller output contact status) are monitored and recorded by the main process control system. In addition to the centralized data collection and display at the main process control panel, basic process conditions are provided by local gauges and indicators.

4.3 FACILITY DESCRIPTION

The treatment system facility is located just west of the 231-Z Building and just north of 19th Street. Treatment system components are placed in and adjacent to the main process building, measuring 12 m by 23 m (39 ft by 75 ft). Manifolds for 8 of the 14 extraction wells and all of the injection wells are housed within smaller identical buildings measuring 5 m by 7 m (16 ft by 23 ft). Piping from the remaining six extraction wells enters directly into the process building. The process building and manifold buildings provide a measure of freeze protection to the existing treatment tanks.

4.3.1 Equipment Layout

The following delineates the relative locations of the major facility and process components:

- The main process building's floor is diked integrally with the foundation and slopes toward the leak detection sump, which is located adjacent to the middle of the north wall of the building.

- The two 48,075-L (12,700-gal) polyethylene surge tanks used for influent and treated liquid effluent are set to the immediate southeast and southwest, respectively, of the building sump. Process pumps and filters, through which the exiting stream from each surge tank passes, are mounted on a skid placed at the south edge of each tank. The filters combine centrifugal separation to remove large particles, with cartridge filtration to remove the remaining smaller particles.
- The off-gas treatment system is located just south of the treated effluent pump/cartridge filter skid, at the southwest corner of the main process area. The off-gas treatment system consists of the following components:
  - An air-cooled condensing unit rated at 50,000 British thermal units (BTU)/hour serving as the off-gas chiller
  - An 11-kW, two-stage electric heater serving as the off-gas reheater
  - Six 794-kg (1,750-lb) portable GAC canisters configured as three pairs of canisters in parallel in each of two stages to remove vapor-phase VOCs from the off-gas stream.
- The electrical room, measuring approximately 6 m by 6 m (20 ft by 20 ft), is located within the southwest corner of the main process building. The process control equipment is contained within this environmentally controlled room.
- A 6-m by 6-m (20-ft by 20-ft) storage area is located adjacent to the electrical room within the southeast corner of the main process building.
- Roll-up access doors to the main process building are located on the east and west walls of the treatment area to allow access to the portable GAC canisters.
- The air-stripper pad is located approximately 6 m (20 ft) north of the northeast corner of the main process building. The air-stripper pad contains the following process components:
  - The air-stripping tower is located at the center of the pad and extends 18 m (60 ft) in height and 1.5 m (5 ft) in diameter. It contains one section of packing that measures approximately 12 m (37 ft) in height.
  - A process pump used to transport treated groundwater from the bottom of the air-stripping tower to the treated liquid effluent surge tank is located just south of the tower.
  - A 50-horsepower blower used to provide the air stream to the air-stripping tower is located just west of the tower. The air-stripper pad is diked and has a leak-containment sump at the southeast corner.

4.3.2 Piping System

Ancillary equipment such as (but not limited to) piping, fittings, and pumps are treated in accordance with the secondary containment requirements of WAC 173-303-640 ("Dangerous Waste Regulations – Tank Systems"). All below-grade treatment system piping (associated with extraction wells 299-W15-34, 299-W15-35, 299-W15-36, 299-W15-45, and 299-W15-47) located outside of the buildings is double-contained, high-density polyethylene pipe with continuous leak detection. This piping is either buried 0.9 m (3 ft) below ground surface or is covered by 0.9 m (3 ft) of soil cover. Buried piping is preferred because of lower damage risk from personnel, equipment, and adverse weather conditions. However, piping is placed aboveground along certain sections of the well network piping routes to avoid underground interferences without a continuous leak detection system. In a letter to Ecology and EPA DOE states that using above grade piping without continuous leak detection was based on experience of usage at 100-HR-3 and 100-KR-4 (Use of Single-Wall Piping for 200-ZP-1 Pump-and-Treat Expansion, [05-AMCP-0036, 2004] November 10, 2004). In addition, it was noted that the 200-ZP-1 extraction wells will be constructed using single-walled piping installed above grade, combined with daily leak inspections. The use of single-wall piping combined with daily leak inspection is consistent with the requirements in WAC 173-303-640 "Dangerous Waste Regulations- Tank Systems."

All piping within buildings is single-walled, with the building foundation providing secondary containment for 100% of the capacity of the largest tank within its boundaries. The foundation of each building is concrete, with all sections serving as secondary containment, sealed without drains, and sloped to a low point with a liquid alarm serving for leak detection. All concrete that serves as secondary containment is treated with an impermeable epoxy coating. Any detected leaks within any building will result in automatic treatment system shutdown.

Pipelines used to connect the expanded extraction well network (299-W15-40, 299-W15-43, 299-W15-44, 299-W15-765, 299-W15-6, 299-W15-1, 299-W15-7, 299-W15-11, and 299-W15-46) to the treatment system are aboveground. These piping segments are not equipped with leak detection but rather are inspected daily for leaks.

Due to the absence of significant subsurface interferences, the injection piping route consists only of buried pipe. All piping is sloped at least 1% towards specific low points to provide pipe-draining capability and to facilitate leak detection. The low points are equipped with accessible drain valves.

Leak detection is provided on process piping outside of the treatment building, the extraction well manifold building, the air-stripper pad, and the injection well manifold building. This leak detection system is associated with 5 of the 14 extraction wells, including wells 299-W15-34, 299-W15-35, 299-W15-36, 299-W15-45, and 299-W15-47. The piping for the remaining nine extraction wells is aboveground and requires daily inspection in place of a leak detection system. Activation of the leak detection system for the five extraction wells referenced above is audibly and visually annunciated at the main process control annunciator panel. The specific location of the leak is determined by operations personnel through a review of the leak detection system status panel. The leak detection system status is also monitored and recorded at the main control panel. Upon detection of a leak in any of the process piping between an extraction well and the treatment building manifold, the system will automatically shut down.

This page intentionally left blank.

5.0 OPERATIONS AND MAINTENANCE

Soil and Groundwater Remediation Project (S&GRP) personnel are responsible for management, operations, and maintenance of the Phase II and III treatment system. Operational and maintenance requirements for the groundwater treatment system will include the following:

- Waste management
- Routine inspections
- Operating and monitoring data collection to support the performance monitoring and evaluation program
- Recordkeeping, data evaluation, and reporting
- Tower packing changeouts
- Calibration of carbon tetrachloride analyzers and other instrumentation.
- Tower biological fouling removal
- GAC and filter changeouts.

5.1 PREVENTIVE MAINTENANCE

A preventive maintenance program has been implemented to detect and prevent potential system malfunctions. The preventive maintenance program includes the following items, at a minimum:

- Periodic equipment inspection to identify and replace worn pump and piping components (i.e., hoses, pump seals, and check valves)
- Periodic lubrication of various valves and regulators
- Calibration schedules for system instrumentation.

5.2 WASTE MANAGEMENT

Waste streams generated from the treatment of groundwater with the 200-ZP-1 pump-and-treat system include the following:

- Filter elements
- GAC
- Miscellaneous waste generated within the facility
- Investigation-derived waste.

Waste generated during operations will be disposed of according to *Waste Management Plan for the Expedited Response Action for 200 West Area Carbon Tetrachloride Plume and the 200-ZP-1 and 200-PW-1 Operable Units* (DOE/RL-2004-40).

5.2.1 Filter Elements

The pump-and-treat system is designed with in-line filters to collect fine particulates. Fine particles present in the groundwater are collected on the filter elements located in filter housings. The filter elements are removed from the filter housings and replaced as needed to maintain system efficiency. The filter elements are dewatered and transferred into appropriate containers for offsite shipment. Water from the filter removal process will be reintroduced to the influent side of the 200-ZP-1 pump-and-treat system.

5.2.2 Granular Activated Carbon

The pump-and-treat system includes three pairs of vapor-phase GAC canisters for removing the carbon tetrachloride from different points in the system before discharging to the atmosphere. There is also a 208–L (55-gal) drum that is connected to the atmospheric vent for the influent tank. The spent GAC from the canisters is regenerated, while that from the drum is not. The "spent GAC" refers to the GAC that is not regenerated, while the GAC that is shipped offsite for regeneration is termed "loaded GAC."

Loaded GAC canisters are typically shipped offsite for regeneration at a facility approved by the U.S. Environmental Protection Agency (EPA) and are then returned for reuse. The S&GRP samples the GAC canisters before offsite shipment and submits the GAC samples to a laboratory for radiological and hazardous constituent analyses. If the laboratory analyses demonstrate that the GAC is acceptable for offsite shipment, the loaded GAC canisters are shipped to a regeneration facility. The regeneration facility is responsible for additional laboratory analyses to determine whether the constituents in the spent GAC are within the facility's permit requirements.

The spent GAC is designated as a dangerous waste and assigned with waste codes of "F001," "F002," "F003," "F004," and "F005." Spent GAC from the drum is sampled to determine whether it meets Environmental Restoration Disposal Facility (ERDF) waste acceptance criteria, which requires that concentrations are below the land disposal restriction (LDR) constituents that apply to wastes such as carbon tetrachloride, chloroform, and TCE (e.g., halogenated volatile organics). If the spent GAC meets the ERDF waste acceptance criteria, the waste is then disposed at the ERDF. If the spent GAC does not meet ERDF waste acceptance criteria, it is sent offsite to a permitted *Resource Conservation and Recovery Act of 1976* (RCRA) treatment, storage, and disposal facility for disposal or for regeneration. The EPA will make a periodic "offsite determination."

5.2.3 Miscellaneous Waste Generated Within the Facility

The operations and maintenance of process facilities and ancillary equipment will generate additional routine waste. These waste materials will be segregated to ensure proper handling and disposition and to minimize the commingling of potentially dangerous waste with nondangerous waste. The following waste streams are anticipated to be generated during routine operations and maintenance of the pump-and-treat system. This waste may or may not be dangerous waste, depending on the nature of the material and its exposure to groundwater:

- Spent lubricating oils and paint waste from pumps, compressors, blowers, and general maintenance activities
- Equipment that cannot be returned to service
- Other miscellaneous waste that might contact a dangerous waste (e.g., plastic sheeting, glass, rags, paper, waste solvent, or aerosol cans).

The waste will be temporarily stored at the facility, designated, and then sent to the appropriate facility in accordance with applicable waste acceptance criteria.

5.2.4 Investigation-Derived Waste

Investigation-derived waste (i.e., drill cuttings) and waste generated from decommissioning of the pump-and-treat system will be designated and disposed at the ERDF or other appropriate facility based on applicable waste acceptance criteria.

5.3 ROUTINE INSPECTIONS

Routine inspections of the equipment, facilities, operations, and procedures will be conducted in accordance with Phase II and III operating and calibration procedures by S&GRP personnel. Inspection schedules will be developed based on the requirements of WAC 173-303-320(1), "General Inspections," and an evaluation of the rate of possible equipment deterioration and the probability of an environmental or human health incident. Appropriate inspection records will be prepared and retained to document the findings and to recommend and implement corrective actions resulting from the routine inspections.

Aboveground pipeline segments not protected by leak detection systems will be inspected daily by operations personnel.

5.4 MONITORING PROGRAM

Operation of the Phase II and III treatment system includes periodic monitoring of systems and equipment, as well as performance and aquifer response monitoring, as described in Section 7.0.

5.5 RECORDKEEPING

Onsite S&GRP personnel assigned to conduct system surveillance are responsible for preparing, reviewing, and maintaining required records. Each record is signed by the person conducting the surveillance activity and preparing the record. Periodic recordkeeping audits are conducted by S&GRP personnel. Records are maintained to document, at a minimum, system performance, operating status, compliance with regulatory requirements, and significant incidents that occur during operation.

System operating status records are maintained to document operating history and to correlate with system performance evaluations. Regulatory records, including waste management and health and safety records, are maintained to document regulatory compliance. Operating records are kept to document specific information, such as the following:

- General:
  - Weather conditions
  - Laboratory data (field-screening and offsite laboratory data)
  - Spills, unusual incidents, emergencies, and other accidents
- Operations:
  - Pumping system operating status (record of functional or nonfunctional status)
  - Pumping system level setting (i.e., level settings in wells)
  - Volume of contaminated groundwater extracted or injected from or into each well, as well as the total volume of groundwater treated by the system

- Record of waste generated and manifests for loaded GAC canisters sent offsite for reactivation
- Treatment system contaminant removal

- Maintenance:
  - System preventive maintenance (both maintenance schedule and tasks performed)
  - System malfunctions and maintenance required
  - Inspections of equipment, facilities, and procedures
  - Calibration records.

6.0 AIR MONITORING AND CONTAINMENT OF UNPLANNED LIQUID RELEASES

This section presents how air monitoring, to ensure proper operation of the air treatment system, is performed and the design measures that are employed to contain unplanned liquid releases.

6.1 AIR MONITORING

Periodic air monitoring is conducted during Phase II and III treatment system operations. An on-line Brüel and Kjær® 1302 photoacoustic multi-gas analyzer draws samples from the off-gas heater outlet, the ambient air inside the building, and the outlet of each of the GAC columns. The sampling and analysis requirements and calibration standards are presented in the S&GRP's environmental engineering procedures. Each sample is analyzed for carbon tetrachloride, with results processed, recorded, and displayed at the main control panel.

In addition to activity-specific air monitoring, a real-time carbon tetrachloride analyzer monitors the effluent vapor stream (off-gas) as it exits the treatment system. If the carbon tetrachloride off-gas concentration limit of 14 ppmv is exceeded, an alarm annunciates, the treatment system shuts down, and field personnel are notified via an auto-dialer.

Monitoring of the ambient air within the treatment building is also performed. If the concentration of carbon tetrachloride in the ambient air exceeds the limit of 5 ppmv, an alarm annunciates, the treatment system automatically shuts down, and field personnel are notified via an auto-dialer. Flow instrumentation is provided in the off-gas effluent stream for flow rate display, balance, process control, alarm, and data acquisition purposes.

All air releases are handled in accordance with the 200-ZP-1 Phase II and III pump-and-treat procedures and the site-specific health and safety plan.

6.2 UNPLANNED LIQUID RELEASES

If an unplanned release (e.g., leak) is detected in the pipelines, if the liquid-level alarms in the building, or if the air-stripper foundations detect a leak, the treatment system will automatically shut down and field personnel will be notified via an auto-dialer.

All unplanned liquid releases will be handled in accordance with the 200-ZP-1 Phase II and III pump-and-treat procedures and the site-specific health and safety plan.

Brüel and Kjær® is a registered trademark of Brüel & Kjær Sound & Vibration Measurement A/S Corporation Denmark, Skodsborgvej 307 DK-2850 Nærum, Denmark.

This page intentionally left blank.

7.0 PROCESS SAMPLING AND ANALYSIS PLAN

This section presents the process sampling and analysis plan (SAP) to be followed for gathering data to support the performance objectives of the 200-ZP-1 Phase II and III IRM. The primary focus of the process sampling program is to monitor the contaminant levels in groundwater extracted for treatment, to monitor specific process parameters, and to ensure that applicable limits for the liquid and air discharges are met. Data obtained from the sampling effort may also provide information useful for optimizing the treatment process.

7.1 DESCRIPTION OF TREATMENT SYSTEM AND WASTE STREAMS

The 200-ZP-I Phase II and III treatment system uses conventional air-stripping and vapor-phase GAC absorption technology to remove VOCs from contaminated groundwater extracted for treatment. Figure 4-1 shows a line diagram of the treatment system. Water collected from each groundwater extraction well is collected in the influent surge tank (T-01). The water from the influent surge tank is pumped to the top of the air-stripper tower (V-01), where the water flows downward through plastic packing material while uncontaminated air is forced upward in the tower through the cascading water. The VOCs are transferred from the liquid stream to the air stream across the liquid/vapor interfaces. The treated liquid collects in a sump at the bottom of the air-stripper tower, where it is then pumped to the effluent surge tank (T-02). Treated water is then pumped to wells, where it is then injected into the aquifer.

The air stream containing the stripped VOC contaminants (off-gas) flows to the top of the air-stripping tower and returns entrained water vapor to the cascading water stream. The contaminated off-gas is then chilled to remove water vapor and reheated before it is passed through two stages of GAC columns. The first stage removes a large percentage of the VOC vapors from the off-gas. The second stage acts as a polishing stage to remove residual VOC vapors from the gaseous effluent exiting the primary column. Finally, the treated off-gas is exhausted to the atmosphere or recycled through the air blower and tower.

Groundwater collected from the extraction wells contains three volatile COCs: carbon tetrachloride, chloroform, and TCE. The concentration of the principal contaminant, carbon tetrachloride, is anticipated to range from 2,000 to 5,000 μg/L. The maximum chloroform and TCE concentrations are expected to be about 50 μg/L and 20 μg/L, respectively. The concentration of each contaminant in the effluent stream reinjected into the aquifer will be less than their respective MCLs (*200-ZP-1 Phase II Interim Remedial Measure Conceptual Design Report* [BHI-00194]).

At the potential maximum design water flow rate [1,893 L/min (500 gpm)], the anticipated concentration of carbon tetrachloride vapors in the untreated off-gas is about 10 ppmv. The anticipated concentrations of chloroform and TCE in the untreated off-gas are <5 ppmv. At the potential maximum design airflow rate (38 m^3/min [1,350 ft^3/min]), the concentration of carbon tetrachloride exhausted to the atmosphere will be maintained below 14 ppmv.

7.2 SAMPLE LOCATION, ANALYTES, AND FREQUENCY

Table 7-1 lists the sample collection locations, sample matrix, analytes of concern, and frequency at which samples will be collected for field laboratory/process analysis using field-screening techniques. Figure 4-1 shows the sampling locations on a line diagram of the 200-ZP-1 Phase III pump-and-treat system. At a minimum during initial system startup, water and air samples will be collected and analyzed using field-screening methods every 15 to 20 minutes to assess the performance of the treatment system. This will ensure that three or four liquid samples have been collected and analyzed before any treated water is discharged to the injection well. After adequate system operation has been verified, air and water samples will be collected and analyzed hourly for the first 8 hours of operation, and then daily for the first week of operation.

Table 7-1. Process Sample Locations, Analytes, Matrices, and Frequencies for Phase III Operations. (2 sheets)

Sample Location	Analytes	Sample Matrix	Sample Frequency
Extraction well #1 (299-W15-45)	CCl_4, TCM, TCE	Groundwater	At least once per month during routine system operation.
Extraction well #2 (299-W15-34)	CCl_4, TCM, TCE	Groundwater	At least once per month during routine system operation.
Extraction well #3 (299-W15-35)	CCl_4, TCM, TCE	Groundwater	At least once per month during routine system operation.
Extraction well #4 (299-W15-47)	CCl_4, TCM, TCE	Groundwater	At least once per month during routine system operation.
Extraction well #5 (299-W15-36)	CCl_4, TCM, TCE	Groundwater	At least once per month during routine system operation.
Extraction well #6 (299-W15-6)	CCl_4, TCM, TCE	Groundwater	At least once per month during routine system operation.
Extraction well #7 (299-W15-40)	CCl_4, TCM, TCE, Tc-99[a] Cr[a], I-129, H-3	Groundwater	At least once per month during routine system operation.
Extraction well #8 (299-W15-43)	CCl_4, TCM, TCE, Tc-99[a] Cr[a], I-129, H-3	Groundwater	At least once per month during routine system operation.
Extraction well #9 (299-W15-44)	CCl_4, TCM, TCE, Tc-99[a] Cr[a], I-129, H-3	Groundwater	At least once per month during routine system operation.
Extraction well #10 (299-W15-765)	CCl_4, TCM, TCE, Tc-99[a] Cr[a], I-129, H-3	Groundwater	At least once per month during routine system operation.
Extraction well #11 (299-W15-1)	CCl_4, TCM, TCE, Tc-99[a] Cr[a], I-129, H-3	Groundwater	At least once per month during routine system operation.
Extraction well #12 (299-W15-7)	CCl_4, TCM, TCE, Tc-99[a] Cr[a], I-129, H-3	Groundwater	At least once per month during routine system operation.
Extraction well #13 (299-W15-11)	CCl_4, TCM, TCE, Tc-99[a] Cr[a], I-129, H-3	Groundwater	At least once per month during routine system operation.
Extraction well #14 (299-W15-46)	CCl_4, TCM, TCE, Tc-99[a] Cr[a], I-129, H-3	Groundwater	At least once per month during routine system operation.
Post-tank T-01 (at 0.5-in. BV TSL02-V01)	CCl_4, TCM, TCE, Tc-99, I-129, H-3	Process water	At least once per month during routine system operation. Monthly fixed laboratory confirmation samples for VOC analyses.
Post-tank T-02 (at 0.5-in. BV 101-V01)	CCl_4, TCM, TCE, Tc-99, I-129, H-3	Process water	At least once per month during routine system operation. Monthly fixed laboratory confirmation samples for VOC analyses.

Table 7-1. Process Sample Locations, Analytes, Matrices, and Frequencies for Phase III Operations. (2 sheets)

Sample Location	Analytes	Sample Matrix	Sample Frequency
Post-air stripper 0.75-in. valve near TSA02-V01)	CCl_4, TCM, TCE	Process air	At least once per month during routine system operation. Monthly fixed laboratory confirmation samples for VOC analyses.
Post-GAC treatment (0.75-in, valve near TSA03-PI)	CCl_4, TCM, TCE	Process air	At least once per month during routine system operation. Monthly fixed laboratory confirmation samples for VOC analyses.

[a] Tc-99 and chromium are analyzed in a fixed laboratory on quarterly basis. Nitrate is analyzed in the field laboratory on an as-needed basis.

CCl_4 = carbon tetrachloride
Cr = chromium
FY = fiscal year
GAC = granular activated carbon
TCE = trichloroethylene
TCM = chloroform
Tc-99 = technetium-99

After sufficient data are collected to indicate that the system parameters are stable, samples will be collected less frequently. As shown in Table 7-1, the sampling frequency is at least once (but not more than twice) a month during routine, stable system operation. In addition to routine sampling, additional samples may be collected as needed to assess system performance during system upsets or to monitor specific conditions such as anticipated breakthrough between GAC columns.

While the treatment system is operating under routine conditions, process water samples are collected for analysis by a fixed laboratory each calendar quarter. In addition, process air samples will be collected and analyzed by a fixed laboratory on a monthly basis. These sample results are used to confirm the field-screening results. As shown in Table 7-1, process water samples are collected from two sampling locations: post-tank T-01 (influent water) and post-tank T-02 (effluent water). Process air samples are collected after the air-stripping tower (pre-GAC treatment) and after the GAC treatment columns (post-GAC treatment). Table 7-1 lists the analyses and frequencies of sampling for the extraction wells, process water, and process air treatment trains.

7.2.1 Sample Identification

Samples collected for onsite field laboratory analysis are assigned numbers as appropriate and are recorded in the project field logbook. At a minimum, each sample is labeled with the following: sample location, sample date, sample time, and the sampler's initials. Chain-of-custody records are completed at the conclusion of each sampling event and must accompany samples at all times.

For all samples, sample custody will be maintained in accordance with existing Hanford Site protocols. The custody of samples will be maintained from the time that the samples are collected until ultimate disposal of the samples, as appropriate. A chain-of-custody record will be initiated in the field at the time of sampling and will accompany each set of samples (cooler) shipped to any laboratory. For shipped samples, wire or laminated waterproof tape will be used to seal the coolers. The analyses requested for each sample will be indicated on the accompanying chain-of-custody form. Chain-of-custody procedures will be followed throughout sample collection, transfer, analysis, and disposal to ensure that sample integrity is maintained. Each time the responsibility for the custody of the sample changes, the new and previous custodians will sign the record and note the date and time. Process samples collected to monitor the treatment system during routine operations are assigned Hanford Environmental Information System (HEIS) numbers for sample tracking and reporting purposes. For shipped samples, the sampler will make a copy of the signed record before sample shipment and transmit the copy to S&GRP Sample and Data Management.

7.2.2 Sampling Equipment and Procedures

Samples collected for onsite field laboratory analysis are collected using the equipment and techniques prescribed in accordance with 200-ZP-1 pump-and-treat system and S&GRP procedures. All analytical equipment will be operated in accordance with manufacturer specifications. Liquid samples collected for aqueous headspace analysis will be collected and analyzed in the field laboratory using gas chromatography and aqueous headspace analysis (Table 7-2). The most current revision of the procedure maintained by S&GRP for this sampling and analysis will be used. The procedure includes analysis of method blanks and laboratory control samples. The procedure also requires applicable initial instrument calibration and ongoing calibration checks.

Table 7-2. Parameters for Samples Sent for Field Laboratory Analysis. (2 sheets)

Analyte	Method	RDL	Precision (RPD)	Accuracy (% Recovery)	Holding Time	Analysis Frequency	Container, Volume
Air Parameters							
Carbon tetrachloride	Photoacoustic analyzer	1 ppm	±20	75 to 125	1 day	Monthly	1-L Tedlar® bag
Methyl ethyl ketone (MEK)	Photoacoustic analyzer	1 ppm	±20	75 to 125	1 day	Monthly	1-L Tedlar bag
Methylene chloride	Photoacoustic analyzer	1 ppm	±20	75 to 125	1 day	Monthly	1-L Tedlar bag
Water Parameters							
Carbon tetrachloride	Aqueous headspace	5 μg/L	±20	75 to 125	1 day	Monthly	Amber glass with septum, 40 mL
Chloroform	Aqueous headspace	5 μg/L	±20	75 to 125	1 day	Monthly	Amber glass with septum, 40 mL
TCE	Aqueous headspace	5 μg/L	±20	75 to 125	1 day	Monthly	Amber glass with septum, 40 mL
Tetrachloro-ethylene	Aqueous headspace	1 mg/L	±20	75 to 125	1 day	Monthly	Amber glass with septum, 40 mL

Table 7-2. Parameters for Samples Sent for Field Laboratory Analysis. (2 sheets)

Analyte	Method	RDL	Precision (RPD)	Accuracy (% Recovery)	Holding Time	Analysis Frequency	Container, Volume
Dissolved oxygen	Hach® laser procedure	0.01 mg/L	±0.1 mg/L @<8 mg/L; ±0.2 mg/L @<8 mg/L	N/A	1 day	Quarterly	Plastic, 50 mL
pH -	Electrode	0.1 pH	±0.005 pH units	N/A	1 day	Quarterly	Glass or plastic, 50 mL
Nitrate	Hach 8171 for medium range	0 to 4.5 mg/L NO_3-N	±20	75 to 125	1 day	As needed	Glass or plastic, 50 mL

NOTES: Hach® is a registered trademark of the Hach Company, Loveland, Colorado. Tedlar® is a registered trademark of E.I. du Pont de Nemours and Company, Wilmington, Delaware.
N/A = not applicable
ppm = parts per million
RDL = required detection limit
RPD = relative percent difference
TCE = trichloroethylene

Air samples for analysis by the field laboratory are typically collected in 1-L Tedlar® bags, or other air sampling bags of appropriate size. The samples are then analyzed using photoacoustic methods.

Samples intended for fixed laboratory confirmatory analysis will be collected using the equipment and techniques prescribed for the appropriate analytical method, as described in the *Remedial Investigation/Feasibility Study Work Plan for the 200-ZP-1 Groundwater Operable Unit* (hereinafter referred to as the 200-ZP-1 remedial investigation/feasibility study [RI/FS] work plan [DOE/RL-2003-55]). The procedures in the 200-ZP-1 RI/FS work plan for sampling groundwater are based on Chapters 1 and 7 of EPA's *Test Methods for Evaluation of Solid Waste, Physical/Chemical Methods* (SW-846) and other EPA methods, as noted in Table 7-3.

7.2.3 Sample Handling and Analysis

During routine system operation, field-screening samples obtained from the pre-treatment and post-treatment portions of the liquid and air streams are collected and analyzed at least once (but not more than twice) per month. These routine samples are identified with HEIS numbers obtained from Sample and Data Management. Field-screening samples generally are analyzed within 8 hours.

Note that, in some cases, the screening samples may be shipped to a fixed laboratory for analysis. This is done when field methods cannot meet recommended detection limits or when equipment is not operating. In these cases, the procedures used by the fixed laboratory will be invoked with shorter turnaround times.

Tedlar® is a registered trademark of E.I. du Pont de Nemours and Company, Wilmington, Delaware.

Table 7-3. Parameters for Samples Sent for Fixed Laboratory Analysis. (2 sheets)

Analyte	Method	RDL	Precision (RPD)	Accuracy (% Recovery)	Holding Time	Container, Volume
Air Parameters[a]						
Carbon tetrachloride	EPA TO 15 or equivalent	10 ppbv	±25	70 to 130	30 days	6 L, summa
Chloroform	EPA TO 15 or equivalent	10 ppbv	±25	70 to 130	30 days	6 L, summa
TCE	EPA TO 15 or equivalent	10 ppbv	±25	70 to 130	30 days	6 L, summa
Acetone	EPA TO 15 or equivalent	10 ppbv	±25	70 to 130	30 days	6 L, summa
Methylene chloride	EPA TO 15 or equivalent	10 ppbv	±25	70 to 130	30 days	6 L, summa
Tetrachloroethylene	EPA TO 15 or equivalent	10 ppbv	±25	70 to 130	30 days	6 L, summa
Methyl ethyl ketone (2-butanone)	EPA TO 15 or equivalent	10 ppbv	±25	70 to 130	30 days	6 L, summa
Water Parameters						
Carbon tetrachloride	8260B	5 µg/L	±20	75 to 125		
Chloroform	8260B	5 µg/L	±20	75 to 125	14 days if preserved to pH<2 with HCl, 7 days with out preservation, cool 4°C	Amber glass with septum, 40 mL, no headspace
TCE	8260B	5 µg/L	±20	75 to 125		
Acetone	8260B	20 µg/L	±20	75 to 125		
Methylene chloride	8260B	5 µg/L	±20	75 to 125		
Tetrachlorothylene	8260B	5 µg/L	±20	75 to 125		
Methyl ethyl ketone (2-butanone)	8260B	10 µg/L	±20	75 to 125		
Total suspended solids	160.2	5 mg/L	±20	75 to 125	7 days, cool 4°C	Glass or plastic, 400 mL
Total chromium	200.8[c] or 6010 or 6020	10 µg/L	±25	75 to 125	6 months	Plastic 500 mL
Technetium-99[d]	Liquid scintillation	20 pCi/L	±30	70 to 130	6 months	Glass or plastic, 2 L
pH	150.1	0.05 pH	±0.05	+/- .05	ASAP, 4°C	Plastic, 100 mL
Nitrate	300.0[b]	250 µg/L	±20	75 to 125	28 days, cool 4°C	Glass or plastic, 300 mL

Table 7-3. Parameters for Samples Sent for Fixed Laboratory Analysis. (2 sheets)

Analyte	Method	RDL	Precision (RPD)	Accuracy (% Recovery)	Holding Time	Container, Volume

[a] Neither volatile organic analyte analysis for an air matrix nor the dissolved oxygen test is currently on contract with the offsite laboratory.
[b] From *Methods for the Determination of Inorganic Substances in Environmental Samples* (EPA/600/R-93-100).
[c] Approved EPA Methods 200.8 are found in *Methods for the Determination of Metals in Environmental Samples - Supplement I* (EPA/600/R-94-111).
[d] Quick turnaround times of 48 hours may be requested.
ASAP = as soon as possible
EPA = U.S. Environmental Protection Agency
ppbv = parts per billion by volume
RDL = required detection limit
RPD = relative percent difference
TCE = trichloroethylene

Required detection limits (RDLs) for the analytes of concern are presented in Tables 7-2 and 7-3. The field laboratory RDLs are those that can be reasonably achieved while giving rapid turnaround times. The RDLs for the confirmation analysis of the liquids are based on proving that water returned to the unconfined aquifer meets applicable drinking water standards (DWSs) for each VOC in the effluent stream. The RDLs in the fixed laboratory analysis for the air method are determined so, if desired, the project data can show that discharges to the atmosphere do not exceed Washington State small-quantity emission limits (*CERCLA Substantive Requirement Document 200-ZP-1 Phases II and III Interim Remedial Measure Groundwater Treatment Project* [BHI-00453]). The air RDL values are based on maximum air volumes for continuous operation.

Liquid samples collected for confirmatory analysis at a fixed laboratory are collected, stored, and handled according to the EPA SW-846 methods referenced in Tables 7-2 and 7-3. Air samples are collected and handled in accordance with the specifications of the analytical method. At a minimum, confirmatory fixed laboratory analyses of liquid and air samples will be made for the following VOCs:

- Primary:
  - Carbon tetrachloride
  - Chloroform
  - TCE
- Potential trace constituents:
  - Acetone
  - Methylene chloride
  - Tetrachloroethylene
  - Methyl ethyl ketone.

In addition, liquid process samples may be tested for, but not limited to, the following for evaluating process operations and efficiencies: total suspended solids, dissolved oxygen, and pH. Liquid samples from extraction well #7 (299-W15-40), well #8 (299-W15-43), well #9 (299-W15-44), well #10 (299-W15-765), well #11 (299-W15-1), well #12 (299-W15-7), well #13 (299-W15-11), and well #14 (299-W15-46) shall also be tested for technetium-99 and chromium on a quarterly basis.

Note that since ambient air within the treatment building contains low concentrations of carbon tetrachloride, field blank samples often show trace concentrations of carbon tetrachloride. Any carbon tetrachloride concentrations detected in field blank samples are then subtracted from process sampling results.

7.3 DATA-HANDLING REQUIREMENTS

It is anticipated that field-screening data will be available to the project lead within 24 hours of analysis. During system startup and upset conditions, copies or verbal notification of field laboratory data will be available to the project lead or other onsite personnel immediately after completion of the analyses. If desired by the project, field laboratory personnel will prepare trend plots of selected field laboratory data such as pre-treatment or post-treatment analyte concentrations for the liquid or air streams.

Field-screening results and information pertinent to the analysis will be documented in the field logbook, which will become part of the administrative record. Data will be available to project personnel as soon as possible following the analyses; same-day or next-day release of data is anticipated. Sample residue will be returned to the treatment system for disposal.

One annual report is prepared each FY. This report summarizes the field-screening results for all routine samples identified with HEIS numbers. Field laboratory and fixed laboratory samples are logged into HEIS, and the appropriate quality control (QC) associated with HEIS is used.

For fixed laboratory analysis, the existing data management systems will be used. At the direction of the task lead, all or a subset of the analytical data packages will be subject to final technical review by qualified personnel before submittal to the regulatory agencies or inclusion in reports. Electronic data access, when appropriate, will be via a database (e.g., HEIS). Where electronic data are not available, hard copies shall be provided in accordance with Section 9.6 of the Tri-Party Agreement (Ecology et al. 2003).

7.4 QUALITY ASSURANCE/QUALITY CONTROL

Field screening analyses are conducted with appropriate QC, such as method blanks and laboratory control samples. Data quality requirements for field laboratory analysis and fixed laboratory analyses are shown in Tables 7-2 and 7-3 respectively.

8.0 PERFORMANCE MONITORING PLAN

The purpose of this performance monitoring plan is to define the data collection program for monitoring the performance and effectiveness of the IRM Phase III pump-and-treat operations in the 200-ZP-1 OU and the two new extraction wells at the 241-T Tank Farm that are piped to the Effluent Treatment Facility (ETF). Data collection requirements are based on the RAOs defined in the interim action ROD for the 200-ZP-1 OU (EPA et al. 1995). The applicable RAOs are described in Section 1.2. Aquifer response monitoring consists of a water-level monitoring network and a groundwater well sampling network. The following sections describe the makeup of these networks, their relationship to the RAOs in the interim action ROD, and the specific monitoring criteria for assessing IRM operations.

The requirements for aquifer response monitoring may be modified during operations to provide additional data to optimize hydraulic containment efforts, to reduce groundwater contaminant concentrations, and to collect data for developing a final remedy. Modifications may include changes to pumping rates and schedules (i.e., increasing, decreasing, or temporarily discontinuing pumping from specific extraction wells) and/or the number of extraction, injection, or monitoring wells. In any case, the performance criteria described below will be met.

Operation of the 200-ZP-1 OU IRM will potentially impact RCRA and other monitoring well networks in the vicinity (*An Analysis of Potential Impacts to the Groundwater Monitoring Network in the Central Plateau* [DOE/RL-95-101]). Data from this performance monitoring plan will be available to other Hanford Site contractors that are responsible for groundwater monitoring programs. These data are expected to assist in the evaluation of contaminant impacts and compliance with applicable regulatory requirements.

The following sections describe the specific field data analyses that will be conducted to evaluate the performance criteria for each RAO (i.e., the water-level monitoring network and the groundwater sampling network).

8.1 WATER-LEVEL MONITORING NETWORK

In order to satisfy RAO #1, or prevent further movement of contaminants from the highest concentration area of the plume, groundwater-level measurements will be taken at various extraction wells, injection wells, and monitoring wells. Water-level measurements in monitoring wells will be recorded on an hourly basis with dedicated electronic data loggers and in-well transducers, and uploaded by S&GRP personnel. During planned transient water table changes (e.g., during startups and shutdowns), water levels may be recorded at the extraction wells and nearby monitoring wells at a more rapid rate (e.g., fast linear and/or log-scale modes). The accuracy and precision for water-level measurements is 1.5 cm (0.05 ft). Table 8-1 lists the water-level collection wells and the measurement methods and frequencies for Phase III operations. Figure 3-2 shows the locations of groundwater monitoring wells.

Table 8-1. Water-Level Monitoring Methods and Frequencies for the 200-ZP-1 Interim Remedial Measure. (2 sheets)

Well Name	Well Type[a]	Measurement Method[b]	Frequency
299-W10-4	Near-field	Transducer	Hourly
299-W10-5	Near-field	Transducer	Hourly
299-W10-26	Near-field	Transducer	Hourly
299-W14-14	Near-field	Transducer	Hourly
299-W15-1	Extraction	Transducer	Hourly
299-W15-6	Extraction	Transducer	Hourly
299-W15-7	Extraction	Transducer	Hourly
299-W15-11	Extraction	Transducer	Hourly
299-W15-17	Deep	Transducer	Hourly
299-W15-29	Injection	Transducer	Hourly
299-W15-30	Intermediate	Transducer	Hourly
299-W15-31A	Near-field	Transducer	Hourly
299-W15-32[c]	Near field	Transducer	Hourly
299-W15-33[c]	Near field	Transducer	Hourly
299-W15-34	Extraction	Transducer	Hourly
299-W15-35	Extraction	Transducer	Hourly
299-W15-36	Extraction	Transducer	Hourly
299-W15-37[c]	Near field	Transducer	Hourly
299-W15-38	Near-field	Transducer	Hourly
299-W15-39	Near-field	Transducer	Hourly
299-W15-40	Extraction	Transducer	Hourly
299-W15-41	Near-field	Transducer	Hourly
299-W15-42	Near-field	Transducer	Hourly
299-W15-43	Extraction	Transducer	Hourly
299-W15-44	Extraction	Transducer	Hourly
299-W15-45	Extraction	Transducer	Hourly
299-W15-46	Extraction	Transducer	Hourly
299-W15-47	Extraction	Transducer	Hourly
299-W15-49	Near field	Transducer	Hourly
299-W15-50	Near Field	Transducer	Hourly
299-W15-765	Extraction	Transducer	Hourly
299-W18-1	Intermediate	Transducer	Hourly
299-W18-16	Baseline	Transducer	Hourly
299-W18-23	Near-field	Transducer	Hourly
299-W18-36	Injection	Transducer	Hourly

Table 8-1. Water-Level Monitoring Methods and Frequencies for the 200-ZP-1 Interim Remedial Measure. (2 sheets)

Well Name	Well Type[a]	Measurement Method[b]	Frequency
299-W18-37	Injection	Transducer	Hourly
299-W18-38	Injection	Transducer	Hourly
299-W18-39	Injection	Transducer	Hourly
699-39-79	Near-field	Transducer	Hourly

[a] Well type is divided into three classes, depending on relative positions to extraction and injection wells:
Near field: Expected to show hydraulic response during operations.
Intermediate: Located between the extraction and injection wells within the 2,000 ppb contour.
Baseline: Located outside of the 2,000 ppb contour but with no expected hydraulic influence.
[b] Transducer measurements are collected electronically via data loggers.
ppb = parts per billion

As noted in Table 8-1, monitoring wells are identified as near-field, intermediate, and baseline wells according to their spatial relationship to the extraction wells and the injection wells. Near-field wells are expected to be influenced hydraulically by the extraction wells and injection wells. Intermediate wells lie between the extraction and injection wells (i.e., inside or near the 2,000 ppb contour) and may or may not be impacted hydraulically. Baseline wells are upgradient from the injection wells, downgradient from the extraction wells, or cross-gradient from either, and are expected to be outside the area of immediate hydraulic influence.

8.1.1 Data Evaluation

Each quarter, water-level data will be converted into hydraulic head data and used to generate potentiometric surface maps. The effectiveness of hydraulic containment will be determined, as demonstrated by an inward hydraulic gradient at the containment perimeter. The aquifer response will be modeled to predict rates and effectiveness of remediation in the annual and semi-annual performance monitoring report prepared each FY.

Transient and near steady-state water-level data will also be evaluated to estimate the hydraulic conductivity of the aquifer near the extraction and injection wells. These data and analyses will be used to update the groundwater model and thereby improve predictive modeling on the rate and effectiveness of remediation.

Water-level data will also be used to evaluate groundwater flow conditions for optimizing extraction rates and pumping schedules and for maintaining hydraulic containment while maximizing removal (reduction) of contaminated groundwater. An assessment of system effectiveness may indicate that maximum contaminant removal will occur by extracting more groundwater from one well and less from another. Extraction rates may then be modified to optimize contaminant reduction. For any modified operational scheme, hydraulic containment will remain the primary goal.

8.1.2 Data Storage and Reporting

Data will be compiled and preserved in electronic format where the data will be readily accessible for processing. Data collection began prior to initiation of Phase III operations and will continue during the lifetime of the operation. As the viability or usefulness of data collected from wells changes, wells made be added or removed from this network.

8.2 GROUNDWATER SAMPLING NETWORK

To reduce contamination in the area of highest concentrations of carbon tetrachloride (RAO #2), a sampling network of wells was established. Details of the 200-ZP-1 OU Phase III groundwater sampling program are also found in Appendix A of the 200-ZP-1 RI/FS work plan (DOE/RL-2003-55) and in the process SAP presented in Section 7.0. The groundwater sampling network described herein presents modifications to what are termed the remedial action assessment (RAA) wells. The RAA wells are those wells that (1) will provide baseline information on volatile organic contamination and nitrate in the 2,000 to 3,000 ppb area of the carbon tetrachloride plume, and (2) will be used to determine the impacts of groundwater remediation on volatile organic contamination in the described area.

Some of these wells will also be used for hydraulic monitoring, as described in Section 8.1. The plume-periphery assessment wells and interim action point-of-compliance wells will continue to be sampled. The sampling requirements for the RAA wells are described below; however, the quality assurance (QA)/QC requirements are the same as those found in the 200-ZP-1 RI/FS work plan (DOE/RL-2003-55).

The process SAP (Section 7.0) provides the requirements for sampling Phase III extraction wells and injection wells. Information obtained from process samples will be used to supplement information obtained from RAA monitoring wells.

Groundwater sampling and analysis activities (as described below) will continue throughout Phase III operations. Periodic evaluations of the groundwater sampling network may necessitate modifications to the network (e.g., adding sampling wells, increasing sampling frequencies, or reducing both of these).

Groundwater sampling and analysis activities are presented in Section 8.5 for performance monitoring of two new extraction wells located near the 241-T Tank Farm in the 200-ZP-1 OU.

8.2.1 Well Locations

All wells that will be sampled for the 200-ZP-1 IRM are presented in Appendix A of the 200-ZP-1 RI/FS work plan (DOE/RL-2003-55). Groundwater sampling activities will continue to be coordinated with other Site groundwater monitoring programs to reduce sampling and analytical costs. Table A3-2 in Appendix A of the 200-ZP-1 RI/FS work plan (DOE/RL-2003-55) lists the RAA groundwater sampling wells that will be used to monitor the performance of the pump-and-treat system and the sampling schedules for each well.

8.2.1.1 Extraction/Injection Wells. The Phase II groundwater extraction system consisted of three extraction wells and one injection well: 299-W15-33 (replaced in FY04 by 299-W15-45), 299-W15-34, 299-W15-35, and 299-W15-29, respectively. Phase III operations expanded to include three additional extraction wells and four additional injection wells, including those wells already listed (299-W15-32 [replaced in FY04 by 299-W15-47], 299-W15-36, 299-W15-37 [not in service as of 2001], and 299-W18-36, 299-W18-37, 299-W18-38, and 299-W18-39, respectively). In FY05, wells 299-W15-40, 299-W15-43, 299-W15-44, and 299-W15-765 were converted to extraction wells to capture the higher concentration region of the carbon tetrachloride plume. In FY08, monitoring wells 299-W15-1, 299-W15-7, 299-W15-11, and 299-W15-46 were converted to extraction wells and added to the 200-ZP-1 pump-and-treat system.

8.2.1.2 Remedial Action Assessment Monitoring Wells. Table A3-2 in Appendix A of the 200-ZP-1 RI/FS work plan (DOE/RL-2003-55) identifies the list of monitoring wells to be sampled in support of remedial action performance assessment.

8.2.2 Frequency/Analytes and Methods

Table A3-2 in Appendix A of the 200-ZP-1 RI/FS work plan (DOE/RL-2003-55) identifies the frequency at which monitoring wells will be sampled and the analyses to be performed.

8.2.3 Data Evaluation

Two times per year, the analytical results from the RAA monitoring wells will be used to assess the performance of the pump-and-treat system. Contaminant concentration changes over time will be plotted for the extraction and monitoring wells and will be used to evaluate capture system effectiveness and efficiency.

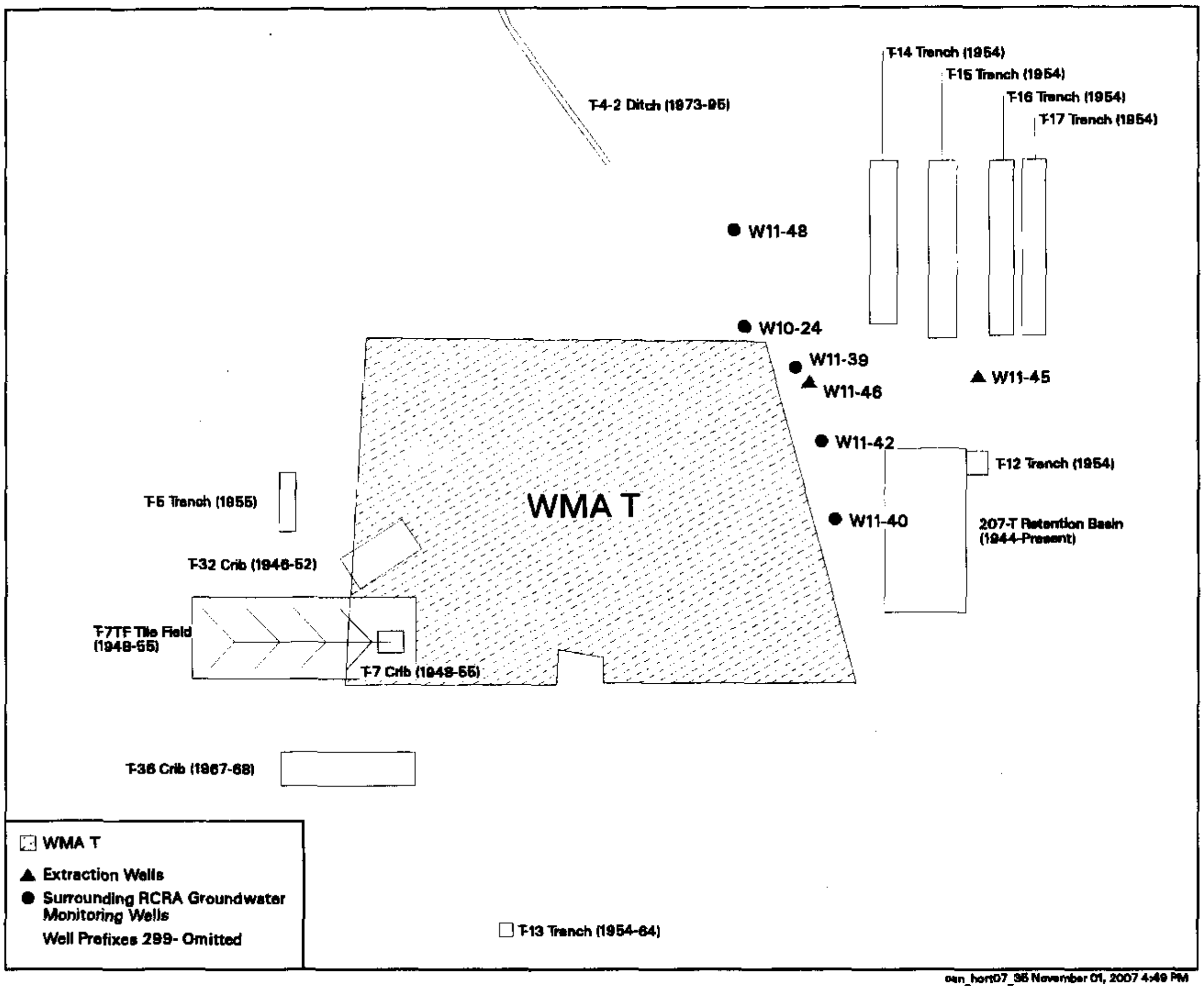
For evaluation of contaminant reduction within the 2,000 to 3,000 ppb contour of the carbon tetrachloride plume, the rate of mass reduction versus the number of pore volumes removed will be calculated. This information will be combined with output from a hydraulic computer model to determine the capture zone effectiveness. These evaluations will also be useful to assess how to optimize the system to ensure full hydraulic containment, to most efficiently reduce contaminant mass, and to determine what additional data are needed to develop the final remedy action.

8.3 ADDITIONAL PERFORMANCE MONITORING IN THE 200-ZP-1 OPERABLE UNIT

Monitoring wells 299-W11-45 and 299-W11-46 were converted to extraction wells in early FY07. As shown in Figure 8-1, the two converted wells are located northeast of the 241-T Tank Farm and are piped in and connected to the Liquid Effluent Retention Facility (LERF). Extracted groundwater from the two wells is treated at the ETF.

An assessment of groundwater monitoring wells that are appropriate for evaluating the performance of the two new extraction wells includes a set of target analytes (including water quality parameters) and sampling frequencies for each extraction and monitoring well. The results of the assessment are presented in the following subsections.

Figure 8-1. Locations of the Groundwater Performance Wells.



8.3.1 Well Locations

The five groundwater monitoring wells listed below are proposed for evaluating the performance of the two new extraction wells (299-W11-45 and 299-W11-46). Four of the five monitoring wells are currently included in a RCRA groundwater monitoring program. Well 299-W11-48 is not currently monitored under CERCLA or RCRA. The locations of the five groundwater monitoring and the two extraction wells are shown above in Figure 8-1:

- 299-W10-24 (RCRA monitoring well)
- 299-W11-39 (RCRA monitoring well)
- 299-W11-40 (RCRA monitoring well)
- 299-W11-42 (RCRA monitoring well)
- 299-W11-48.

8.3.2 Performance Monitoring

Table 8-2 presents the sample collection locations, the analytes for analysis, and the frequency of sampling that will aid in monitoring the performance of the two new extraction wells. The current analytes and sampling frequencies are also shown in Table 8-2 for the proposed performance monitoring wells. The wells will also be monitored quarterly for the following water quality parameters: alkalinity, dissolved oxygen, pH, specific conductance, turbidity, temperature, and oxidation/reduction.

Table 8-2. Analytes and Sampling Frequencies for the Performance Monitoring of Wells 299-W11-45 and 299-W11-46.

	Constituents of Concern										
Monitoring Well	VOCs[a]	Chromium (Total)	Nitrate (Anions)	Technetium-99	Tritium	Gamma Scan[b]	Gross Beta[c]	Gross Alpha	Metals, Filtered[d]	Anions[e]	Iodine-129
299-W10-24	Q	Q	Q	Q	Q	SA	SA	SA	Q	Q	Q
299-W11-39	Q	Q	Q	Q	Q	SA	SA	SA	Q	Q	Q
299-W11-40	Q	Q	Q	Q	Q	SA	SA	SA	Q	Q	Q
299-W11-42	Q	Q	Q	Q	Q	SA	SA	SA	Q	Q	Q
299-W11-45	Q	Q	Q	Q	Q	SA	SA	SA	Q	Q	Q
299-W11-46	Q	Q	Q	Q	Q	SA	SA	SA	Q	Q	Q
299-W11-48	Q	Q	Q	Q	Q	SA	SA	SA	Q	Q	Q

NOTE: This table is adapted from the *RCRA Assessment Plan for Single-Shell Tank Waste Management Area T* (PNNL-15301).

[a] VOCS include, but are not limited to, carbon tetrachloride, TCE, chloroform, and methylene chloride.

[b] Gamma scan = Analytes include, but are not limited to, cobalt-60, cesium-137, europium-152, and europium-154.

[c] Gross beta = Indicator parameter for strontium-90 and other beta emitters.
Gross alpha = Indicator parameter for uranium isotopes and other alpha emitters.

[d] Metals = Analytes include, but are not limited to, bismuth, chromium, manganese, sodium, magnesium, potassium, and calcium.

[e] Anions = Analytes include, but are not limited to, nitrite, nitrate, chloride, sulfate, and fluoride.

Q = quarterly
SA = semi-annual
TCE = trichloroethylene
VOC = volatile organic compound

Periodic evaluations of the groundwater sampling network may necessitate modifications to the network (e.g., changing the wells that are selected for sampling or adjusting sampling frequencies). Sampling frequencies might be reduced after sufficient data are collected to indicate that analytical results are stable.

8.3.3 Water-Level Monitoring Network

Water-level data will be collected from monitoring wells that are selected for performance evaluation of the two new extraction wells. Water-level data will be collected from the five monitoring wells listed in Table 8-3, as described in Section 8.2. Water-level measurements at monitoring and extraction wells will be recorded on an hourly basis with dedicated data loggers and in-well transducers. During planned transient water table changes (e.g., startups and shutdowns), water levels may be recorded at the extraction wells and nearby monitoring wells at a more rapid rate (e.g., fast linear and/or log-scale modes).

Table 8-3 lists the water-level collection wells and measurement methods and frequencies. The monitoring wells in this section are identified as near-field and proximal wells according to their spatial relationship to the extraction wells. Near-field wells may be influenced hydraulically by the extraction wells. Proximal wells lie in the vicinity of the extraction wells and may or may not be impacted hydraulically.

Table 8-3. Water Level Monitoring Methods and Frequencies for the Performance Monitoring of Wells 299-W11-45 and 299-W11-46.

Well Name	Well Type[a]	Measurement Method[b]	Frequency
299-W10-24	Proximal	Transducer	Hourly
299-W11-39	Near-field	Transducer	Hourly
299-W11-40	Proximal	Transducer	Hourly
299-W11-42	Near-field	Transducer	Hourly
299-W11-45	Extraction	Transducer	Hourly
299-W11-46	Extraction	Transducer	Hourly
299-W11-48	Proximal	Transducer	Hourly

[a] Well type is divided into two classes, depending on relative position to extraction wells:
Near-field: May show a hydraulic response during operations,
Proximal: Located close to, but may or may not be hydraulically influenced.

[b] Transducer measurements are collected electronically via universal serial bus (USB) data loggers.

8.3.4 Groundwater Sampling Network

Details of the 200-ZP-1 OU additional groundwater sampling program are found in Appendix A of the 200-ZP-1 RI/FS work plan (DOE/RL-2003-55). The groundwater sampling network described herein includes modifications to what are termed as the RAA wells, which are presented in Section 8.2.

9.0 HEALTH AND SAFETY PLAN

Operations personnel are required to conform to the requirements of the site-specific health and safety plan, which addresses the health and safety considerations for operations personnel, maintenance personnel, and visitors. In addition, the requirements and action levels that trigger upgrading personal protection are also outlined in the health and safety plan.

This page intentionally left blank.

10.0 PERFORMANCE AND REGULATORY COMPLIANCE

This section details the applicable or relevant and appropriate requirements (ARARs), the criteria used to monitor performance, and how the 200-ZP-1 IRM will obtain compliance with each requirement.

10.1 APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

The purpose of this section is to discuss how each ARAR identified in the interim action ROD (EPA et al. 1995) will be met during the remedial action. The discussions of ARAR compliance in this section apply to the interim action ROD.

All activities associated with remedial action for the 200-ZP-1 OU covered under the interim action ROD will occur "onsite," as that term is defined under the "National Oil and Hazardous Substances Pollution Contingency Plan" (40 CFR 300). As a result, the remedial actions described in this document need only meet the substantive requirements of the ARARs established in the interim action ROD.

The 200-ZP-1 IRM ARARs include DWSs, state effluent discharge standards, solid and hazardous designation and management standards, and air standards (e.g., for venting releases from tanks or piping).

10.1.1 Chemical-Specific Applicable or Relevant and Appropriate Requirements

Chemical-specific ARARs are typically health- or risk-based numerical regulatory values or methodologies applied to site-specific media to establish cleanup criteria for remedial actions. The chemical-specific ARARs identified in the interim action ROD are as follows:

- ***Safe Drinking Water Act* (SDWA):** The "National Primary Drinking Water Regulations" (40 CFR 141) MCLs for public drinking water supplies are relevant and appropriate for screening groundwater cleanup levels and evaluating the effectiveness of the treatment system. The EPA has delegated authority to implement the SDWA (40 CFR 141) to the State of Washington. The state has established MCLs for public drinking water supplies in WAC 246-290 ("Public Water Supplies"). Although the groundwater addressed in this remedial design report is not a current drinking water supply, these standards are ARARs because of reference through "Underground Injection Control Program" (WAC 173-218) regulations. The state underground injection standards prohibit injection of fluids that exceed DWSs. The treatment system is designed to meet the MCLs for carbon tetrachloride (5.0 µg/L), chloroform (80.0 µg/L), and TCE (5.0 µg/L).
- **"Controls for New Sources of Toxic Air Pollutants" (WAC 173-460):** This section specifies systematic control of new sources emitting toxic air pollutants in order to prevent air pollution, reduce emissions to the extent reasonably possible, and maintain such levels of air quality that will protect human health and safety. Washington State requires that new projects present the use of the best available control technology for toxic air pollutants, quantify emissions, and demonstrate protection of human health. The treatment system has the potential to emit toxic air pollutants (i.e., carbon tetrachloride, chloroform, and TCE). These toxic air pollutants are removed from the air stream with

GAC, which is considered the best available control technology. Emissions will be reduced to the extent reasonably possible.

10.1.2 Action-Specific Applicable or Relevant and Appropriate Requirements

Action-specific ARARs are typically technology- or activity-based regulatory requirements or limitations triggered by a particular action such as treatment, transport, and/or disposal of hazardous waste. The action-specific ARARs established in the interim action ROD (EPA et al. 1995) are identified below, along with a discussion explaining how the ARARs will be met during implementation of the remedial action:

- **"Minimum Standards for Construction and Maintenance of Wells" (WAC 173-160):** The state's minimum standards for construction and maintenance of wells specify standards for the construction, operation, and abandonment of resource protection (i.e., monitoring) wells. A well installation description of work that included design specifications for the wells was prepared and received/approved by DOE and the regulatory agencies. In addition, "Regulation and Licensing of Well Contractors and Operators" (WAC 173-162) requires certification of drilling contractors and operators. This requirement will be met by verifying certification of drillers prior to initiating any drilling operation.
- **"Underground Injection Control Program" (WAC 173-218):** Washington State's "Underground Injection Control Program" regulation specifies the procedures and practices that are applicable to the injection of fluids through wells. In particular, the regulation states that no fluids may be injected that result in a violation of any primary DWSs or that otherwise adversely affect the beneficial use of the aquifer. The treatment system is designed to treat carbon tetrachloride, TCE, and chloroform so contaminant levels remaining in the effluent will meet the respective DWSs before reinjection. To facilitate treatment, small quantities of chemicals (e.g., indicator chemicals associated with the sampling system) might be reinjected with the treated groundwater. Prior to using any new chemical, an evaluation will be made to demonstrate that the chemical will not result in a violation of a DWS or otherwise adversely affect the beneficial use of the groundwater.
- **"Dangerous Waste Regulations" (WAC 173-303):** The EPA has delegated the authority to implement RCRA to the State of Washington. As a result, the regulations promulgated by the state to implement RCRA (the dangerous waste regulations) are the primary ARAR for dangerous wastes generated during the remedial action. Activities performed to comply with the state regulations also will comply with the Federal RCRA regulations specified in the interim action ROD (EPA et al. 1995).
  - **"Designation of Dangerous Waste" (WAC 173-303-070):** This section of the state's waste regulations specifies that procedures will be used to determine if wastes generated during the remedial action classify as dangerous or extremely hazardous wastes. The designation procedures cover both RCRA hazardous wastes (i.e., ignitability, corrosivity, reactivity, toxicity characteristic wastes, and listed wastes) and state-only dangerous wastes (i.e., wastes that meet the criteria for toxic or persistent, dangerous wastes). Based on a reasonable search of historical documents and personal interviews, it has been concluded that the waste generated during this

action is "F001-," "F002-," "F003-," "F004-," and "F005"-listed hazardous waste based on disposal of carbon tetrachloride as a spent solvent.

- **"Land Disposal Restrictions" (WAC 173-303-140):** The state's LDR regulations incorporate the Federal RCRA LDR requirements (currently maintained under Federal authority) set forth in "Land Disposal Restrictions" (40 CFR 268) and establish LDRs for certain state-only dangerous wastes, such as wastes classified as extremely hazardous and carbonaceous/organic wastes. As discussed above, it is currently anticipated that the wastes generated during the interim remedial actions would be listed wastes. Non-wastewater streams will be treated as necessary to meet the LDR treatment standard of 6 mg/kg (6 ppm) for carbon tetrachloride prior to disposal at ERDF. Wastes that already meet the LDR standards may be land disposed at ERDF with no further treatment.
- **"Use and Management of Containers" (WAC 173-303-630):** The remedial actions described in this report will require the use of containers to store listed wastes. All storage containers will meet the requirements of WAC 173-303-630, including compatibility with the waste and appropriate labeling and inspections.
- **Tank Systems (WAC 173-303-640[4]):** The remedial actions described in this report will require the use of tanks to store or treat hazardous wastes. Dangerous waste storage tanks are required to meet the requirements of WAC 173-303-640, including requirements for secondary containment, compatibility with the waste, corrosion protection (as necessary), and leak detection. Phase I of this action did not meet the standards for secondary containment for tank systems; however, because this phase was of short duration, an interim action waiver was approved in the interim action ROD to allow continued operation of the Phase I system without secondary containment for tank systems. This interim action waiver ceased when Phase II operations were initiated, and Phase III meets the requirements of secondary containment.

Note that in accordance with WAC 173-303-640, five of the nine extraction wells have belowground piping that is fitted with a leak detection system. The piping associated with the other nine extraction wells is aboveground and is inspected daily for leaks, as required by WAC 173-303-640.

- **Interim Control of Hazardous Waste Injection (RCRA 3020):** RCRA prohibits the disposal of hazardous waste by underground injection. This section of RCRA allows for injection of hazardous waste if the action is taken under Section 104 or Section 106 of CERCLA, and the contaminated groundwater is treated to substantially reduce hazardous constituents prior to injection such that the response action will, upon completion, be sufficient to protect human health and the environment. The water drawn out of the aquifer will be reinjected after treatment. The treatment system will provide substantial treatment to reduce TCE, chloroform, and carbon tetrachloride concentrations.

10.1.3 Location-Specific Applicable or Relevant and Appropriate Requirements

Location-specific ARARs are restrictions placed on hazardous substance concentrations or remedial actions based on the specific location of the substance or action. The location-specific ARARs established in the interim action ROD (EPA et al. 1995) are discussed below:

- ***National Archeological and Historical Preservation Act* (16 U.S.C. 469, 36 CFR 65):** This act is applicable to the recovery and preservation of artifacts in areas where an action may cause irreparable harm, loss, or destruction of significant artifacts. An initial cultural resources review was completed prior to site activity. No culturally sensitive areas were identified. A cultural resource specialist will be available onsite during any future earth-disturbing activities. If artifacts or other indicators of cultural significance are noted, all work at that location will be stopped and a site-specific evaluation will be performed, including involvement of Tribal authorities as appropriate, to determine whether further actions to preserve artifacts are necessary.
- ***Endangered Species Act of 1973* (16 U.S.C. 1531, 50 CFR 200 and 402):** The *Endangered Species Act* requires that Federal agencies consult with the Department of the Interior to ensure that actions they authorize, fund, or implement do not jeopardize the continued existence of endangered or threatened species or adversely affect their critical habitat. Several listed and candidate endangered or threatened species have been identified in and around the Hanford Site. An ecological review was completed prior to site activity to identify the presence of threatened, endangered, or sensitive species and habitat. If species or habitats are identified, construction and operation plans will be modified as necessary on a case-by-case basis to minimize impacts to the species or habitat. In addition, an ecological resource specialist will perform periodic site visits during construction and operation to evaluate changes in the local ecological conditions. If any threatened, endangered, or sensitive species are noted during these visits, appropriate actions will be taken on a case-by-case basis.

10.1.4 Other Criteria, Advisories, or Guidance to Be Considered

Information to be considered generally consists of Federal, state, and local criteria, advisories, and proposed standards that are not legally binding (i.e., are not promulgated regulations) but that may be useful in establishing cleanup goals or remedial alternatives that are protective of human health and the environment. The to-be-considered information identified in the interim action ROD (EPA et al. 1995) is discussed below:

- ***The Future for Hanford: Uses and Cleanup – The Final Report of the Hanford Future Site Uses Working Group*:** This report (HFSUWG 1992) identifies a range of future land-use options for various geographic areas of the Hanford Site. The working group identified a single cleanup scenario for the Central Plateau, which includes the 200-ZP-1 OU. The scenario generally focuses on uses for waste management within and immediately surrounding the 200 East and 200 West Areas. The scenario also assumes that efforts will be made to prevent the spread of groundwater contamination to other parts of the Site. Implementation of the 200-ZP-1 IRM is consistent with this scenario.
- **ERDF waste acceptance criteria:** Waste acceptance criteria (e.g., concentration limits and waste form limitations) have been developed for the ERDF (*Environmental Restoration Disposal Facility Waste Acceptance Criteria* [WCH-191]). This document provides the primary requirements that waste must meet in order to be accepted for disposal at the ERDF. It also cites specific regulations to direct the user to the level of detail necessary for criteria implementation. Key criteria that apply to wastes generated under this IRM include a carbon tetrachloride limit of 6 mg/kg and a prohibition on free liquids. Prior to disposal at ERDF, each waste type will be evaluated on the basis of either process knowledge or analytical data to determine whether the ERDF waste

acceptance criteria are met. If the criteria are not, the waste will be treated as necessary to meet the criteria. Additional discussion on waste management is provided in Section 4.2.

This page intentionally left blank.

11.0 REPORTING REQUIREMENTS

11.1 PROGRESS REPORTS

Summaries of field activities conducted and data obtained during the implementation of the Phase III IRM are presented in FY annual summary reports for 200-ZP-1 pump-and-treat operations. Future summary reports will be presented in progress reports that will be prepared by S&GRP and submitted monthly to DOE and EPA.

11.2 ANNUAL REPORT

An annual 200-ZP-l IRM performance evaluation report will be submitted to DOE, the regulatory agencies, and onsite contractors as needed. The contents of the report will include, but are not limited to, the following:

CONTENTS

1.0 INTRODUCTION
2.0 SYSTEM PERFORMANCE
    2.1 ACTIVITIES AND DEVELOPMENTS
    2.2 EXTRACTION SYSTEM PERFORMANCE
    2.3 TREATMENT SYSTEM PERFORMANCE
    2.4 CONTAMINANT MONITORING
    2.5 AQUIFER RESPONSE
3.0 QUALITY ASSURANCE/QUALITY CONTROL
4.0 CONCLUSIONS
5.0 RECOMMENDATIONS
6.0 COST PERFORMANCE
7.0 REFERENCES
APPENDICES

11.3 FINAL REPORT

A final groundwater extraction and treatment system implementation task remedial design report will be prepared upon completion of the 200-ZP-1 Phase III IRM. The report will document the effects of the 200-ZP-1 IRM on the 2,000 to 3,000 ppb contour of the carbon tetrachloride plume based on data collected during the years of system operation. The purpose of analyzing data over the years of operation is to ensure that the local geological conditions influenced by the IRM have equilibrated.

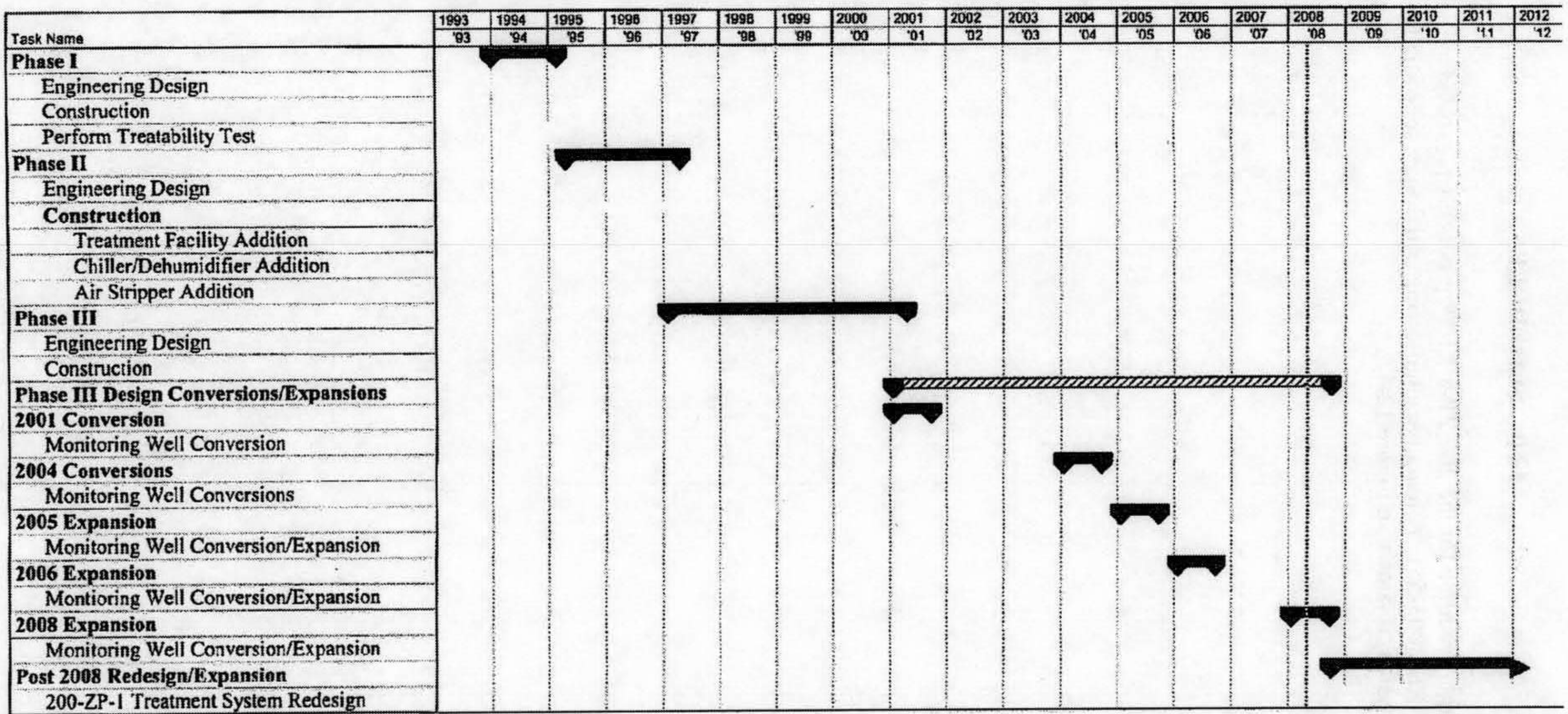
In addition, the final report will document the attainment of the defined 200-ZP-1 interim action ROD goals. For a detailed discussion of 200-ZP-1 IRM goals, see the interim action ROD (EPA et al. 1995).

This page intentionally left blank.

12.0 SCHEDULE

The implementation schedule for the 200-ZP-1 RI/FS process is presented in the 200-ZP-1 RI/FS work plan (DOE/RL-2003-55). A tentative engineering and design schedule for the 200-ZP-1 pump-and-treat system is shown in Figure 12-1.

Figure 12-1. Engineering and Design Schedule for the 200-ZP-1 Pump-and-Treat System.



13.0 COST

The costs associated with construction and implementation of the 200-ZP-1 Phase III IRM are discussed in the FY04 annual report (DOE/RL-2004-72) and more current FY annual summary reports for 200-ZP-1 pump-and-treat operations.

This page intentionally left blank.

14.0 REFERENCES

05-AMCP-0036, 2004, *Use of Single Wall Piping for 200-ZP-1 Pump-and-Treat Expansion*, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

05-AMCP-0204, 2005, *Plan for Action on the Single-Shell Tank Farm Waste Management Area and 200-ZP-01 Groundwater Operable Unit*, U.S. Department of Energy Office of River Protection, Richland, Washington.

36 CFR 65, "National Historic Landmarks Program," *Code of Federal Regulations*.

40 CFR 141, "National Primary Drinking Water Regulations," *Code of Federal Regulations*.

40 CFR 268, "Land Disposal Restrictions," *Code of Federal Regulations*.

40 CFR 300, "National Oil and Hazardous Substances Pollution Contingency Plan," *Code of Federal Regulations*.

BHI-00110, 1994, *Engineering Evaluation/Conceptual Plan for the 200-ZP-1 Operable Unit Interim Remedial Measure*, Rev. 0, Bechtel Hanford, Inc., Richland, Washington.

BHI-00159, 1995, *Design Criteria for the 200-ZP-1 Interim Remedial Measure*, Rev. 0, Bechtel Hanford, Inc., Richland, Washington.

BHI-00194, 1995, *200-ZP-I Phase II Interim Remedial Measure Conceptual Design Report*, Rev. 0, Bechtel Hanford, Inc., Richland, Washington.

BHI-00453, 1996, *CERCLA Substantive Requirement Document 200-ZP-1 Phases II and III Interim Remedial Measure Groundwater Treatment Project*, Rev. 0, Bechtel Hanford, Inc., Richland, Washington.

BHI-00464, 1996, *Hanford Sitewide Groundwater Remediation Strategy Supporting Technical Information*, Rev. 0, Bechtel Hanford, Inc., Richland, Washington.

BHI-00952-01, 1996, *200-ZP-1 Phase Interim Remedial Measure quarterly Report, August – October 1996*, Rev. 0, Bechtel Hanford, Inc., Richland, Washington.

BHI-00952-02, 1997, *200-ZP-1 Phase Interim Remedial Measure Quarterly Report, October – December 1996*, Rev. 0, Bechtel Hanford, Inc., Richland, Washington.

Comprehensive Environmental Response, Compensation, and Liability Act of 1980, 42 U.S.C. 9601, et seq.

DOE/RL-91-32, 1991, *Expedited Response Action Proposal (EE/CA & EA) for 200 West Carbon Tetrachloride Plume*, Draft B, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE/RL-92-16, 1993, *200 West Area Groundwater Aggregate Area Management Study Report*, Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE/RL-93-68, 1994, *Interim Remedial Measure Proposed Plan for the 200-ZP-1 Operable Unit*, Rev. 3, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE/RL-94-12, 1994, *Treatability Test Plan for the 200-ZP-1 Operable Unit*, Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE/RL-95-30, 1995, *200-ZP-1 Operable Unit Treatability Test Report*, Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE/RL-95-101, 1995, *An Analysis of Potential Impacts to the Groundwater Monitoring Network in the Central Plateau*, Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE/RL-96-07, 1996, *200-ZP-1 Interim Remedial Measure Remedial Design Report*, Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE/RL-96-81, 1997, *Waste Site Grouping for 200 Areas Soil Investigations*, Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE/RL-2002-67, 2003, *Fiscal Year 2002 Annual Summary Report for the 200-UP-1 and 200-ZP-1 Pump-and-Treat Operations*, Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE/RL-2003-55, 2004, *Remedial Investigation/Feasibility Study Work Plan for the 200-ZP-1 Groundwater Operable Unit*, Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE/RL-2004-40, 2005, *Waste Management Plan for the Expedited Response Action for 200 West Area Carbon Tetrachloride Plume and the 200-ZP-1 and 200-PW-1 Operable Units*, Rev. 6 (Reissue), U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE/RL-2004-72, 2005, *Fiscal Year 2004 Annual Report for 200-UP-1 and 200-ZP-1 Pump-and-Treat Operations*, Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE/RL-2006-24, 2006, *Remedial Investigation Report for the 200-ZP-1 Groundwater Operable Unit*, Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE/RL-2006-73, 2007, *Fiscal Year 2006 Annual Report for 200-UP-1 and 200-ZP-1 Pump-and-Treat Operations*, Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE/RL-2007-28, 2008, *Feasibility Study Report for the 200-ZP-1 Groundwater Operable Unit*, Draft B, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE/RL-2007-33, 2008, *Proposed Plan for the Remediation of the 200-ZP-1 Groundwater Operable Unit*, Draft B, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

Ecology, EPA, and DOE, 2003, *Hanford Federal Facility Agreement and Consent Order* (Tri-Party Agreement), 2 vols., as amended, 89-10, Rev. 6, Washington State Department of Ecology, U.S. Environmental Protection Agency, and U.S. Department of Energy, Olympia, Washington.

Endangered Species Act of 1973, 16 U.S.C. 1531, et seq.

EPA, 1994, *Methods for Monitoring Pump-and-Treat Performance*, U.S. Environmental Protection Agency, Washington, D.C.

EPA/600/R-93-100, 1993, *Methods for the Determination of Inorganic Substances in Environmental Samples*, U.S. Environmental Protection Agency, Washington, D.C.

EPA/600/R-94-111, 1994, *Methods for the Determination of Metals in Environmental Samples – Supplement I*, NTIS PB94-184942, U.S. Environmental Protection Agency, Washington, D.C.

EPA, Ecology, and DOE, 1995, *Declaration of the Interim Record of Decision for the 200-ZP-1 Operable Unit*, #016085, U.S. Environmental Protection Agency, Washington State Department of Ecology, and U.S. Department of Energy, Olympia, Washington.

Harbaugh, A. W., E. R. Banta, M. C. Hill, and M. G. McDonald, 2000, *MODFLOW-2000, the U.S. Geological Survey Modular Ground-Water Model – User Guide to Modularization Concepts and the Ground-Water Flow Process*, Open-File Report 00-92, p. 121, U.S. Geological Survey, Reston, Virginia.

HFSUWG, 1992, *The Future for Hanford: Uses and Cleanup – The Final Report of the Hanford Future Site Uses Working Group*, prepared by the Hanford Future Site Uses Working Group for the U.S. Department of Energy, U.S. Environmental Protection Agency, Washington State Department of Ecology, and U.S. Department of Energy, Richland Operations Office.

National Archeological and Historical Preservation Act, 16 U.S.C. 469, et seq.

PNL-6120, 1987, *Environmental Monitoring at Hanford for 1986*, Rev. 0, Pacific Northwest Laboratory, Richland, Washington.

PNNL-15301, 2005, *RCRA Assessment Plan for Single-Shell Tank Waste Management Area T*, Pacific Northwest National Laboratory, Richland, Washington.

Pollock, D. W., 1994, *User's Guide for MODPATH/MODPATH-PLOT, Version 3: A Particle-Tracking Post-Processing Package for MODFLOW, the U S. Geological Survey Finite-Difference Ground-Water Flow Model*, Open-File Report 94-464, p. 249, U.S. Geological Survey, Reston, Virginia.

Resource Conservation and Recovery Act of 1976, 42 U.S.C. 6901, et seq.

Safe Drinking Water Act of 1974, 42 U.S.C. 300f, et seq.

Superfund Amendments and Reauthorization Act of 1986, 42 U.S.C. 9601, et seq.

SW-846, 1997, *Test Methods for Evaluation of Solid Waste, Physical/Chemical Methods*, 3rd edition (as amended by Update I [July 1992], Update IIA [August, 1993], Update IIB [January 1995], and Update III), U.S. Environmental Protection Agency, Washington, D.C.

WAC 173-160, "Minimum Standards for Construction and Maintenance of Wells," *Washington Administrative Code.*

WAC 173-162, "Regulation and Licensing of Well Contractors and Operators," *Washington Administrative Code.*

WAC 173-218, "Underground Injection Control Program," *Washington Administrative Code.*

WAC 173-303, "Dangerous Waste Regulations," *Washington Administrative Code.*

WAC 173-460, "Controls for New Sources of Toxic Air Pollutants," *Washington Administrative Code.*

WAC 246-290, "Public Water Supplies," *Washington Administrative Code.*

WCH-191, 2008, *Environmental Restoration Disposal Facility Waste Acceptance Criteria*, Rev. 0, Washington Closure Hanford, LLC, Richland, Washington.

WHC-SD-EN-TI-014, 1992, *Hydraulic Model for the 200 West Groundwater Aggregate Area*, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

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

WMP-18977, 2003, *Data Quality Objectives Summary Report Supporting the 200-ZP-1 Operable Unit Remedial Investigation/Feasibility Study Process*, Rev. 0, Fluor Hanford, Inc., Richland, Washington.

WMP-26178, 2005, *Performance Evaluation Report for Soil Vapor Extraction Operations at the 200-PW-1 Carbon Tetrachloride Site, Fiscal Year 2004*, Rev. 0, Fluor Hanford, Inc., Richland, Washington.

Zheng, C., and P. Wang, 1999, *MT3DMS: A Modular Three-Dimensional Multi-Species Transport Model for Simulation of Advection, Dispersion, and Chemical Reactions of Contaminants in Groundwater Systems; Documentation and User's Guide*, Contract Report SERDP-99-1, U.S. Army Engineer Research and Development Center, Vicksburg, Mississippi.

APPENDIX A

ENGINEERING AND DESIGN REFERENCES

This page intentionally left blank.

APPENDIX A

ENGINEERING AND DESIGN REFERENCES

References providing information on the engineering and design specifications are presented in this section. Also included are references to project quality control, health and safety, descriptions of work, evaluation plans, waste management plans, and sampling and analysis plans for various 200-ZP-1 Operable Unit pump-and-treat tasks.

- BHI-00038, 1995, *200-ZP-1 Groundwater Sampling and Analysis Plan/Quality Assurance Plan*, Rev. 2, Bechtel Hanford, Inc., Richland, Washington.
- BHI-00315, 1995, *Site Specific Health and Safety Plan: 200-ZP-1 Groundwater Well Drilling*, Rev. 0, Bechtel Hanford, Inc., Richland, Washington.
- BHI-00327, 1995, *Safety Assessment for the Proposed Pilot-Scale Treatability Test for the 200-ZP-1 Groundwater Operable Unit*, Rev. 0, Bechtel Hanford, Inc., Richland, Washington.
- BHI-00191, 1995, *Site Specific Health and Safety Plan: 200-ZP-1 DNAPL Well Drilling*, Rev. 0, Bechtel Hanford, Inc., Richland, Washington.
- BHI-0155, 1995, *200-ZP-1 IRM Implementation Description of Work*, Rev. 0, Bechtel Hanford, Inc., Richland, Washington.
- BHI-00893, 1996, *Readiness Evaluation Report for Operation of the 200-ZP-1 Pump-and-Treat System*, Rev. 0, Bechtel Hanford, Inc., Richland, Washington.
- BHI-00232, 1996, *Readiness Evaluation Plan for Operation for the 200-ZP-1 Pump-and-Treat System*, Rev. 1, Bechtel Hanford, Inc., Richland, Washington.
- BHI-01474, 2001, *Sampling and Analysis Instruction for Characterization of the 200-ZP-1 and 200-ZP-2 Spent Granulated Activated Carbon and Filter Elements*, Rev. 0, Bechtel Hanford, Inc., Richland, Washington.
- DOE/RL-2000-40, 2007, *Waste Management Plan for the Expedited Response Action for 200 West Area Carbon Tetrachloride Plume and the 200-ZP-1 and 200-PW-1 Operable Units*, Rev. 7, U.S. Department of Energy, Richland Operations Office, Richland, Washington.
- DOE/RL-2002-17, 2002, *Sampling and Analysis Plan for the 200-ZP-1 Groundwater Monitoring Well Network*, Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington.
- DOE/RL-2006-54, 2006, *Sampling and Analysis Instruction for the Characterization of the 200-ZP-1 and 200-ZP-2 Spent Granulated Activated Carbon and Filter Elements*, Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington.
- DOE/RL-2006-46, 2006, *Sampling and Analysis Plan for Deep Groundwater Wells 299-W11-48 (C5243) and 299-W10-32 (C5244) Near Waste Management Area T in the 200-ZP-1 Operable Unit, Fiscal Year 2006*, Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

- SGW-33045, 2007, *Description of Work for Fiscal Year 2007: 200-ZP-1 Operable Unit Monitoring Wells*, Rev. 0, Fluor Hanford, Inc., Richland, Washington.

Table A-1 presents a list of the 200-ZP-1 engineering and design drawings.

Table A-1. 200-ZP-1 Operable Unit Design Drawings. (14 sheets)

H-2-825321	1	PHASE II PUMP AND TREAT PROCESS FACILITY BUILDING PLAN AND ELEVATION
H-2-825323	2	PROCESS FACILITY BUILDING FOUNDATION PLAN
H-2-825324	3	PHASE II IRM PUMP & TREAT DESIGN AIR STRIPPER FOUNDATION PLAN & DETAILS
H-2-825326	1	PHASE II IRM PUMP & TREAT DESIGN PROCESS FACILITY PLAN
	2	200-ZP-1 PHASE II IRM PUMP & TREAT PROCESS FACILITY PLAN
H-2-825327	4	PHASE III IRM INJECTION/EXTRACTION MANIFOLD BUILDING PLAN AND ELEVATIONS
H-2-825328	2	PROCESS FACILITY BUILDING EXTERIOR ELEVATIONS
H-2-825329	0	200 WEST AREA ZP-1 PUMP AND TREAT DESIGN EXTRACTION WELL PIPING TO WELL 299-W15-30
H-2-825330	4	PHASE II IRM PUMP AND TREAT DESIGN PLAN AND PROFILE PIPING TO INJECTION WELL
H-2-825331	2	PUMP AND TREAT PROCESS FACILITY BUILDING FOUNDATION DETAILS
H-2-825332	3	PHASE II IRM PUMP AND TREAT DESIGN PLAN AND PROFILE PIPING TO INJECTION WELL
H-2-825333	3	PHASE II IRM PUMP AND TREAT DESIGN PLAN AND PROFILE PIPING TO INJECTION WELL
H-2-825334	3	PHASE II IRM PUMP AND TREAT DESIGN PLAN AND PROFILE PIPING TO INJECTION WELL
H-2-825377	4	PHASE III IRM PUMP AND TREAT DESIGN TYPICAL BURIED PIPING DETAILS
	5	200 WEST AREA 200-ZP-1 PUMP AND TREAT TYP BURIED PIPING DETAILS
H-2-825378	10	200-ZP-1 PHASE III IRM P&T TYPICAL WELL DETAILS
	11	200-ZP-1 PHASE III IRM P&T TYPICAL WELL DETAILS
	9	200 WEST AREA 200-ZP-1 PHASE III IRM PUMP AND TREAT DESIGN TYPICAL WELL DETAILS
	0	200 WEST AREA 200-ZP-1 PUMP AND TREAT WELL HEAD DETAILS
	1	200-ZP-1 ZP-1 PUMP AND TREAT TYPICAL WELL DETAILS
	0	200 WEST AREA 200-ZP-1 PUMP AND TREAT ANCHOR DETAILS
	1	200 WEST AREA 200-ZP-1 PUMP AND TREAT ANCHOR DETAILS

Table A-1. 200-ZP-1 Operable Unit Design Drawings. (14 sheets)

H-2-825379	5	PHASE II IRM PUMP AND TREAT DESIGN TYPICAL MANHOLE DETAILS
H-2-825380	7	PHASE III IRM PUMP & TREAT DESIGN TYPICAL EXTRACTION/INJECTION PIPING TRENCH SECTIONS
H-2-825381	1	PHASE II IRM PUMP AND TREAT DESIGN MECHANICAL SITE PLAN
H-2-825387	10	200 WEST AREA 200-ZP-1 PHASE II IRM PUMP AND TREAT DESIGN ELECTRICAL ONE LINE DIAGRAM PROCESS BUILDING
	11	200 WEST AREA 200-ZP-1 PHASE II IRM PUMP AND TREAT DESIGN ELECTRICAL ONE LINE DIAGRAM PROCESS BUILDING
	12	200-ZP-1 PHASE 2 IRM P. & T. DESIGN ELEC. ONE LINE DIAGRAM PROC. BUILD.
H-2-825388	10	PHASE III IRM PUMP & TREAT DESIGN PROCESS FACILITY ELECTRICAL POWER PLAN
H-2-825390	2	PHASE II PUMP AND TREAT DESIGN WATER INTERFERENCES PLOT PLAN
H-2-825391	2	PHASE II PUMP AND TREAT DESIGN ELECTRICAL INTERFERENCES PLOT PLAN
H-2-825392	4	200-ZP-1 PUMP & TREAT CONDUIT PENETRATION PLAN ELECTRICAL ROOM
H-2-825399	6	PHASE II IRM EXTRACTION DESIGN INJECTION WELL MANIFOLD BUILDING PIPING
H-2-825401	3	PHASE III IRM PUMP AND TREAT EXTRACTION DESIGN INJECTION WELL MANIFOLD BUILDING INSTRUMENT LOCATION
H-2-825402	5	PHASE II IRM PUMP AND TREAT DESIGN INSTRUMENT SITE PLAN
H-2-825405	10	200 WEST AREA 200-ZP-1 PHASE II IRM PUMP AND TREAT DESIGN ELECTRONIC LEAK DETECTION SCHEMATIC
	11	200 WEST AREA ZP-1 PUMP AND TREAT ELECTRONIC LEAK DETECTION SCHEMATIC
H-2-825417	0	PUMP AND TREAT DESIGN PROCESS FLOW DIAGRAM (PFD)
H-2-825418	5	PHASE II IRM PUMP AND TREAT DESIGN ELECTRICAL ABBREVIATIONS AND SYMBOLS LIST
H-2-825419	6	200 WEST AREA 200-ZP-1 PHASE III IRM PUMP AND TREAT DESIGN ELECTRICAL SITE PLAN-WEST AREA
H-2-825420	8	PHASE III IRM PUMP AND TREAT DESIGN POWER TO SITE/GROUNDING AND UNDERGROUND DUCT

Table A-1. 200-ZP-1 Operable Unit Design Drawings. (14 sheets)

H-2-825425	7	PHASE III IRM PUMP AND TREAT DESIGN ELECTRICAL DUCT SCHEDULES
	8	200-ZP-1 PHASE III IRM PUMP AND TREAT DESIGN ELEC DUCT/CONDUIT SCHDS
H-2-825426	7	PHASE III IRM PUMP AND TREAT DESIGN ELECTRICAL SECTIONS
H-2-825427	4	PHASE III IRM PUMP AND TREAT DESIGN ELECTRICAL DETAILS
H-2-825428	10	200 WEST AREA 200-ZP-1 PHASE III IRM PUMP AND TREAT DESIGN ELECTRICAL PANEL AND LIGHTING FIXTURE SCHEDULES
	11	200 WEST AREA 200-ZP-1 PUMP AND TREAT PANEL AND LIGHTING FIXTURE SCHEDULE
	12	200 WEST AREA 200-ZP-1 PUMP AND TREAT PANEL AND LIGHTING FIXTURE SCHEDULE
H-2-825430	6	PHASE II IRM PUMP AND TREAT DESIGN ELECTRICAL SECTIONS
H-2-825431	4	PHASE III IRM PUMP AND TREAT DESIGN ELECTRICAL DUCT SCHEDULES
H-2-825433	6	200-ZP-1 PHASE II IRM PUMP & TREAT DESIGN MISCELLANEOUS ELECTRICAL DETAILS
	7	200-ZP-1 PHASE II IRM PUMP AND TREAT DESIGN MISC. ELECTRICAL DETAILS
	8	200-ZP-1 PHASE II IRM PUMP AND TREAT DESIGN MISC. ELECTRICAL DETAILS
	9	200-ZP-1 PHASE II IRM PUMP AND TREAT DESIGN MISC. ELECTRICAL DETAILS
H-2-825455	4	PHASE III IRM PUMP AND TREAT DESIGN GENERAL ABBREVIATIONS AND SYMBOLS LIST
H-2-825457	4	PHASE II IRM PUMP & TREAT DESIGN PLAN & PROFILE PIPING TREAT BUILDING TO A/S PAD
H-2-825809	5	PHASE II IRM PUMP AND TREAT DESIGN PIPING AND INSTRUMENTATION DIAGRAM (P&ID)
	6	200 WEST 200-ZP-1 PUMP AND TREAT P & ID
H-2-825810	6	PHASE II IRM PUMP AND TREAT DESIGN PIPING AND INSTRUMENTATION DIAGRAM (P&ID)
	7	200 WEST AREA 200-ZP-1 PUMP AND TREAT P&ID
	8	200 WEST AREA 200-ZP-1 PUMP AND TREAT P&ID
H-2-825811	11	200 WEST AREA 200-ZP-1 PHASE II IRM PUMP AND TREAT DESIGN PIPING AND INSTRUMENTATION DIAGRAM (P&ID)
	12	200 WEST AREA 200-ZP-1 PUMP AND TREAT P&ID

Table A-1. 200-ZP-1 Operable Unit Design Drawings. (14 sheets)

H-2-825812	5	200-ZP-1 PHASE II IRM PUMP AND TREAT DESIGN PIPING AND INSTRUMENTATION DIAGRAM (P&ID)
	6	200 WEST 200-ZP-1 PUMP AND TREAT P & ID
H-2-825813	7	200 WEST AREA 200-ZP-1 PHASE II IRM PUMP AND TREAT DESIGN PIPING AND INSTRUMENTATION DIAGRAM (P&ID)
	8	200 WEST AREA 200-ZP-1 PUMP AND TREAT P & ID
H-2-825814	6	PHASE II IRM PUMP AND TREAT DESIGN PIPING AND INSTRUMENTATION DIAGRAM (P&ID)
	7	200 WEST AREA 200-ZP-1 PUMP AND TREAT P & ID
H-2-825815	3	PHASE II IRM PUMP AND TREAT DESIGN PIPING AND INSTRUMENTATION DIAGRAM (P&ID)
	4	200 WEST AREA 200-ZP-1 PUMP AND TREAT P&ID
	5	200 WEST AREA 200-ZP-1 PUMP AND TREAT P&ID
H-2-825816	4	200 WEST LOCATION 200-ZP-1 PHASE II IRM PUMP AND TREAT DESIGN PIPING AND INSTRUMENTATION DIAGRAM (P&ID)
	5	200 WEST LOCATION 200-ZP-1 PUMP AND TREAT P&ID
	6	200 WEST AREA 200-ZP-1 PUMP AND TREAT P & ID
	7	*200 WEST AREA 200-ZP-1 PUMP AND TREAT P & ID*
H-2-825846	1	PHASE II IRM PUMP AND TREAT DESIGN AIR STRIPPER GENERAL ARRANGEMENT
H-2-825847	2	PHASE II IRM PUMP AND TREAT DESIGN AIR STRIPPER TOWER FABRICATION MECHANICAL DETAILS
H-2-825849	2	PHASE II IRM PUMP AND TREAT DESIGN AIR STRIPPER LADDERS AND PLATFORMS
H-2-825852	2	PHASE II IRM PUMP AND TREAT DESIGN INFLUENT PROCESS PUMP GENERAL ARRANGEMENT
H-2-825853	2	PHASE II IRM PUMP AND TREAT DESIGN INFLUENT PROCESS PUMP SKID FABRICATION
H-2-825859	2	PHASE II IRM PUMP AND TREAT DESIGN EFFLUENT INJECTION PUMP GENERAL ARRANGEMENT
H-2-825860	2	PHASE II IRM PUMP AND TREAT DESIGN EFFLUENT INJECTION PUMP SKID FABRICATION
H-2-825861	2	PHASE II IRM PUMP AND TREAT DESIGN EFFLUENT PROCESS PUMP GENERAL ARRANGEMENT
H-2-825862	2	PHASE II IRM PUMP AND TREAT DESIGN EFFLUENT PROCESS PUMP SKID FABRICATION
H-2-825863	2	200 WEST AREA 200 ZP-1 PHASE II IRM PUMP AND TREAT DESIGN DETAILS
	3	200 ZP-1 PHASE II IRM PUMP & TREAT DESIGN DETAILS
	4	200 ZP-1 PHASE II IRM PUMP & TREAT DESIGN DETAILS

Table A-1. 200-ZP-1 Operable Unit Design Drawings. (14 sheets)

	5	200 ZP-1 PHASE II IRM PUMP & TREAT DESIGN DETAILS
	6	200 ZP-1 PHASE II IRM PUMP & TREAT DESIGN DETAILS
	0	200 WEST AREA 200-ZP-1 PUMP AND TREAT DETAILS
H-2-825864	1	PHASE II IRM PUMP AND TREAT DESIGN DETAILS
	2	200 ZP-1 PHASE II IRM PUMP & TREAT DESIGN DETAILS
	0	200 WEST AREA 200-ZP-1 PUMP AND TREAT DETAILS
H-2-825865	2	200 WEST AREA 200-ZP-1 PHASE II IRM PUMP AND TREAT DESIGN DETAILS
H-2-825993	3	200 WEST AREA 200-ZP-1 PHASE II IRM PUMP AND TREAT DESIGN ANALYZER PNEUMATIC DIAGRAM
H-2-825995	6	200-ZP-1 PHASE II IRM PUMP AND TREAT DESIGN MCP POWER FLOW LOOP DIAGRAM
H-2-825996	5	200 WEST AREA 200-ZP-1 PHASE III IRM PUMP AND TREAT DESIGN EXTRACTION WELLS LEVEL LOOP DIAGRAM
	6	200 WEST AREA ZP-1 PUMP AND TREAT WELLS LEVEL LOOP DIAGRAM
	7	200 WEST AREA ZP-1 PUMP AND TREAT WELLS LEVEL LOOP DIAGRAM
H-2-825997	4	PHASE III IRM PUMP AND TREAT DESIGN EXTRACTION WELLS FLOW LOOP DIAGRAM
	5	200-ZP-1 PHASE 3 IRM P. AND T. DESIGN EXTRACT. WELLS FLOW LOOP DIAGRAM
	6	200 WEST AREA ZP-1 PUMP AND TREAT EXTRACTION WELL FLOW LOOP DIAGRAM
H-2-825998	5	200 WEST AREA 200-ZP-1 PHASE II IRM PUMP AND TREAT DESIGN FCV-E01/FCV-E02 LOOP DIAGRAM
H-2-825999	6	200-ZP-1 PHASE III IRM PUMP AND TREAT DESIGN FCV-E03 / FCV-E04 LOOP DIAGRAMS
H-2-826000	7	200 WEST AREA 200-ZP-1 PHASE III IRM PUMP AND TREAT DESIGN FCV-E05 / FCV-E06 LOOP DIAGRAMS
	8	200 WEST AREA ZP-1 PUMP AND TREAT FCV-E05/FCV-E06 LOOP DIAGRAMS
H-2-826001	3	PHASE II IRM PUMP AND TREAT DESIGN FCV-E07/FCV-E08 LOOP DIAGRAM
	4	200-ZP-1 PHASE 2 IRM P. AND T. DESIGN FCV-E07 RCV-E08 LOOP DIAGRAM
H-2-826002	3	PHASE II IRM PUMP AND TREAT DESIGN FCV-E09/FCV-E10 LOOP DIAGRAM
	4	200-ZP-1 PHASE 2 IRM P. AND T. DIAGRAM FCV-E09 FCV-E10 LOOP DIAGRAM

Table A-1. 200-ZP-1 Operable Unit Design Drawings. (14 sheets)

H-2-826003	2	PHASE II IRM PUMP AND TREAT DESIGN TANK T01 LEVEL CONTROL LOOP DIAGRAM
H-2-826004	1	PHASE II PUMP AND TREAT DESIGN AIR STRIPPER LEVEL CONTROL LOOP DIAGRAM
H-2-826005	2	PHASE II IRM PUMP AND TREAT DESIGN TANK T02 LEVEL LOOP DIAGRAM
H-2-826006	1	PHASE II IRM PUMP AND TREAT DESIGN FILTER PRESSURE DIFFERENTIAL LOOP DIAGRAM
H-2-826007	2	PHASE II IRM PUMP AND TREAT DESIGN TANK TEMPERATURES LOOP DIAGRAM
H-2-826008	4	PHASE II IRM PUMP AND TREAT DESIGN ANNUNCIATOR LOOP DIAGRAM
H-2-826009	4	PHASE II IRM PUMP AND TREAT DESIGN ANNUNCIATOR LOOP DIAGRAM
H-2-826010	3	PHASE II IRM PUMP AND TREAT DESIGN ANNUNCIATOR LOOP DIAGRAM
H-2-826011	2	200 WEST AREA 200-ZP-1 PHASE II IRM PUMP AND TREAT DESIGN TSL01/I11 LOOP DIGRAM
H-2-826012	4	PHASE II IRM PUMP AND TREAT DESIGN TSL02 FLOW CONTROL LOOP DIAGRAM
H-2-826013	4	PHASE II IRM PUMP AND TREAT DESIGN PT01/PT02 AFD PUMP CONTROL DIAGRAM
H-2-826014	5	200-ZP-1 PHASE II IRM PUMP AND TREAT DESIGN PT03/PT04 PUMP CONTROL DIAGRAM
H-2-826015	5	200 WEST AREA 200-ZP-1 PHASE II IRM PUMP AND TREAT DESIGN PT01/PT02 AFD PUMP CONTROL DIAGRAM
H-2-826016	2	PHASE III PUMP AND TREAT DESIGN INJECTION WELLS LEVEL LOOP DIAGRAM
H-2-826017	2	PHASE III IRM PUMP AND TREAT DESIGN INJECTION WELLS FLOW LOOP DIAGRAM
H-2-826018	3	200-ZP-1 PHASE II IRM PUMP AND TREAT DESIGN PE01/PE02/PE03 PUMP CONTROL DIAGRAM
H-2-826019	7	200 WEST AREA 200-ZP-1 PHASE III IRM PUMP AND TREAT DESIGN PE04/PE05/PE06 PUMP CONTROL DIAGRAM
	8	200 WEST AREA ZP-1 PUMP AND TREAT PE04/PE05/PE06 PUMP CONTROL DIAGRAM
H-2-826020	3	PHASE II IRM PUMP AND TREAT DESIGN PE07/PE08 PUMP CONTROL DIAGRAM
H-2-826021	2	PHASE II IRM PUMP AND TREAT DESIGN PE09/PE10 PUMP CONTROL DIAGRAM

Table A-1. 200-ZP-1 Operable Unit Design Drawings. (14 sheets)

H-2-826022	2	PHASE II IRM PUMP & TREAT DESIGN ANNUNCIATOR POWER/INTERFACE DIAGRAM
H-2-826023	3	PHASE II IRM PUMP & TREAT DESIGN PLC COMMUNICATIONS
H-2-826024	2	PHASE II IRM PUMP AND TREAT DESIGN HEATER/CHILLER LOOP DIAGRAM
H-2-826025	2	PHASE II IRM PUMP AND TREAT DESIGN TSA03/TSA05 INSTRUMENT LOOP DIAGRAM
H-2-826026	1	PHASE II IRM PUMP AND TREAT DESIGN SAMPLE AIR SOLENOID VALVE LOOP DIAGRAMS
H-2-826027	1	PHASE II IRM PUMP AND TREAT DESIGN SAMPLE AIR SOLENOID VALVE LOOP DIAGRAMS
H-2-826028	2	PHASE II IRM PUMP AND TREAT DESIGN SAMPLE AIR SOLENOID VALVE LOOP DIAGRAMS
H-2-826029	3	PHASE III IRM PUMP AND TREAT DESIGN LEAK DETECTION LOOP DIAGRAM
	4	200 WEST AREA ZP-1 PUMP AND TREAT LEAK DETECTION LOOP DIAGRAM
H-2-826030	1	PHASE II IRM PUMP AND TREAT DESIGN FCV-TSL06 LOOP DIAGRAM
H-2-826032	6	200 WEST AREA 200-ZP-1 PHASE III IRM PUMP AND TREAT DESIGN ELECTRICAL CABLE SCHEDULES
	7	200 WEST AREA ZP-1 PUMP AND TREAT ELECTRICAL CABLE SCHEDULE
	8	200 WEST AREA ZP-1 PUMP AND TREAT ELECTRICAL CABLE SCHEDULE
H-2-826033	4	PHASE II IRM PUMP AND TREAT DESIGN ELECTRICAL CABLE SCHEDULES
H-2-826034	6	200 WEST AREA 200-ZP-1 PHASE III IRM PUMP AND TREAT DESIGN ELECTRICAL CABLE SCHEDULES
	7	200-ZP-1 PHASE 3 IRM PUMP AND TREAT DESIGN ELECTRICAL CABLE SCHEDULES
H-2-826035	2	PHASE II IRM PUMP AND TREAT DESIGN PLC I/O ASSIGNMENT CHART
H-2-826036	6	200 WEST AREA 200-ZP-1 PLC I/O ASSIGNMENT CHART
H-2-826043	2	PHASE II IRM PUMP AND TREAT DESIGN MCP DOOR LAYOUT
H-2-826044	3	PHASE II IRM PUMP AND TREAT DESIGN MCP DOOR LAYOUT
H-2-826045	1	PHASE II IRM PUMP AND TREAT DESIGN MCP DOOR LAYOUT

Table A-1. 200-ZP-1 Operable Unit Design Drawings. (14 sheets)

H-2-826046	1	PHASE II IRM PUMP AND TREAT DESIGN MCP ENCLOSURE
H-2-826048	2	PHASE II IRM PUMP AND TREAT DESIGN ELECTRICAL JUNCTION BOX DETAIL
	3	200 WEST LOCATION 200-ZP-1 PUMP AND TREAT ELECTRICAL TERMINAL BOX DETAILS
	0	200 WEST LOCATION 200-ZP-1 PUMP AND TREAT ELECTRICAL TERMINAL BOX DETAILS
H-2-826049	1	PHASE II IRM PUMP AND TREAT DESIGN ELECTRICAL JUNCTION BOX DETAIL
	2	200 WEST AREA 200-ZP-1 PUMP AND TREAT ELECTRICAL TERMINAL BOX DETAILS
H-2-826050	2	PHASE II IRM PUMP AND TREAT DESIGN ANALYZER INSTRUMENT DETAIL
H-2-826051	2	200 WEST AREA 200-ZP-1 PHASE II IRM PUMP AND TREAT DESIGN HEATER/CHILLER ELECTRICAL CONTROL DIAGRAM
H-2-826052	2	200-ZP-1 PHASE II IRM PUMP & TREAT DESIGN MCP FUSE SCHEDULE
H-2-826053	2	PHASE II IRM PUMP & TREAT DESIGN STARTER CONTROL DIAGRAM
H-2-826054	8	200 WEST AREA 200-ZP-1 PHASE III IRM PUMP AND TREAT DESIGN EXTRACTION WELL STARTER CONTROL DIAGRAMS
	9	200 WEST 200-ZP-1 PUMP AND TREAT CONTROL DIAGRAMS
H-2-826055	2	PHASE II IRM PUMP & TREAT DESIGN EXTRACTION WELL STARTER CONTROL DIAGRAMS
H-2-826056	2	PHASE II IRM PUMP AND TREAT DESIGN MCP INTERNAL WIRING DIAGRAM
H-2-826057	1	PHASE II IRM PUMP AND TREAT DESIGN AFD-PT-01 INTERFACE SCHEMATIC
H-2-826058	1	PHASE II IRM PUMP AND TREAT DESIGN AFD-PT-01 INTERIOR PANEL LAYOUT
H-2-826059	0	PHASE II IRM PUMP AND TREAT DESIGN AFD-PT-01 EXTERIOR PANEL LAYOUT
H-2-826060	1	PHASE II IRM PUMP AND TREAT DESIGN AFD-PT-01 INTERIOR WIRING DIAGRAM
H-2-826062	3	200 WEST AREA 200-ZP-1 PHASE II IRM PUMP AND TREAT DESIGN AFD-P1-01 INTERFACE SCHEMATIC
H-2-826063	1	PHASE II IRM PUMP AND TREAT DESIGN AFD-PI-01 INTERIOR PANEL LAYOUT

Table A-1. 200-ZP-1 Operable Unit Design Drawings. (14 sheets)

H-2-826064	0	PHASE II IRM PUMP AND TREAT DESIGN AFD-PI-01 EXTERIOR PANEL LAYOUT
H-2-826065	2	200 WEST AREA 200-ZP-1 PHASE II IRM PUMP AND TREAT DESIGN AFD-PI-01 INTERIOR WIRING DIAGRAM
H-2-826108	2	ZP-1 PUMP & TREAT INJECTION MAINFOLD BUILDING FOUNDATION PLAN AND DETAILS
H-2-826120	5	200 WEST AREA 200-ZP-1 PHASE III IRM EXTRACTION DESIGN ELECTRICAL SITE PLAN
	6	200 WEST AREA 200-ZP-1 PUMP AND TREAT ELECTRICAL SITE PLAN
	7	200 WEST AREA 200-ZP-1 PUMP AND TREAT ELECTRICAL SITE PLAN
	0	200 WEST AREA 200-ZP-1 PUMP AND TREAT ELECTRICAL SITE PLAN
H-2-826121	4	200 WEST AREA 200-ZP-1 PHASE III IRM EXTRACTION DESIGN EXTRACTION WELL INSTRUMENT SITE PLAN
H-2-826122	2	200 WEST AREA 200-ZP-1 PHASE II IRM EXTRACTION DESIGN MECHANICAL SITE PLAN
	3	200-ZP-1 PH II IRM EXTRACTION DESIGN MECHANICAL SITE PLAN
	4	200-ZP-1 PH II IRM EXTRACTION DESIGN MECHANICAL SITE PLAN
	0	200 WEST AREA 200-ZP-1 PUMP AND TREAT SITE PLAN
	0	200 WEST AREA 200-ZP-1 PUMP AND TREAT UTILITY CORRIDOR PROFILES
	0	200 WEST AREA 200-ZP-1 PUMP AND TREAT UTILITY CORRIDOR DETAILS
	1	200 WEST AREA 200-ZP-1 PUMP AND TREAT UTILITY CORRIDOR DETAILS
H-2-826123	6	200 WEST AREA 200-ZP-1 PHASE III IRM PUMP AND TREAT DESIGN SITE LOCATION MAP
	7	200 WEST AREA 200-ZP-1 PUMP AND TREAT SITE LOCATION MAP
H-2-826124	2	200 WEST AREA 200-ZP-1 PHASE II IRM EXTRACTION DESIGN PLAN AND PROFILE TO EXTRACTION WELL 299-15-33
H-2-826125	2	200 WEST AREA 200-ZP-1 EXTRACTION DESIGN PLAN AND PROFILE TO EXTRACTION WELL 2
H-2-826126	5	PHASE III IRM EXTRACTION DESIGN EXTRACTION WELL MANIFOLD BUILDING NUMBER 1 ELECTRICAL POWER/GROUNDING PLANS

Table A-1. 200-ZP-1 Operable Unit Design Drawings. (14 sheets)

H-2-826127	1	200-ZP-1 EXTRACTION DESIGN PLAN AND PROFILE TO EXTRACTION WELL 2
H-2-826128	2	200 WEST AREA 200-ZP-1 EXTRACTION DESIGN PLAN AND PROFILE TO EXTRACTION MANIFOLD BLDG
H-2-826129	2	PLAN AND PROFILE TO EXTRACTION MANIFOLD BUILDING
H-2-826130	2	PLAN AND PROFILE TO EXTRACTION MANIFOLD
H-2-826131	1	200-ZP-1 EXTRACTION DESIGN PLAN AND PROFILE TO EXTRACTION MANIFOLD BLDG
H-2-826132	1	200-ZP-1 EXTRACTION DESIGN PLAN AND PROFILE TO EXTRACTION WELL 3
H-2-826133	6	200 WEST AREA 200-ZP-1 PHASE II IRM PUMP AND TREAT DESIGN EXTRACTION WELL MANIFOLD BUILDING # 1 PIPING
H-2-826140	5	200 WEST AREA 200-ZP-1 PHASE III IRM EXTRACTION DESIGN EXTRACTION WELL MANIFOLD BUILDING NUMBER 1 INSTRUMENT LOCATION
H-2-826141	6	PHASE III IRM EXTRACTION DESIGN ELECTRICAL DUCT SCHEDULES
H-2-826147	1	200-ZP-1 EXTRACTION DESIGN EXTRACTION MANIFOLD BLDG. FDN. PLAN & DETAILS
H-2-826148	5	PHASE III IRM EXTRACTION DESIGN INSTRUMENTATION WIRING DIAGRAM MANIFOLD BUILDING NUMBER 1
H-2-826157	2	PHASE II IRM PUMP & TREAT DESIGN ELECTRICAL DETAILS
	3	200-ZP-1 PHASE II IRM PUMP AND TREAT DESIGN ELECTRICAL DETAILS
H-2-826169	2	PHASE III IRM PUMP AND TREAT DESIGN PLAN AND PROFILE TO EXTRACTION WELL NUMBER 299-W15-32
H-2-826170	2	200 WEST AREA 200-ZP-1 PHASE III IRM PUMP AND TREAT DESIGN PLAN AND PROFILE TO EXTRACTIN WELL NO. 299-W15-32
	3	200 WEST AREA 200-ZP-1 PUMP AND TREAT PLAN AND PROFILE
H-2-826171	2	PHASE III IRM PUMP AND TREAT DESIGN PLAN AND PROFILE TO EXTRACTION MANIFOLD BUILDING NUMBER 2
H-2-826172	2	PHASE III IRM PUMP AND TREAT DESIGN PLAN AND PROFILE TO EXTRACTION MANIFOLD BUILDING NUMBER 2
H-2-826173	2	PHASE III IRM PUMP AND TREAT DESIGN PLAN AND PROFILE TO EXTRACTION MANIFOLD BUILDING NUMBER 2
	3	200 WEST AREA 200-ZP-1 PUMP AND TREAT PLAN & PROFILE MANIFOLD #2

Table A-1. 200-ZP-1 Operable Unit Design Drawings. (14 sheets)

H-2-826174	2	200-ZP-1 PHASE III IRM PUMP AND TREAT DESIGN PLAN AND PROFILE TO EXTRACTION WELL NO. 299-W15-37
	3	200 WEST AREA 200-ZP-1 PUMP AND TREAT WELL 299-W15-37
H-2-826175	2	PHASE III IRM PUMP AND TREAT DESIGN PLAN AND PROFILE TO INJECTION WELL NUMBER 299-W18-37
H-2-826176	2	PHASE III IRM PUMP AND TREAT DESIGN PLAN AND PROFILE TO INJECTION WELL NUMBER 299-W18-36
H-2-826177	2	PHASE III IRM PUMP & TREAT DESIGN PLAN & PROFILE TO INJECTION WELL NO. 299-W18-38
H-2-826178	3	PHASE III IRM PUMP AND TREAT DESIGN PLAN AND PROFILE TO INJECTION WELL NUMBER 299-W18-38
H-2-826179	2	PHASE III IRM PUMP & TREAT DESIGN PLAN & PROFILE TO INJECTION WELL NO. 299-W18-39
H-2-826180	3	PHASE III IRM PUMP AND TREAT DESIGN PLAN AND PROFILE TO INJECTION WELL NUMBER 299-W18-39
H-2-826209	1	PHASE II IRM PUMP AND TREAT DESIGN MCP INTERNAL WIRING DIAGRAM
H-2-826210	2	PHASE II IRM PUMP AND TREAT DESIGN MCP INTERNAL WIRING DIAGRAM
H-2-826211	1	PHASE II IRM PUMP AND TREAT DESIGN MCP INTERNAL WIRING DIAGRAM
H-2-826212	3	200 WEST AREA 200-ZP-1 PHASE II IRM PUMP AND TREAT DESIGN MCP INTERNAL WIRING DIAGRAM
H-2-826213	2	PHASE II IRM PUMP AND TREAT DESIGN MCP INTERNAL WIRING DIAGRAM
H-2-826214	1	PHASE II IRM PUMP AND TREAT DESIGN MCP INTERNAL WIRING DIAGRAM
H-2-826215	4	200-ZP-1 PHASE II IRM PUMP AND TREAT DESIGN MCP INTERNAL WIRING DIAGRAM
H-2-826216	1	PHASE II IRM PUMP AND TREAT DESIGN MCP INTERNAL WIRING DIAGRAM
H-2-826217	1	PHASE II IRM PUMP AND TREAT DESIGN MCP INTERNAL WIRING DIAGRAM
H-2-826218	4	200-ZP-1 PHASE II IRM PUMP AND TREAT DESIGN MCP INTERNAL WIRING DIAGRAM
H-2-826219	3	200-ZP-1 PHASE II IRM PUMP AND TREAT DESIGN MCP INTERNAL WIRING DIAGRAM
H-2-826220	2	200-ZP-1 PHASE II IRM PUMP AND TREAT DESIGN MCP INTERNAL WIRING DIAGRAM

Table A-1. 200-ZP-1 Operable Unit Design Drawings. (14 sheets)

H-2-826221	1	PHASE II IRM PUMP AND TEAT DESIGN MCP INTERNAL WIRING DIAGRAM
H-2-826222	1	PHASE II IRM PUMP AND TREAT DESIGN MCP INTERNAL WIRING DIAGRAM
H-2-826223	1	EXTRACTION MANIFOLD BUILDING NUMBER 2 FOUNDATION PLAN AND DETAILS
H-2-826224	1	PHASE III IRM PUMP AND TREAT DESIGN ELECTRICAL POLE MAP AND SITE PLAN
H-2-826225	2	PHASE III IRM PUMP AND TREAT DESIGN TAKEOFF AND ANGLE POLE SECTION DETAILS
H-2-826226	1	PHASE III IRM PUMP AND TREAT DESIGN TANGENT POLE SECTIONS AND DETAIL
H-2-826227	1	TRANSFORMER POLE SECTION DETAILS
H-2-826228	1	PHASE III IRM PUMP AND TREAT DESIGN DOWN GUY ASSEMBLY SAG AND TENSION TABLES
H-2-826229	1	PHASE III IRM PUMP AND TREAT DESIGN ELECTRICAL METERING AND GROUNDING DETAIL
H-2-826230	3	200 WEST AREA 200-ZP-1 PHASE III IRM EXTRACTION DESIGN ELECTRICAL SITE PLAN
	4	200 WEST AREA ZP-1 PUMP AND TREAT ELECTRICAL SITE PLAN
H-2-826231	4	200-ZP-1 PHASE III IRM PUMP & TREAT DESIGN EXTRACTION WELL MANIFOLD BUILDING #2 ELECTRICAL ONE LINE DIAGRAM
	5	ZP-1 PUMP AND TREAT EXTRACTION MANIFOLD BUILDING #2 ELECTRICAL ONE-LINE DIAGRAM
	6	ZP-1 PUMP AND TREAT EXTRACTION MANIFOLD BUILDING #2 ELECTRICAL ONE-LINE DIAGRAM
	7	ZP-1 PUMP AND TREAT EXTRACTION MANIFOLD BUILDING #2 ELECTRICAL ONE-LINE DIAGRAM
	8	ZP-1 PUMP AND TREAT EXTRACTION MANIFOLD BUILDING #2 ELECTRICAL ONE-LINE DIAGRAM
H-2-826232	1	PHASE III IRM PUMP & TREAT DESIGN EXTRACTION WELL MANIFOLD BUILDING # 2 ELECTRICAL AND GROUNDING PLANS
	2	ZP-1 PUMP AND TREAT EXTRACTION MANIFOLD BUILDING #2 ELECTRICAL AND GROUNDING PLAN
H-2-826233	2	200-ZP-1 PHASE III IRM PUMP & TREAT DESIGN EXTRACTION WELL MANIFOLD BUILDING #2 ELECTRICAL PANEL SCHEDULE

Table A-1. 200-ZP-1 Operable Unit Design Drawings. (14 sheets)

	3	ZP-1 PUMP AND TREAT EXTRACTION MANIFOLD BUILDING #2 ELECTRICAL PANEL SCHEDULE
	4	ZP-1 PUMP AND TREAT EXTRACTION MANIFOLD BUILDING #2 ELECTRICAL PANEL SCHEDULE
H-2-826234	3	200 WEST AREA 200-ZP-1 PHASE III IRM PUMP AND TREAT DESIGN EXTRACTION WELL ELECTRICAL DETAILS
	4	200 WEST AREA ZP-1 PUMP AND TREAT EXTRACTION WELL ELECTRICAL DETAILS
	5	200 WEST AREA ZP-1 PUMP AND TREAT EXTRACTION WELL ELECTRICAL DETAILS
H-2-826235	2	PHASE III IRM PUMP & TREAT DESIGN INJECTION WELL ELECTRICAL DETAILS
	3	200 WEST 200-ZP-1 PUMP AND TREAT ELECTRICAL DETAILS
H-2-826236	4	200-ZP-1 PHASE III IRM PUMP AND TREAT DESIGN ELECTRICAL DUCT SCHEDULES
	5	200 WEST AREA ZP-1 PUMP AND TREAT ELECTRICAL DUCT SCHEDULES
H-2-826237	1	PHASE III IRM PUMP & TREAT DESIGN ELECTRICAL DUCT SECTIONS
	2	200 WEST AREA ZP-1 PUMP AND TREAT ELECTRICAL DUCT SECTIONS
H-2-826238	2	PHASE III IRM PUMP & TREAT DESIGN ELECTRICAL DUCT SECTIONS
H-2-826245	4	200 WEST AREA 200-ZP-1 PHASE III IRM PUMP & TREAT DESIGN EXTRACTION WELL MANIFOLD BUILDING NUMBER 2 PIPING
	5	200 WEST AREA 200-ZP-1 PUMP AND TREAT MANIFOLD BLDG # 2 PIPING
H-2-826246	2	PHASE III IRM PUMP & TREAT DESIGN INJECTION WELLS ELECTRICAL SITE PLAN
H-2-826247	2	PHASE III IRM PUMP & TREAT DESIGN INJECTION WELLS INSTRUMENTATION SITE PLAN
H-2-826248	3	PHASE III IRM PUMP AND TREAT DESIGN MECHANICAL INJECTION SITE PLAN
H-2-826249	1	PHASE III IRM PUMP AND TREAT DESIGN DRAWING AND SPECIFICATION INDEX
H-2-826250	1	PHASE III IRM PUMP & TREAT DESIGN EXTRACTION WELL MANIFOLD BUILDING NUMBER 2 INSTRUMENT LOCATION
	2	200 WEST AREA 200-ZP-1 PUMP AND TREAT MANIFOLD BLDG #2 ISOMETRIC

Table A-1. 200-ZP-1 Operable Unit Design Drawings. (14 sheets)

H-2-826251	3	200-ZP-1 PHASE III IRM PUMP AND TREAT DESIGN MECHANICAL EXTRACTION SITE PLAN
	4	200 WEST AREA ZP-1 PUMP AND TREAT MECHANICAL SITE PLAN
H-2-826252	2	PHASE III IRM PUMP & TREAT DESIGN ELECTRICAL DUCT SCHEDULES
H-2-826254	3	200 WEST AREA 200-ZP-1 PHASE III IRM PUMP AND TREAT DESIGN EXTRACTION WELL INSTRUMENT SITE PLAN
	4	200 WEST AREA ZP-1 PUMP AND TREAT INSTRUMENTATION SITE PLAN
H-2-826269	3	PHASE III IRM EXTRACTION DESIGN SIXTRAK INSTRUMENT WIRING DIAGRAM - CC2A CABINET
H-2-826270	2	PHASE III IRM EXTRACTION DESIGN SIXTRAK INSTRUMENT WIRING DIAGRAM - CC1A CABINET
H-2-826271	2	PHASE III IRM EXTRACTION DESIGN SIXTRAK SYSTEM AND LOCATION DIAGRAM
H-2-826275	0	PHASE II IRM EXTRACTION DESIGN GAC CANISTER PLATFORM
H-2-826276	0	PHASE II IRM EXTRACTION DESIGN GAC CANISTER PLATFORM DETAILS
H-2-826277	5	PHASE II IRM ZP-1 PROGRAMMABLE LOGIC CONTROLLER (PLC)
H-2-827256	3	PHASE III IRM EXTRACTION DESIGN SIXTRAK INSTRUMENT WIRING DIAGRAM - CC2A CABINET
	4	200 WEST AREA ZP-1 PUMP AND TREAT SIXTRAX INSTRUMENT WIRING DIAGRAM - CC2A
H-2-827257	2	200 WEST AREA 200-ZP-1 PHASE III IRM EXTRACTION DESIGN SIXTRAK INSTRUMENT WIRING DIAGRAM - CC1A CABINET
H-2-827404	0	200-ZP-1 GAC PLATFORM PLAN DETAILS & SECTIONS
H-2-827405	0	200-ZP-1 GAC PLATFORM PLAN DETAILS & SECTIONS

APPENDIX B

PLATE MAP SHOWING GROUNDWATER CONTAMINANT CONTOURS

This page intentionally left blank.

200-UP-1 and 200-ZP-1 Monitoring Network

- Existing CERCLA/AEA Monitoring Well
- Existing Extraction Well
- ETF Extraction Well
- New Monitoring Well
- New Monitoring Well At Known Coordinates
- RCRA Monitoring Well
- CERCLA/AEA and RCRA Monitoring Well
- Key Wells Used for Detailed Geochemical and Geotechnical Evaluation and Aquifer Testing
- Additional Well Used to Support Risk Evaluation
- Associated Waste Site
- Other Waste Site
- Operable Unit Boundary

2006 Sample Data

- Chromium Concentrations 100 ug/L
- Carbon Tetrachloride Concentrations 5 and 2000 ug/L
- Iodine-129 Concentrations 1 pCi/L
- Nitrate Concentrations 20 mg/L
- Strontium 90 Concentrations 8 pCi/L
- Technetium-99 Concentrations 900 pCi/L
- Trichloroethylene Concentrations 5 ug/L
- Tritium Concentrations 20,000 pCi/L
- Uranium Concentrations 30 pCi/L

N W E S

0 200 400 600 800 1,000 Meters

0 1,000 2,000 3,000 Feet

Prepared for:
US DEPARTMENT OF ENERGY
RICHLAND OPERATIONS OFFICE

Created and Published by: Central Mapping Services
Fluor Hanford, Richland, WA (509) 373-9076

INTENDED USE: REFERENCE ONLY
Projection: Lambert Conformal Conic
Coordinate System: Washington State Plane, South, Meters
Horizontal Datum: NAD83
Vertical Datum: NAVD88

O:\Projects\2004\Wells\040511_up1zp1MonitoringWells_Byrnes\Maps\060304_zp1up1RiskEvaluationSupportNonOUO_56x42_Rev4.mxd - 3/19/2008 @ 12:45:16 PM

DISTRIBUTION

Onsite

5	U.S. Department of Energy Richland Operations Office		
	DOE Public Reading Room		H2-53
	B. L. Charboneau		A6-38
	J. G. Morse		A6-38
	K. M. Thompson		A6-38
	A. C. Tortoso		A6-38
19	Fluor Hanford, Inc.		
	B. A. Austin		E6-44
	M. A. Baechler		E6-35
	M. E. Byrnes		E6-35
	S. H. Crow		R3-19
	D. B. Erb		E6-35
	B. H. Ford		E6-35
	S. J. Giamberardini		E6-35
	K. M. Hodgson		S0-01
	S. L. Kooiker		R3-19
	R. W. Oldham		E6-35
	S. W. Petersen	(3)	E6-44
	C. L. Rambo		E6-35
	J. G. Riddelle		E6-35
	B. L. Sasser		S0-01
	L. C. Swanson		E6-35
	J. D. Williams		E6-35
	R. W. Whitlock		E6-35
1	Lockheed Martin Services, Inc.		
	Document Processing Center		H6-08
1	Pacific Northwest National Laboratory		
	Hanford Technical Library		P8-55

This page intentionally left blank.