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Draft A

Remedial Investigation/ Feasibility Study Report for the 300-FF-5 Operable Unit

United States
Department of Energy
Richland, Washington

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DISCLM-4.CHP (1-91)

9513333.1217

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EXECUTIVE SUMMARY

INTRODUCTION

This report is the Final Remedial Investigation/Feasibility Study (RI/FS) report for the 300-FF-5 Operable Unit. The 300-FF-5 Operable Unit addresses the groundwater, contaminated saturated soils, river sediments, and river contamination associated with the 300 Area National Priorities List (NPL) site at the U.S. Department of Energy (DOE) Hanford Site, located in Washington State. This RI/FS is being performed to characterize the nature and extent of contamination, assess risks to human health and the environment, and develop and evaluate alternatives for remediation of contamination in the 300-FF-5 Operable Unit that has resulted from 300 Area operations. Remediation goals for this operable unit do not include remediation of contaminants migrating into the operable unit from sources outside the 300 Area. These efforts are consistent with the statutory requirements of the *Comprehensive Environmental Response, Compensation and Liability Act of 1980* (CERCLA), the regulatory requirements of the National Oil and Hazardous Substances Contingency Plan (NCP) (40 CFR 300), and the Hanford Federal Facility Agreement and Consent Order (Tri-Party Agreement) (Ecology et al. 1994), which was negotiated and approved by the DOE, the U.S. Environmental Protection Agency (EPA), and the Washington State Department of Ecology (Ecology). This RI/FS will be used by the Tri-Party Agreement signatories to make a risk management-based selection of remedies for the contamination exceeding the remedial action objectives in the groundwater aquifer, shoreline saturated sediments, and river within the boundaries of the operable unit.

The Phase I RI (DOE-RL 1994d) and the Phase I/II FS (DOE-RL 1994e) have been conducted, and reports have been finalized. The Phase I RI obtained and evaluated data from the first four of seven groundwater monitoring periods and one Columbia River surface water and sediment sampling event. In addition, the Phase I RI evaluated vadose zone soil analytical data and biotic analytical data. The Final RI included herein presents additional data from groundwater sampling rounds 5, 6, and 7 and a second Columbia River sampling event. The RI portions of this report supplement to the Phase I RI report and present additional RI data and associated changes to the evaluations, and risk assessments conducted during the Phase I RI and reported in DOE-RL (1994d). These additional data and evaluations have confirmed the main conclusions and results of the Phase I RI; no fundamental changes to the risk assessment of the Phase I RI have resulted.

The Phase I/II FS (DOE-RL 1994e) consisted of establishing Remedial Action Objectives (RAOs), identifying general response actions, estimating areas and volumes of contamination, and identifying and screening remediation technologies. The technologies retained after screening were assembled into alternatives for remediating the operable unit, and these alternatives were screened to produce a manageable list of alternatives for detailed consideration. This Final FS combines the results of the Phase I/II FS with detailed evaluation and development of alternatives. The alternatives are evaluated using criteria specified in the NCP. The results of the detailed evaluation of alternatives are used by the decision makers to select a preferred remedy for the operable unit.

REMEDIAL INVESTIGATION (RI)

Following are the major conclusions of the Phase I RI.

- Groundwater in the 300-FF-5 Operable Unit is contaminated above maximum contaminant levels (MCLs) (40 CFR 141). 300-FF-5 Operable Unit-derived compounds that exceed MCLs include dichloroethene (DCE), trichloroethene (TCE), nickel, uranium, and coliform bacteria. Coliform bacteria is not considered a contaminant of potential concern because current plans to connect to the city of Richland sewer system will eliminate the source; natural degredation will account for coliform remaining in the system. Uncertainty exists regarding the future levels of these compounds, specifically, predicted concentrations and the length of time required for the contaminants to reach acceptable levels, particularly TCE, DCE, and uranium. For uranium, this uncertainty was related to three factors: (1) uncertainty as to whether uranium migration was dominated by a solubility-controlled release mechanism or a sorption-controlled release mechanism, (2) uncertainty with regard to the uranium distribution coefficient (K_d) value, and (3) uncertainty with regard to the average linear velocity of groundwater. For DCE/TCE, the uncertainty was related to difficulty in characterizing the source of the two compounds in the unconfined aquifer. These factors resulted in uncertainty as to whether the compounds would reach acceptable levels in the unconfined aquifer by the year 2018, the first year the current institutional controls might be relaxed by the DOE for the Hanford Site. The year 2018 is specified in Ecology et al. (1994) as the year in which remedial actions for all operable units on the Hanford Site will be completed.

- Current risks were estimated for industrial exposure to groundwater in the 300 Area and for residential, agricultural, recreational, and industrial exposure to surface water (using average river water contaminant concentrations) off the Hanford Site. The only current human health risk above acceptable levels for the operable unit is the cancer risk estimated for industrial use of groundwater from well 399-4-12 (2×10^{-5}) This estimated risk, however, primarily results from inhalation of chloroform that occurs at concentrations considered acceptable for municipal water supply systems. Chloroform in 300 Area groundwater is expected to be remedied when the 300 Area sanitary sewer is connected to the city of Richland sewer system, which is planned for completion by the end of 1994. If chloroform is not included in the risk assessment, the estimated risk is reduced to 1×10^{-6}. This risk value assumes exposures to river contaminant concentrations reported for water from the 300 Area river intake that are expected to be characteristic of average conditions. Use of maximum river concentrations associated with extreme low flow periods in the Columbia River results in a cancer risk of 5×10^{-6} for the industrial scenario with receptors in the 300 Area.

- Future risks were estimated for industrial exposure to groundwater in the 300 Area, for industrial, residential, recreational, and agricultural exposure to surface water at the 300 Area for the Hanford Site, for industrial, residential, recreational, and agricultural exposure to surface water off the Hanford Site, and for residential, recreational, and agricultural exposure to biota both on and off the Hanford Site. For the future human health risk assessment scenarios, the only scenario that poses a potentially unacceptable risk is the industrial scenario with receptors in the 300 Area.

Approximately half of this risk results from tritium from the 200 Area. By excluding tritium (which is below MCL in 300 Area groundwater) the risk drops to an incremental cancer risk (ICR) of 3×10^{-6} and is attributable to TCE. This is based on the conservative assumption that the current TCE concentrations will remain constant beyond 2018. If the TCE concentrations decrease before 2018, the risk will be less.

- The ecological risk assessment identified a potentially unacceptable risk from three metals: manganese, copper, and nickel. Manganese is estimated to pose a potential risk to birds. Copper and nickel pose a potential risk to aquatic organisms. There was considerable uncertainty in the Phase I RI, however, with respect to the source terms, rates of contaminant uptake, frequency of site use, and other items that were assumed in the risk assessment. For the river, no dilution of the groundwater source terms was considered. The reported risks are therefore considered to represent bounding estimates that probably overestimate the real risk because of the conservative exposure scenarios employed. Reevaluation of the risk conclusions was recommended in light of the limited data set and conservative assumptions on which the ecological risk assessment was conducted.

To address these issues and uncertainties, additional work was proposed in order to complete the RI, including the following:

- **Additional Columbia River sampling to determine average concentrations of 300-FF-5 contaminants of concern in the river.** Because the low river stages occur infrequently and do not represent a time-weighted average exposure, it was deemed appropriate to gather additional river data adjacent to the operable unit to better understand the human and ecological risks associated with surface water pathways.

- **Continued monitoring of the TCE/DCE contamination in groundwater.** Because of the uncertainty in future DCE/TCE levels in groundwater, continued monitoring of the TCE/DCE plumes was recommended to better understand trends in the concentrations of the two compounds and to facilitate predictions of future concentrations.

- **Refinement of the current understanding of the fate and transport of uranium in the groundwater**. Uncertainty in the understanding of the fate and transport of uranium in the unconfined aquifer led to difficulty in making predictions of future uranium concentrations in groundwater and the time required for uranium to reach acceptable levels. To reduce this uncertainty, additional work was recommended, including uranium analyses on filtered and unfiltered split samples to better understand the representativeness of the unfiltered monitoring data and the transport mode of uranium in the unconfined aquifer; a determination of whether a solid phase uranium precipitate in the unconfined aquifer serves as a source of uranium to groundwater; and a refinement of the current estimates of the range of likely uranium K_d values.

The additional work was conducted as part of the Supplemental RI. The Supplemental RI also included three additional rounds of groundwater sampling at selected 300-FF-5 Operable Unit wells. These three rounds (5, 6, and 7) constitute the final rounds of sampling used in this RI/FS.

Based on the evaluations presented in Chapter 4.0 of this report, the following primary conclusions result from the Supplemental RI work:

- **DCE/TCE Trends in the Unconfined Aquifer.** Based on observed data trends, TCE levels have declined to concentrations very near the MCL in a number of wells and may soon fall below the MCL throughout the operable unit. DCE levels, however, appear relatively constant at concentrations above the MCL. Based on these trends, DCE can be expected to remain in the unconfined aquifer at levels above the MCL for an undetermined period of time. The MCL for the two compounds is exceeded only in a very limited area in the vicinity of well 399-1-16B.

- **Filtered vs Unfiltered Uranium Analyses.** The results of uranium analyses on filtered and unfiltered split samples indicate that no significant difference results from filtering. Filtered and unfiltered samples yielded nearly identical total uranium concentrations. This results from either low suspended solids levels in the collected samples or low sorption of uranium to any solids present. Uranium analytical results for unfiltered samples (on which the Baseline Risk Assessment is based) are therefore representative of groundwater conditions in the operable unit.

- **Sorption - Controlled Release Mechanism.** Significant reductions in uranium concentrations have been observed at several wells located along the upgradient perimeter of the uranium plume. These wells are located near a possible location of a solid phase source of uranium in the unconfined aquifer (i.e., in and around the 316-5 process trenches [Figure 1-3]). The reductions are, however, more probably related to the removal and isolation of contaminated sediments at the process trenches during the ERA, which eliminated a primary source of uranium within the vadose zone to the groundwater and to the fact that the uranium plume is associated with the highly transmissive Hanford formation and is rapidly flushed from the unconfined aquifer. These rapid declines in concentration provide evidence that a significant source is not present; however, round 7 data show slight increases in uranium concentrations in some wells that may indicate the presence of uranium in the soils immediately above the average water table level in the area. Fluctuating concentrations in these wells appear related to variations in river stage and tend to support this hypothesis. Uranium migration appears to be controlled by a sorption-controlled release mechanism, as was assumed in uranium migration calculations presented herein and in the Phase I RI report (DOE-RL 1994d).

- **Refinement of the Estimates Regarding Time Required for Uranium to Reach Acceptable Levels.** There was considerable uncertainty in the Phase I RI with respect to future uranium concentrations in groundwater. Evaluations included in this report present refinements to the Phase I RI understanding of the issues that resulted in this uncertainty, allowing for better estimates of the time required for uranium concentrations to reach remediation goals. The best estimate of time required for uranium levels to reach remediation goals (proposed MCL of 20 μg/L) in the unconfined aquifer is approximately 3 to 10 years from late 1993. This compares to estimates in the Phase I RI that suggested uranium levels may still exceed the 20 μg/L level at 2018, the first year the DOE might relax the current institutional controls on groundwater use.

- **Baseline Risk Assessment.** Based on the Supplemental RI data and the data screening conducted, no significant changes resulted to the human health risk assessment, and the conclusions of the baseline risk assessment presented in the Phase I RI were confirmed.

With respect to the ecological risk assessment, further evaluation of the groundwater data collected during the seven rounds of RI sampling have indicated that the three metals (manganese, nickel, and copper) identified in the Phase I RI as potentially posing an unacceptable ecological risk can be eliminated from the risk assessment. The metals are eliminated because they either are present below background in the groundwater or do not exceed their chronic Lowest Observable Effect Level (LOEL) in river springs and in the river. Therefore, there are no compounds associated with the operable unit deemed to pose potentially unacceptable risks to ecologic health.

FEASIBILITY STUDY

The purpose of this FS is to further develop, screen, and evaluate the list of alternatives for remediation of the 300-FF-5 Operable Unit that was assembled and presented in the Phase I/II FS Report (DOE-RL 1994e). The alternatives remaining after screening provide a range of response actions for remediation. This FS represents a primary document as defined by the Tri-Party Agreement. The signatories of the Tri-Party Agreement will use this FS as the basis for selecting a remedy for the 300-FF-5 Operable Unit to mitigate potential risk to human health and the environment.

Remedial Action Objectives

The following remedial action objectives were identified for the 300-FF-5 Operable Unit for the protection of human health. No ecological contaminants of concern were identified; therefore, ecological risk was not included in the development of RAOs.

- Limit current human exposure to contaminated groundwater in the 300-FF-5 Operable Unit.
- Achieve acceptable contaminant concentrations in groundwater by the year 2018.
- Comply with Applicable or Relevant and Appropriate Requirements (ARARs) to the maximum extent practical.

Potential ARARs for determining remediation goals include the Federal Primary Drinking Water (40 CFR 141) MCLs, State Surface Water Quality Standards (WAC 173-201A) and the State Model Toxics Control Act (MTCA, WAC 173-340). The selection of a remedy will depend on the applicability of these regulations to remediation of the 300-FF-5 Operable Unit. Of the three MTCA cleanup levels (Methods A, B, and C), MTCA Method C (industrial) cleanup levels for groundwater are considered most appropriate for the 300-FF-5 Operable Unit because a future industrial scenario is being assumed for the 300 Area.

Remedial action objectives for the 300-FF-5 Operable Unit do not include remediation of contaminants migrating from sources outside the 300 Area. Two upgradient contaminant plumes are

affecting the operable unit: a tritium plume from the northwest, and a plume from the southwest that contains technetium and nitrate. Remediation of these plumes will be covered under feasibility studies for other operable units at the Hanford Site. In addition, the remedy selected for remediation of the 1100-EM-1 Operable Unit groundwater, which includes the technetium/nitrate plume, is natural attenuation with monitoring (Ecology et al. 1993). It is considered a sufficient remedy for the portion of the plume in the 300-FF-5 Operable Unit as well. Remediation of tritium in groundwater is not technically feasible at this time. Therefore, these plumes are addressed only to the extent that they affect remediation of target contaminants from the 300 Area.

Remediation Goals

The remediation goals proposed for the 300-FF-5 Operable Unit represent the maximum acceptable concentration of a contaminant of concern to which human or ecological receptors would be exposed. Remediation goals are generally established for contaminants of concern as the lower of a numeric chemical-specific ARAR or risk-based concentration. The contaminants of concern for the 300-FF-5 Operable Unit include uranium, nickel, TCE, and DCE. The MCLs are proposed as remediation goals for each of these contaminants. Uranium is by far the most extensive contaminant. Nickel, TCE, and DCE are only above MCLs in the vicinity of one well cluster location (399-1-16). Attainment of remediation goals would allow use of site groundwater under an industrial scenario.

Development of Remedial Alternatives

To assemble remediation alternatives, a list of potentially applicable technologies was developed and screened in the Phase I/II FS Report (DOE-RL 1994e). These technologies were screened (considering site conditions and contaminants of concern) based on effectiveness, implementability, and cost. The retained technologies were then assembled into a wide range of alternatives for remediation of the 300-FF-5 Operable Unit.

A range of alternatives was developed that includes no action (required under the NCP), limited action (e.g., institutional controls), containment, and treatment to remove contaminants from the site for landfill disposal. To address various degrees of active remediation, two categories of active remedial alternatives were developed: "extensive" alternatives and "selective" alternatives.

- "Extensive" remediation refers to the greatest extent of active remediation that would be performed.

- "Selective" remediation refers to active remediation of the most contaminated areas, allowing natural aquifer flushing of remaining contaminated areas.

The following initial list of alternatives was assembled for the 300-FF-5 Operable Unit in the Phase I/II FS Report (DOE-RL 1994e):

Alternative 1:	No Action
Alternative 2:	Institutional Controls
Alternative 3:	Selective Hydraulic Containment
Alternative 4:	Selective Hydraulic Containment with In-Situ Flushing
Alternative 5:	Extensive Hydraulic Containment
Alternative 6:	Extensive Hydraulic Containment with Selective In-Situ Flushing

Alternative 7:	Selective Slurry Wall Containment
Alternative 8:	Selective Slurry Wall Containment with Minimal Extraction
Alternative 9:	Selective Slurry Wall Containment with In-Situ Flushing
Alternative 10:	Extensive Slurry Wall Containment
Alternative 11:	Extensive Slurry Wall Containment with Minimal Extraction
Alternative 12:	Extensive Slurry Wall Containment with Selective In-Situ Flushing
Alternative 13:	Selective Hydraulic Containment with a River Cutoff Wall
Alternative 14:	Selective In-Situ Flushing with a River Cutoff Wall
Alternative 15:	Selective Aquifer Dredging
Alternative 16:	Extensive Aquifer Dredging.

The alternatives were screened based on effectiveness, implementability, and cost to derive a reduced list for detailed evaluation in this FS. The following alternatives remained after screening.

Alternative 1: (A)*: No Action. Assumes current institutional controls would be lost. Monitoring of groundwater and surface water would be continued to verify the effectiveness of this remedy (i.e., the exported decrease in contaminants).

Alternative 2: (B)*: Institutional Controls. Current institutional controls would be continued and expanded to prevent human exposure to groundwater contamination. Monitoring of groundwater and surface water would be continued. Deed and groundwater use restrictions would be instituted.

Alternative 3: (C)*: Selective Hydraulic Containment. Groundwater extraction and treatment would be conducted in the portion of the uranium plume containing the highest concentrations. Treated groundwater would be discharged to the Columbia River. Treatment sludges would be disposed at the Environmental Restoration and Disposal Facility (ERDF).

Alternative 5: (D)*: Extensive Hydraulic Containment. This alternative is the same as Alternative C except that the entire uranium plume above MCLs will be extracted and treated. The groundwater extraction and treatment rates would be much greater than for Alternative C.

Alternative 8: (E)*: Selective Slurry Wall Containment with Minimal Extraction. Groundwater with the highest concentrations of uranium would be contained within a slurry wall. Minimal groundwater extraction would provide treatment and ensure that no contaminants escape. Extracted groundwater would be treated and discharged to the Columbia River, and treatment sludges would be disposed at the ERDF.

Alternative 11: (F)*: Extensive Slurry Wall Containment with Minimal Extraction. This alternative is the same as Alternative E except that the entire uranium plume above MCLs would be contained within the slurry wall. Groundwater extraction and treatment rates would be larger than for Alternative E.

*The Phase I/II FS Report used numeric designations for the alternatives. This FS re-assigned the retained alternatives with alphabetic designations and simplified the names of the alternatives.

Evaluation of the Alternatives

The retained alternatives (A through F) are evaluated in terms of the nine CERCLA and NCP [40 CFR 300.430(e)(a)] criteria:

- Overall protection of human health and the environment
- Compliance with ARARs
- Long-term effectiveness and permanence
- Reduction in toxicity, mobility, and volume
- Short-term effectiveness
- Implementability
- Cost
- State acceptance
- Community acceptance.

The FS evaluates the alternatives against the first seven criteria. The evaluation against the remaining two criteria, state and community acceptance, is based on state and public comments on the FS and the Proposed Plan and will be documented in the Record of Decision (ROD) for the operable unit.

The information to be used in selecting a preferred alternative is presented in this report for use by the decision makers. For this site, the decision makers are the signatories to the Tri-Party Agreement: DOE, EPA, and Ecology. Following review of this FS, DOE, EPA, and Ecology will prepare a proposed plan identifying the preferred alternative, which is provided with the FS for public review and comment. The final decision will be documented in the ROD for the operable unit.

The first two criteria, overall protection of human health and the environment and compliance with ARARs, are considered threshold criteria that must be met for an alternative to be selected, unless a waiver is obtained from the EPA. Alternative A, No Action, does not meet the overall protectiveness criterion, because this alternative could lose current institutional controls that protect humans from exposures to contaminated groundwater. Alternatives B through F all meet the "overall protection of human health and the environment" criterion. Alternatives B through F meet the second threshold criterion, "compliance with ARARs", but an alternative concentration limit (ACL) in accordance with CERCLA section 121(d)(2)(B)(ii) may need to be obtained for Alternatives B (Institution Controls), C (Selective Hydraulic Containment) and E (Selective Slurry Wall Containment). Under Alternatives B, C and E, groundwater containing contaminants above MCLs will be discharged to the Columbia River for an estimated 3 to 10 years. Although river sampling results representing average river concentrations do not indicate a human or environmental risk, the

MTCA (if an ARAR) requires that groundwater contaminant concentrations be below MCLs before discharge to surface water. This requirement will be met by all remediation alternatives within a reasonable time frame in accordance with WAC 173-340-360(6). Alternatives D (Extensive Hydraulic Containment) and F (Extensive Slurry Wall Containment) contain or intercept all groundwater above MCLs before discharge, with subsequent treatment of groundwater followed by disposal of treatment sludges in the ERDF.

Active remediation systems, particularly the hydraulic containment alternatives, may only be operational for a relatively short time before remediation goals are achieved. Active remediation of groundwater could not begin until after completion of (1) the alternative selection process, (2) necessary treatability studies, (3) final remedial design of the selected alternative, (4) selection of remediation contractors, and (5) construction of groundwater extraction and treatment systems. Because of the time required to complete all of these activities, active remediation would likely begin in the next 2 to 4 years. Given the results indicating that natural flushing may achieve remediation goals for uranium within 10 years, the benefits of installing and operating an active remediation system may be minimal. Impacts to workers and the environment associated with the active remedial systems may outweigh the benefit of the system. The costs for implementation and operations and maintenance for active remediation are high considering similar results would be achieved in an acceptable time frame by inexpensive natural actions.

The extent of remedial action (i.e., the remediation area) will significantly affect the implementability and cost of remediation alternatives. Any construction activity associated with remedial action will increase adverse ecological effects, by destroying habitat and disturbing wildlife and possibly cultural artifacts. The adverse effects of remedial action would be less with a smaller remediation area. A typical advantage of active remediation systems is that they accelerate cleanup and achieve remediation goals in less time than would occur naturally. For the 300-FF-5 Operable Unit, remediation goals will be achieved in the same time period for Alternatives A (No Action) and B (Institutional Controls) as for the hydraulic containment alternatives (C and D), and in a much shorter time period than the slurry wall containment alternatives (E and F). Final determinations of ARARs, particularly the applicability of the MTCA, is significant in determining the need for active remediation.

Estimated costs are presented in Table ES-1 for each alternative. Probabilistic cost analysis was performed for this FS (Appendix G), and shows high uncertainty in the cost estimates. However, the relative significance of the uncertainties varies depending on the alternatives being compared. The cost uncertainties are not highly significant when comparing alternatives with different degrees of active remediation (e.g., institutional controls vs. selective remediation vs. extensive remediation). However, there is significant uncertainty as to whether the slurry wall alternative would cost more or less than a hydraulic containment alternative for a given cleanup level.

The selection of the 300-FF-5 remedial action should consider the potential remedial actions at the 300-FF-1 and 300-FF-2 Operable Units to ensure compatibility and avoid overlap. Location of remedial systems for 300-FF-5, such as extraction and treatment systems or slurry walls, may impact potential remedial activities within the source operable units. Coordination of remedial efforts in the 300 Area would be accomplished via the management structure established for the 300 Area operable units.

Table ES-1. Summary of Estimated Costs for 300-FF-5 Remediation Alternatives.

Alternative		Table No.[a]	Estimated Costs (millions)[b]		
			Capital	Operating[c]	Total
A	No Action	G-1	$0.0	$0.9	$0.9
B	Institutional Controls	G-2	$0.1	$1.3	$1.4
C	Selective Hydraulic Containment	G-3	$7.9	$5.3	$13
D	Extensive Hydraulic Containment	G-3	$41	$19	$60
E	Selective Slurry Wall Containment	G-4	$17	$17	$34
F	Extensive Slurry Wall Containment	G-4	$77	$23	$100

[a] See Appendix G.
[b] Costs are for mid-1994.
[c] Net present value of operating and monitoring costs; assumes 5% interest (net of inflation); Estimated time periods for operations and monitoring are 6 years for Alternatives A through D, and 100 years for Alternatives E and F.

Conclusions

The current incremental cancer risk resulting from 300 Area groundwater is estimated to be acceptable, based on exposure to groundwater well 399-4-12 (the existing industrial well) and exposures to average Columbia River conditions. There is no unacceptable risk to human health or the environment provided direct exposure to contaminated groundwater is prevented. In addition, groundwater contamination resulting from 300 Area operations is expected to decrease below levels of concern by the year 2018, except for the possibility that nickel, TCE, and DCE could remain at concentrations slightly above their MCLs near one well cluster. Unlike many sites, where institutional controls would be required indefinitely, this site may require them for only a relatively short time. Institutional controls can be considered highly reliable as long as the Hanford Site remains under DOE jurisdiction (presumably until at least the year 2018). The negative aspects of the active remedial systems include worker safety and environmental effects during implementation and high costs for the realized benefit. The institutional controls alternative provides adequate protection of human health and the environment, limits short term effects to the workers and the environment, and achieves the same results in an acceptable time period at a fraction of the cost of active remediation. Therefore, it appears that Institutional Controls, Alternative B, deserves strong consideration during selection of a preferred alternative.

ACRONYMS

ACL	alternate concentration limit
ALE	Arid Lands Ecology Reserve
API	American Petroleum Institute
ARAR	applicable or relevant and appropriate requirement
ART	Alternative Remedial Technologies
BPA	Bonneville Power Administration
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
CFR	Code of Federal Regulations
CFU	colony forming units
CLP	Contract Laboratory Program
CQA	construction quality assurance
CsOPC	contaminants of potential concern
DCE	1,2-dichloroethene (total and trans)
DNAPL	dense nonaqueous phase liquid
DNR	Washington State Department of Natural Resources
DOE	United States Department of Energy
DOW	Washington State Department of Wildlife
DQO	Data Quality Objective
ECN	engineering change notice
Ecology	Washington State Department of Ecology
EMI	electromagnetic inductance
EPA	United States Environmental Protection Agency
ERA	Expedited Response Action
ERDF	Environmental Restoration Disposal Facility
FFTF	Fast Flux Test Facility
FS	feasibility study
GPR	ground penetrating radar
HCRL	Hanford Cultural Resources Laboratory
HEIS	Hanford Environmental Information System
HQ	hazard quotient
HRA-EIS	Hanford Remedial Action - Environmental Impact Statement
HSBRAM	Hanford Site Baseline Risk Assessment Methodology
ICP	inductively coupled plasma
ICR	incremental cancer risk
LICR	lifetime incremental cancer risk
LOEL	lowest observable effects level
MCL	maximum contaminant level
MSL	mean sea level
MTCA	Model Toxics Control Act
NAAQS	National Ambient Air Quality Standards
NCP	National Oil and Hazardous Substances Contingency Plan
NEPA	National Environmental Policy Act
NGVD	national geodetic vertical datum
NOEL	no observable effect level
NPL	National Priorities List

ACRONYMS (continued)

OSHA	Occupational Safety and Health Administration
PCB	polychlorinated biphenyls
PDF	probabilistic distribution function
PM-10	particulates less than 10 microns in diameter
PNL	Pacific Northwest Laboratory
PQL	practical quantification limit
PSD	Prevention of Significant Deterioration
PUD	public utility district
PUREX	Plutonium Uranium Extraction
QAPjP	Quality Assurance Project Plan
QC	Quality Control
RAO	remedial action objective
RCRA	Resource Conservation and Recovery Act
R&D	Research and Development
RI	remedial investigation
RL	Richland field office (of DOE)
ROD	Record of Decision
SARA	Superfund Amendments and Reauthorization Act
SDG	Sample Delivery Group
SRC	Syracuse Research Corporation
TAL	target analyte list
TBC	To Be Considered
TCE	trichloroethene (trichloroethylene)
TCLP	Toxicity Characteristic Leachate Procedure
TMA	Thermo Analytical
TOC	total organic carbon
TOX	total organic halogen
TPA	Tri-Party Agreement
TSP	total suspended particulates
USGS	United States Geological Survey
UTL	upper tolerance limit
VOA	volatile organic analysis
VOC	volatile organic compound
WAC	Washington Administrative Code
WHC	Westinghouse Hanford Company

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1.0 INTRODUCTION

The Hanford Site is owned and operated by the U.S. Department of Energy (DOE). The site is located in southcentral Washington State and is organized into numerically designated operational areas including the 100, 200, 300, 400, 600, 700, 1100, and 3000 Areas (Figure 1-1). In November 1989, the U.S. Environmental Protection Agency (EPA) placed the 300 Area (as well as other areas) on the National Priorities List (NPL) pursuant to the *Comprehensive Environmental Response, Compensation and Liability Act of 1980* (CERCLA), as amended by the *Superfund Amendments and Reauthorization Act of 1986* (SARA). The 300 Area has been divided into three operable units: 300-FF-1, 300-FF-2, and 300-FF-5. Four former operable units, 300-FF-2, 300-FF-3, 300-FF-4, and 300-IU-1 were consolidated into the 300-FF-2 Operable Unit. The 300-FF-5 Operable Unit, the subject of this remedial investigation/feasibility study (RI/FS), covers groundwater, contaminated saturated soils, river sediments, and river contamination within the 300 Area of the Hanford Site. The 300-FF-1 Operable Unit covers waste and contaminated vadose zone soils for the major liquid waste disposal units in the 300 Area. The 300-FF-2 Operable Unit covers waste and contaminated vadose soils in the remainder of the 300 Area, in all of the 400 Area, and in selected portions of the 600 Area. The 300-FF-2 Operable Unit also includes groundwater beneath the 400 Area and selected portions of the 600 Area.

1.1 BACKGROUND

The Hanford Site is a 1,450-km^2 (560-mi^2) tract of land located along the Columbia River in southeastern Washington and covers portions of Benton, Grant, Franklin, and Adams Counties (Figure 1-1). The Hanford Site is located approximately 280 km (174 mi) southeast of Seattle and 210 km (130 mi) southwest of Spokane. Operated by the Federal Government since 1943, the primary mission of the Hanford Site has been nuclear energy research and development and plutonium production for military use.

Initial construction at the 300 Area fuels fabrication complex was completed in 1943. The location of the 300 Area is presented in Figure 1-1. Most of the facilities in the area were involved in the fabrication of nuclear reactor fuel elements. In addition to the fuel manufacturing processes, many technical support, service support, and research and development activities related to fuels fabrication were carried out in the 300 Area. In the early 1950's, construction began in the 300 Area on the research and development facilities known as the Hanford Laboratories. As the Hanford Site production reactors shut down, fuel fabrication activities in the 300 Area ceased and research and development activities increased. Current research and development activities focus on peaceful uses of plutonium, reactor fuels development, liquid metal technology, fast-flux test facility support, gas-cooled reactor development, life science research, and environmental restoration technologies.

In accordance with the National Oil and Hazardous Substances Contingency Plan (NCP), the RI/FS is being performed for the 300-FF-5 groundwater operable unit to characterize the nature and extent of contamination left as a result of historical activities, assess risks to human health and the environment, and develop and evaluate remediation alternatives. The location of the 300-FF-5 Operable Unit with respect to the overlying 300-FF-1 and 300-FF-2 Operable Units is presented in Figures 1-2 and 1-3. These efforts are covered by the Hanford Federal Facility Agreement and Consent Order (Tri-Party Agreement) (Ecology et al. 1994), which was negotiated and approved by the DOE, the EPA, and the State of Washington Department of Ecology (Ecology)

in May 1989. This agreement governs all CERCLA efforts at the Hanford Site. It also governs RCRA, as well as other actions.

Several reports have been completed that provide information relevant to this 300-FF-5 RI/FS. Following are some of the more significant:

- RI/FS Work Plan for the 300-FF-5 Operable Unit (DOE-RL 1990c).
- 300-FF-5 Phase I RI Report (DOE-RL 1994d). All references to "Phase I RI" herein refer to the Phase I Remedial Investigation Report prepared for the 300-FF-5 Operable Unit, unless specifically identified otherwise.
- 300-FF-5 Phase I/II Feasibility Study Report (DOE-RL 1994e). All references to the "Phase I/II FS" herein refer to the Phase I/II Feasibility Study Report prepared for the 300-FF-5 Operable Unit, unless specifically identified otherwise.
- 300-FF-1 Remedial Investigation Report (DOE-RL 1993c).
- 300-FF-1 Feasibility Study Report (DOE-RL 1994f).
- RI/FS Work Plan for the 300-FF-2 Operable Unit (in progress) (DOE-RL 1994h).

1.2 PURPOSE

The purpose of the 300-FF-5 Operable Unit RI is to gather and develop the necessary information to assess the nature and extent of contamination in operable unit environmental media, to understand the associated risks posed to human health and the environment, and to support the development and evaluation of remedial alternatives during the FS. The RI/FS analysis will, in turn, be used by Tri-Party Agreement signatories to make a risk management-based selection of remedies for the contamination in the groundwater aquifer and shoreline saturated sediments within the boundaries of the 300-FF-5 Operable Unit. This report is consistent with the statutory requirements of CERCLA, the regulatory requirements of the NCP, and the Tri-Party Agreement.

1.3 OVERVIEW OF THE REMEDIAL INVESTIGATION/FEASIBILITY STUDY PROCESS

In accordance with EPA guidance (EPA 1988b), an RI/FS is generally conducted in the following steps:

<u>RI Process</u>

1. Use of the Data Quality Objective (DQO) process to develop and implement an RI program.
2. Presentation and evaluation of RI data.

3. Evaluation of the physical, ecological, and social setting. This evaluation uses data obtained during the RI and other available information.

4. Determination of the nature and extent of contaminated media.

5. Estimation of the future fate and transport of contamination.

6. Evaluation of risks for human and ecological exposure to contamination and establishment of the baseline risk assessment.

FS Process

7. Establishment of remedial action objectives (RAOs) (cleanup goals) for contaminants and media of interest. These objectives are developed based on the findings of the baseline risk assessment and applicable or relevant and appropriate requirements (ARARs).

8. Identification of the applicable general response actions (e.g., containment, removal, and treatment).

9. Estimation of the areas and volumes of contaminated media that exceed remedial action objectives based on information developed during the RI.

10. Identification and screening of potentially applicable technologies for each contaminated medium to obtain a set of technologies feasible for use in achieving RAOs.

11. Assembly of retained technologies into remediation alternatives that cover the full range of possible response actions. The alternatives are then screened based on effectiveness, implementability, and cost to eliminate alternatives that are impractical, not feasible, or too costly relative to the other alternatives.

12. Further development and detailed evaluation of the alternatives to support selection of a remedy for the operable unit.

The RI and FS has been conducted in phases. Phase I of the RI has been conducted, and the report has been finalized. The Phase I RI obtained and evaluated data from the first four groundwater monitoring periods and one Columbia River surface water and sediment sampling event. This RI/FS report includes additional data from groundwater monitoring rounds 5, 6, and 7 and a second Columbia River water sampling event. The RI portions of this report supplement the Phase I RI report and present additional RI data and changes to the, evaluations, and risk assessments that were conducted during the Phase I RI. The Phase I/II FS report for the 300-FF-5 Operable Unit (DOE-RL 1994e) has been completed and finalized. The Phase I/II FS consisted of steps 7 through 11 (outlined above).

The FS in this report combines the results of the first two FS phases with step 12, development and detailed evaluation of alternatives. Any changes to the results and conclusions of

the Phase I/II FS that are necessary with regard to additional RI data are provided in this FS. In this FS, the alternatives are evaluated using criteria in the NCP (40 CFR 300.430):

- Overall protection of human health and the environment
- Compliance with ARARs
- Long-term effectiveness
- Reduction in toxicity, mobility, and volume
- Short-term effectiveness
- Implementability
- Cost.

The first two criteria are considered "threshold" criteria that an alternative must meet to be acceptable. The remaining five criteria are the primary criteria used in comparative evaluation of alternatives. The results of the evaluation of alternatives are used by the decision makers to select a preferred remedy for the operable unit. The proposed remedy and basis for its selection are presented in a Proposed Plan. Two additional selection criteria, state acceptance and community acceptance, are determined based on comments received on the Proposed Plan. The final remedy selection is then made and promulgated in a Record of Decision (ROD).

1.4 NATIONAL ENVIRONMENTAL POLICY ACT INTEGRATION

In accordance with the DOE Secretarial Policy on the National Environmental Policy Act (NEPA) (June 1994), DOE CERCLA documents are to incorporate NEPA values to the extent practicable and make CERCLA documents available to the public as early as possible. NEPA was established to insure that environmental resources are provided adequate consideration along with economic and technical considerations in decision making. The Council on Environmental Quality NEPA implementing regulations codified in 40 CFR 1500 through 1508 prescribe the recommended format for an environmental impact statement (EIS). The primary purpose of a NEPA EIS is to insure that decision-makers and the public are informed of the anticipated environmental impacts of the proposed action and alternatives. Therefore, the scope of this document has been expanded to provide substantive NEPA values not normally considered in a CERCLA FS. Many NEPA values, such as a statement of purpose and need, description of alternatives for the proposed action including a no action alternative, description of the affected environment (including meteorology, hydrology, geology, ecological resources and land-use), applicable laws and guidelines, short-and long-term impacts on human health and the environment, emissions to air and water, and cost are typically included in a FS. Other NEPA values not normally considered in a CERCLA FS, include evaluation of cultural resources, socioeconomic, transportation, indirect and cumulative impacts, irreversible and irretrievable commitment of resources, environmental justice and mitigation of impacts. These have been incorporated to the extent appropriate to this FS.

1.5 INTEGRATION WITH OTHER 300 AREA OPERABLE UNITS

The 300-FF-5 Operable Unit is intended to address remediation of contaminated groundwater, saturated soils, and Columbia River sediments within its defined area. The 300-FF-1 and 300-FF-2 Operable Units are intended to address wastes and contaminated vadose zone soil remediation. The three Operable Units are interconnected because soil contaminants can migrate into groundwater. The approach taken in this RI/FS, consistent with the 300-FF-1 RI and FS (DOE-RL

1993c and 1994f) and 300-FF-2 Work Plan (in progress), is to address existing groundwater contamination in the 300-FF-5 RI and FS. Potential future groundwater contamination is being addressed in the 300-FF-1 RI and FS (DOE-RL 1993c and 1994f) and 300-FF-2 RI/FS process. It is assumed in this RI/FS that future contamination to 300-FF-5 groundwater from 300-FF-1 and 300-FF-2 sources will be limited by remedial actions implemented for these operable units. For the 300-FF-5 Operable Unit remediation to be successful, however, it is necessary that the 300-FF-1 and 300-FF-2 Operable Units control continued groundwater impacts to levels that are consistent with the remediation goals of the 300-FF-5 Operable Unit.

Therefore, while the alternatives for 300-FF-1, 300-FF-2 and 300-FF-5 are being developed and evaluated separately, the remedy for one can affect the other. Therefore, it will be important to coordinate the selection and implementation of remedial actions for the 300 Area operable units to ensure compatibility and avoid overlap. The organizational structure in place for management of this work is structured to ensure that coordination of all 300 Area operable unit work is achieved. This organization in turn coordinates with other entities that manage and operate the facilities in the areas covered by the 300 Area operable units.

1.6 REPORT ORGANIZATION

This RI/FS report is organized into the following sections:

- **Section 1, Introduction** - This section presents a brief description and background on the 300 Area, a statement of the purpose of the document, and a discussion of the RI/FS process.

- **Section 2, Phase I Remedial Investigation Overview** - This section presents a brief description of the operable unit and summarizes the information obtained during the Phase I RI, including the baseline risk assessment. This section also provides a description of the affected environment for NEPA.

- **Section 3, Supplemental Remedial Investigation Data Collection Activities** - This section presents 300-FF-5 RI data obtained since the Phase I RI was completed. This section also identifies RI data that will be collected and available in subsequent drafts of this RI/FS report.

- **Section 4, Refinement of the Baseline Risk Assessment** - Additional RI data are evaluated with respect to the Phase I RI data. Changes to nature and extent of contamination, fate and transport of contamination, and the baseline risk assessment are discussed, where necessary.

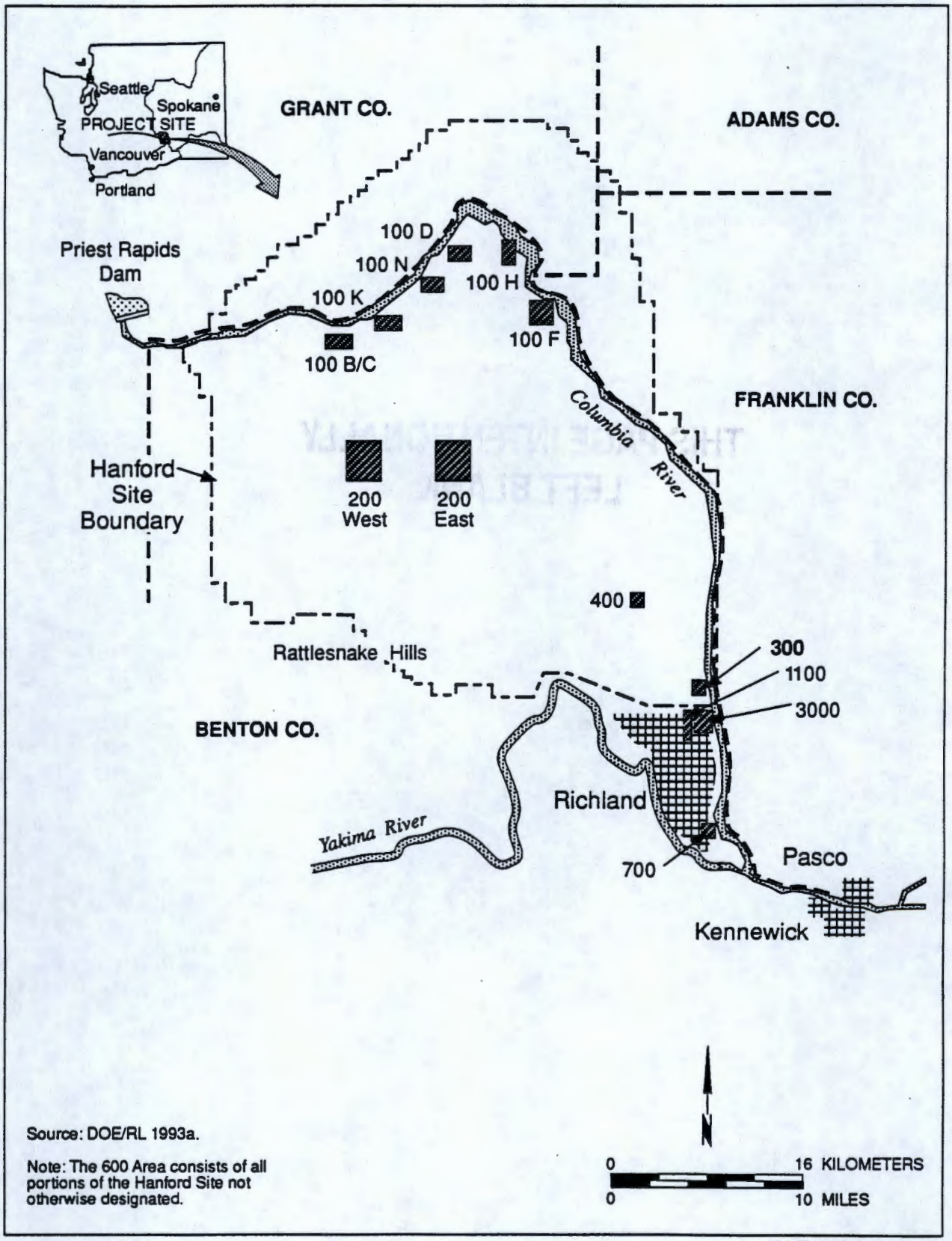
- **Section 5, Feasibility Study Objectives and Screening of Remediation Technologies and Alternatives** - This section identifies changes in potential ARARs from those established in the 300-FF-5 Phase I/II FS Report (DOE-RL 1994e). Remedial action objectives are revised in accordance with more recent available RI data, as necessary. Areas and volumes of contaminated media are estimated. An overview of the Phase I/II remedial technology screening is provided. This section also summarizes the remedial alternatives developed in the Phase I/II FS and screens

those alternatives as appropriate with consideration of additional RI information and evaluations.

- **Section 6, Feasibility Study Detailed Analysis of Remediation Alternatives** - In this section, the retained remedial alternatives are evaluated against the CERCLA evaluation criteria. Natural resources are also assessed to include the impacts on these resources and to assess the ease of restoration. NEPA evaluation criteria are also addressed. The alternatives are compared to each other based on the criteria evaluations to provide a basis for selecting a remedy for the 300-FF-5 Operable Unit.

- **Section 7, Conclusions** - An overall summary and conclusions of the RI and FS contained in this report are provided in this section.

- **Section 8, References** - This section cites the documentation referenced in the body of this report.



Source: DOE/RL 1993a.

Note: The 600 Area consists of all portions of the Hanford Site not otherwise designated.

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Figure 1-1. Hanford Site Operational Areas.

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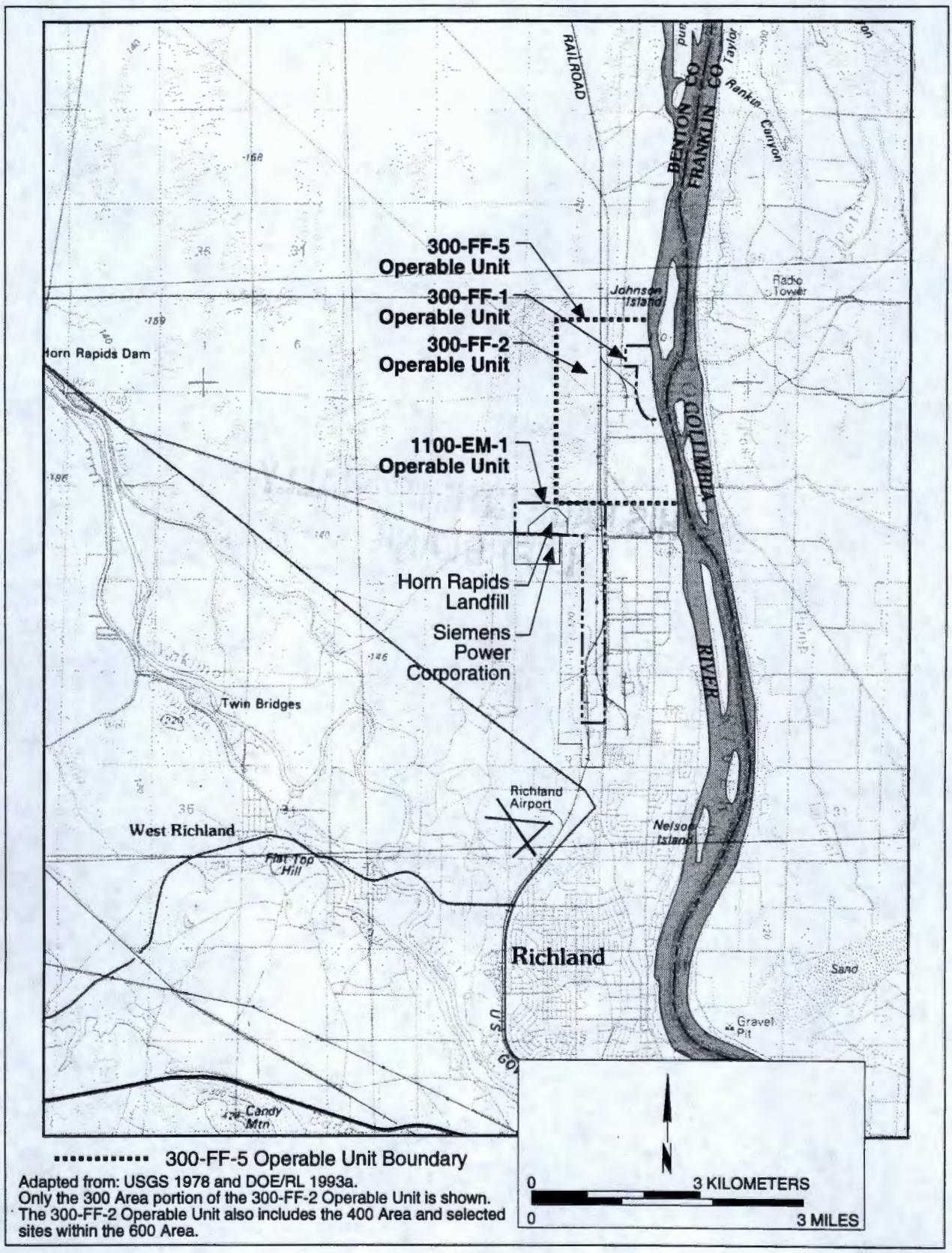

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Figure 1-2. 300-FF-5 Operable Unit Vicinity.

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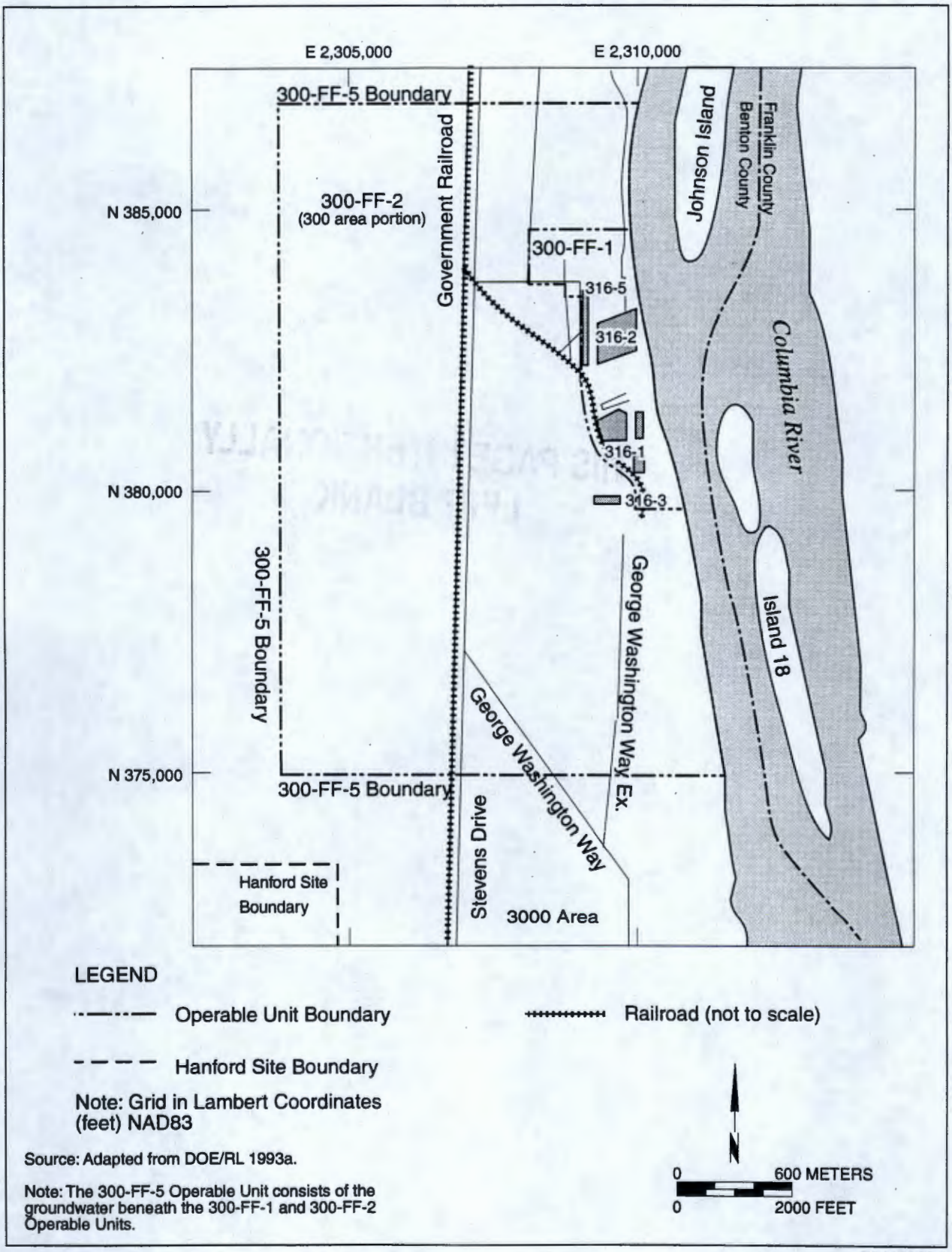

Figure 1-3. Location of Operable Units Within the 300 Area.

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2.0 PHASE I REMEDIAL INVESTIGATION OVERVIEW

To establish the background and justification for the Supplemental 300-FF-5 Operable Unit Remedial Investigation, this chapter presents an overview of the Phase I RI study. This overview summarizes the work conducted, results, and the recommendations for the completion of the operable unit RI. Section 2.1 summarizes the Phase I RI data collection activities. Section 2.2 describes the physical characteristics of the operable unit and relevant characteristics of the Hanford Site and nearby communities. Characteristics of these locations are included so that potential impacts associated with remediation of the 300-FF-5 Operable Unit may be evaluated in accordance with DOE Secretarial policy on integration of NEPA requirements into CERCLA documents. The nature and extent of contamination, as assessed under the Phase I RI, is discussed in Section 2.3. Section 2.4 discusses work related to analyses of contaminant fate and transport. The results of the baseline risk assessment are presented in Section 2.5, and Section 2.6 presents Phase I RI conclusions and recommendations for further activities to complete the 300-FF-5 Operable Unit RI effort. For additional details of the Phase I RI, refer to DOE-RL (1994d) from which this chapter has been summarized. Work conducted since the Phase I RI to complete this RI is presented in Chapters 3.0 and 4.0.

2.1 PHASE I DATA COLLECTION ACTIVITIES

The 300-FF-5 Operable Unit RI was conducted in accordance with the 300-FF-5 Operable Unit RI/FS Work Plan (DOE-RL 1990c) and Work Plan Change Notices 300-FF-5-01 through 300-FF-5-21 (ECN 186756). This section provides a brief overview of the various data collection activities undertaken during the initial phase of the RI. Interpretations of these data are provided in the subsequent sections of this chapter.

RI data collection activities are presented below by the following environmental-medium- or environmental-discipline-specific task categories:

- Contaminant sources investigation
- Surface water and sediment investigation
- Geological investigation
- Soil investigation
- Groundwater investigation
- Meteorological investigation
- Ecological investigation.

2.1.1 Contaminant Sources Investigation

The 300-FF-5 Operable Unit is a groundwater operable unit containing no waste sources; however, it underlies and is downgradient of several source operable units. The 300-FF-1 Phase I RI Report (DOE-RL 1993c) discusses most of the waste generating activities having discharges that could affect the 200-FF-5 Operable Unit. These activities/processes include fuel fabrication operations, water treatment and disposal operations, support operations (e.g., convertible coal/oil powerhouse), and disposal of sanitary waste from the various facilities in the 300 Area.

The fuel fabrication operations also generated solid waste that was disposed of in solid waste burial grounds. Most of these burial grounds are in the 300-FF-2 source operable unit and contain mixed waste of mostly unknown composition, but are known to contain various fission products and isotopes of uranium and plutonium. In addition to the burial grounds, the 300-FF-2 Operable Unit also contains a wide spectrum of active and inactive operational facilities associated with fuels fabrication, waste disposal, and research and development (R&D). An RI/FS Work Plan is currently being prepared for the 300-FF-2 Operable Unit (DOE-RL 1994h). Waste sites assigned to the 300-FF-2 Operable Unit are summarized in a DOE-RL (1994h) and Deford et al. (1994). The locations of the 300-FF-1 and 300-FF-2 Operable Units in relation to the 300-FF-5 Operable Unit are shown in Figures 1-2 and 1-3.

2.1.2 Surface Water and Sediment Investigation

To support the evaluation of exposure pathways associated with the Columbia River and riparian sediments adjacent to the operable unit, the following major data collection activities were conducted under this task.

- Collect and analyze water and sediment samples from the active springs or seepage areas
- Collect and analyze water samples from the river at near-shore locations adjacent to active seeps and along the contaminated groundwater plume
- Monitor the river stage adjacent to the 300-FF-5 Operable Unit.

Fourteen active riverbank springs and near-shore submerged springs were identified during visual inspection of the 300-FF-5 Operable Unit shoreline along the western bank of the Columbia River (WHC 1993b). The locations of these spring sites are shown in Figure 2-1. Seep samples from five active seeps (SP-6, -7, -9, -11, and -12) were collected in a single round of sampling for chemical analysis during September 1992. Sediment samples were collected at spring sites SP-6, -7, -9, and -12; the sediment surrounding spring site SP-11 was too coarse for sample collection. Near-shore river water samples were collected at locations near the actively flowing riverbank springs or seep areas, upstream of spring SP-6, and immediately downstream of spring sites SP-9 and SP-11. At each site, river water was collected 1, 3, and 6 m (3, 10, 20 ft) from the shoreline at mid-water depth. To maximize the potential for the seeps to be actively flowing and exposed for sampling, all sampling was conducted during a period when the river flow was artificially lowered (coordinated with upstream Priest Rapids Dam).

One river-stage recorder was operated throughout the study to collect hourly river water elevation data (Campbell et al. 1993). This recorder was used to determine optimum sampling times and provided data used to evaluate surface water and groundwater interactions.

These tasks were performed in accordance with Hulstrom (1992a). Details of the sampling activities are presented in Westinghouse Hanford Company (WHC) (WHC 1993b).

2.1.3 Geological Investigation

2.1.3.1 Geophysical Surveys. Surface geophysical survey techniques were used to:

- Evaluate the reflective properties of major sedimentary units, the water table, and the top of the basalt
- Determine the existence of a proposed paleochannel (Lindberg and Bond 1979) located near the eastern boundary of the 300-FF-5 Operable Unit and parallel to the present-day Columbia River
- Define the lateral extent of the Ringold lower mud unit for confirmation that this unit is continuous below the operable unit.

The techniques employed included shallow High Resolution Seismic Reflection Surveys, Seismic Refraction, Ground Penetrating Radar (GPR), and Electromagnetic Induction (EMI). Details of the survey procedures, equipment used, and data processing can be found in Kunk et al. (1993).

In addition to the surface geophysics, both gross gamma and spectral gamma surveys were conducted in boreholes. The surveys were performed primarily in the confined aquifer boreholes after placing each string of temporary casing. Logging intervals missed in the confined aquifer boreholes due to equipment or scheduling difficulties were surveyed from similar intervals in the deep unconfined boreholes. Spectral gamma and gross gamma survey logs and survey methods and procedures are presented in Swanson et al. (1992).

The primary objective of the spectral gamma surveys was to detect and quantify gamma-ray-emitting radionuclides present in the subsurface material. The logging configuration used on this and other projects has frequently detected radionuclide activities as low as 0.3 pCi/g (Swanson et al. 1992). Spectral gamma surveys were conducted in eight monitoring wells (699-S-29-E16B and -E16C; 399-8-5C; 699-S27-E9B and -E9C; 399-1-10B and -13B; and 399-1-14B). The spectral gamma ray surveys did not identify any radionuclides.

The primary objective of the gross gamma surveys was to locate possible zones of gamma-emitting radionuclides. Gross gamma surveys can also help interpret the borehole lithology. Gross gamma-ray logging was performed in 10 boreholes (699-S29-E16C; 699-S19-E14; 699-S22-E9C; 399-8-5C; 399-1-21B; 699-S27-E9C; 699-S28-E12; 399-1-10B and -13B; and 399-1-14B). This method was marginally useful in correlating thick fine-grained sequences such as the lower mud unit; the ability to consistently correlate coarse-grained units was poor (Swanson et al. 1992).

2.1.3.2 Geologic Characterization. The geologic characterization activities were completed to determine site-specific geologic and hydrologic conditions associated with the 300-FF-5 Operable Unit. Geologic and hydrogeologic data were obtained through the installation of additional wells/boreholes, which expanded the existing groundwater monitoring network. Detailed information on drilling procedures, lithologic logging, and well construction is provided in Swanson et al. (1992).

Wells and Boreholes. Nineteen new monitoring wells were installed (Table 2-1) to augment the existing network of wells (Figure 2-2) in the 300 Area (Swanson et al. 1992). Two additional boreholes [4T(699-522-E9T) and 7T (699-527-E9T)], which were located near well clusters 699-S22-

E9X and 699-S27-E9X, respectively, were constructed as temporary pumping wells for aquifer testing and were later decommissioned. Of the 19 wells, 16 were drilled using the cable tool drilling method, and three borings (699-S22-E9A, 399-8-5A, and 699-S29-E16A) were drilled using the sonic drill method (Volk et al. 1992).

Physical Property Testing. A total of 227 soil samples (Swanson et al. 1992) were collected for laboratory testing of physical properties in support of the geologic characterization of the 300-FF-5 Operable Unit. The physical testing included sieve analysis, hydrometer analysis, permeameter testing, and moisture content. The results of the laboratory physical testing are provided in Swanson et al. (1992).

2.1.4 Soil Investigation

The goal of the soil investigation task was to determine the lateral extent and distribution of contaminants in the unsaturated (vadose zone) and saturated sediments outside the vertical projections of source boundaries of adjacent operable units (DOE-RL 1990c). The vadose zone soil samples from boreholes at some distance and upgradient from known sources were used as representative background samples for the 300-FF-5 Operable Unit RI. The saturated sediment samples were used to determine aquifer matrix contamination for the 300-FF-5 Operable Unit RI.

Samples of vadose zone and aquifer sediments were collected from each borehole or cluster site at 1.5-m (5-ft) intervals and at distinct stratigraphic changes. The soil sampling activities were conducted in accordance with the 300-FF-5 Operable Unit Work Plan (DOE-RL 1990c).

2.1.5 Groundwater Investigation

To augment the existing well network, 19 new groundwater monitoring wells and two pumping wells were installed. The borings were drilled in four clusters of three wells; one cluster of two wells; and five single-well sites. Wells monitoring the top of the unconfined aquifer are designated "A" (e.g., 399-1-17A); wells monitoring the bottom of the unconfined aquifer are designated "B" (e.g., 399-1-17B); and wells monitoring the top of the uppermost confined aquifer are designated "C" (e.g., 399-1-17C). Two additional boreholes (699-S22-E9T and 699-S27-E9T) were drilled as temporary wells for aquifer testing and were later decommissioned. Table 2-1 summarizes relevant well construction information for the new wells. The locations of the wells are shown in Figure 2-2.

2.1.5.1 Hydrostratigraphy. The new wells were geologically logged during drilling, and soil samples were taken at 1.5-m (5-ft) intervals or at identifiable lithologic changes to delineate hydrofacies based on identified lithofacies and extent and distribution of contaminants. Selected wells were geophysically logged to assist in stratigraphic analysis. A summary of the field work performed in the 300-FF-5 Operable Unit including lithologic logs, geophysical logs, and summary sheets for the 19 new monitoring wells is provided in Swanson et al. (1992).

2.1.5.2 Groundwater Contaminant Distribution. Groundwater quality data have been collected, evaluated, and reported for many years under the Hanford Sitewide groundwater monitoring program.

Additional studies include Jaquish and Mitchell (1988), Evans et al. (1988), Jaquish and Bryce (1990), Woodruff et al. (1991), and Woodruff and Hanf (1992).

The 19 new wells were sampled and instrumented to determine groundwater flow directions and to determine if waste disposal sites that are considered actual or potential major sources of contamination are contributing to groundwater contamination. Groundwater sampling dates for monitoring wells in the 300-FF-5 Operable Unit are provided in Table 2-2.

2.1.5.3 Hydraulic Properties. Aquifer tests consisting of step drawdown, constant discharge, slug, slug interference, constant head, and laboratory tests were conducted to determine hydraulic properties of the subsurface units in the 300-FF-5 Operable Unit. The testing was performed at well cluster sites 699-S22-E9X and 699-S27-E9X (see Figure 2-2) in accordance with the test plan (Swanson 1992). Details of the wells, test types, and flow rates are provided in Table 2-3. Test results and summaries are provided in Swanson et al. (1992).

2.1.5.4 Aquifer Intercommunication. Four clusters of three wells (699-S29-E16A, B, and C; 699-S22-E9A, B, and C; 399-8-5A, B, and C; and 699-S27-E9A, B, and C) (Figure 2-2) were completed at three levels to permit measurement of groundwater potentials and contaminant concentrations throughout vertical profiles within the unconfined aquifer and between the semiconfined and upper confined aquifer.

Pressure transducers connected to dataloggers were used to measure groundwater elevations simultaneously and hourly at 34 wells in the 300-FF-5 Operable Unit and the stage of the Columbia River. The transducers were installed in 22 "A" wells, 7 "B" wells and 5 "C" wells, and in the river stage recorder. The hourly groundwater and river water elevation data were contoured and used to prepare an animated time-sequence video that graphically portrays the groundwater and surface water interactions in the 300-FF-5 Operable Unit (Campbell et al. 1993). Additional details regarding the transducer monitoring network are presented in Campbell et al. (1993).

In addition to the general question of aquifer intercommunication and vertical gradients at the operable unit, of special concern were problems associated with the 399-1-16 well cluster due to contamination detected at confined aquifer well 399-1-16C and a declining head differential observed since well installation with respect to the unconfined aquifer. It is suspected that the annular seal in well 399-1-16C has failed and that the casing joint has leaked. The intent of water elevation monitoring at the well cluster was evaluating the integrity of the 399-1-16C annular seal and the need for possible well remediation. Section 2.3.2 discusses the results of this monitoring.

2.1.5.5 Groundwater Modeling. Water levels, contaminant distributions, aquifer properties, and geology were used to develop a conceptual model for groundwater flow and contaminant transport within the 300-FF-5 Operable Unit. Based on this conceptual model, a numerical model was developed to quantify groundwater flow and contaminant transport of uranium.

2.1.6 Meteorological Investigation

The meteorological investigations were conducted as part of the first phase of the 300-FF-5 Operable Unit Phase I RI. The results of the meteorological investigations are presented in Hulstrom (1992b).

2.1.7 Ecological Investigation

The ecological investigations for the 300-FF-5 Operable Unit were conducted in conjunction with the 300-FF-5 Operable Unit Phase I RI and consisted of collecting data related to potential receptor organism populations, both human and wildlife. The human ecological investigations are described in DOE-RL (1993c).

2.1.7.1 Wildlife Ecological Investigation. Data gathered under the wildlife ecological investigation for the 300-FF-5 Operable Unit RI included the compilation of existing biological information and a survey of biological resources of the operable unit.

Data Compilation. Existing biological information was compiled to develop a general understanding of the wildlife ecology of the operable unit and vicinity. A description of the general wildlife ecology of the Hanford Site was obtained from Cushing (1991) and a recent annual environmental monitoring report for the Hanford Site (Jaquish and Bryce 1990). Operable unit-specific information was obtained from various reports (Eberhart et al. 1982; Fitzner et al. 1981; Gano and States 1982; Rogers and Rickard 1977; and Sackschewsky et al. 1992).

Biological Surveys. Biological resources of the operable unit were investigated by Pacific Northwest Laboratory (PNL) and are reported in Brandt et al. (1993a). Vegetation of the 300-FF-5 Operable Unit and upstream area was surveyed between March and May 1992. Vegetation survey results are presented in Table 2-4. Information about vegetation communities and species composition are presented in Table 2-5 and Figure 2-3. Surveys were confined within a zone defined by the crest of the river bank and the margin of the Columbia River. The operable unit and upstream riparian/riverine habitat were surveyed for the occurrence of birds, mammals, and reptiles weekly from June 13, 1992 to July 1, 1992, and from December 16 to December 23, 1992. Survey procedures followed those defined in the 300-FF-5 Operable Unit work plan and support plans (DOE-RL 1990c). The occurrence of small mammals was assessed by live trapping. The Hanford Site literature database was reviewed for information regarding the occurrence and biology of vegetation and animals likely to occur in the operable unit.

An endangered and threatened species survey for the 300-FF-5 Operable Unit was included in the 1992 biological survey. This survey consisted of a review of literature published by the Washington State Department of Wildlife (DOW 1987) and the Washington State Department of Natural Resources (DNR). The DOW and DNR were also requested to review their records for sightings of endangered or threatened animal or plant species, respectively, in the vicinity of the operable unit.

In addition to the biological resources survey (Brandt et al. 1993a), PNL conducted a biotic uptake assessment of the operable unit (Brandt et al. 1993b). The survey was conducted to locate and evaluate any evidence of, or potential for, uptake of toxic substances by plants or animals. The PNL biologists documented the uptake of selected contaminants by small mammals and vegetation.

2.1.7.2 Sensitive Environments. Sensitive environmental resources were identified by evaluating known occurrences of protected species, ecologically sensitive species, and keystone species on or near the operable unit. The evaluation was based on field assessments described previously (Brandt et al. 1993a) and on review of the Hanford Site literature describing the ecology and distribution of the biological resources with the potential to occur in the operable unit and vicinity.

2.1.8 Data Validation

Sampling procedures, analytical methods, and data validation requirements for environmental media were specified in the Quality Assurance Project Plan (QAPjP) of the 300-FF-5 Operable Unit Work Plan (DOE-RL 1990c). Data validation was conducted in accordance with established procedures and guidelines developed for chemical and radiological analyses (WHC 1992a and 1992b). The chemical guidelines are consistent with EPA procedures and guidelines (Bleyler 1988a and 1988b).

The 300-FF-5 RI was performed using data (four quarterly sampling rounds) received as of May, 1993. Full data validation was performed on a minimum 20% of the 300-FF-5 Operable Unit data, as specified in the 300-FF-5 Work Plan (DOE-RL 1990c). The remaining data were adjusted from laboratory blank sample results for each sample delivery group.

2.2 SITE SUMMARY

The 300-FF-5 Operable Unit is a groundwater operable unit that contains no waste sources but underlies and is downgradient of other operable units or waste sites. The location of the 300-FF-5 Operable Unit at the Hanford Site and in relation to the other 300 Area operable units is shown in Figures 1-2 and 1-3. Source facilities, operable units, and suspected chemical processes and activities that may have impacted the 300-FF-5 Operable Unit include the following.

- The 300-FF-5 Operable Unit, containing waste management units associated with fuel fabrication and support operations. A description of these waste generation activities is presented in the 300-FF-1 Phase I RI (DOE-RL 1993c).

- The 300-FF-2 Operable Unit, containing waste sites throughout the 300 and 400 Areas and in selected portions of the 600 Area. Included in the 300-FF-2 Operable Unit are all waste sites in the 300 Area that are not part of the 300-FF-5 Operable Unit, all waste sites in the 400 Area, and selected 300 Area-related sites located throughout portions of the 600 Area. The 300-FF-2 Operable Unit includes the former 300-FF-2, 300-FF-3, 300-FF-4, and 300-IU-1 Operable Units, which were all combined into a single 300-FF-2 Operable Unit during Tri-Party Agreement negotiations (Ecology et al. 1994). The more than 160 individual waste sites contained within the 300-FF-2 Operable Unit are associated with a variety of Hanford Site operations, including fuel fabrication operations, waste treatment and disposal, and research and development. A description of the 300-FF-2 waste generating activities and waste sites is included in the 300-FF-2 RI/FS Work Plan (currently under preparation) and Deford et al. (1994).

- A tritium plume, believed to originate from the 200-PO-2 Operable Unit, currently migrating south and east from the 200 East Area.

- The Horn Rapids Landfill, a waste management unit assigned to the 1100-EM-1 Operable Unit (located 1.6 km [1 mi]) to the south and west of the 300 Area), containing primarily office and construction wastes. A plume of

trichloroethene, technetium-99, and nitrate emanates from the vicinity of the landfill, and is migrating toward the 300 Area.

2.2.1 Topography

The 300-FF-5 Operable Unit is situated in an area having a relatively moderate semiarid climate characterized by low precipitation, high evapotranspiration and relatively high winds. The Columbia River is adjacent to the 300-FF-5 Operable Unit and is the discharge point for the 300-FF-5 groundwater. Major groundwater seeps along the west bank of the Columbia River in the vicinity of the 300-FF-5 Operable Unit have been identified and mapped and are shown in Figure 2-1. The ground surface overlying the operable unit has a generally flat topography with a lack of well defined drainages. The 300 Area is approximately 119 m (390 ft) above mean sea level. The topography is generally flat and slightly irregular. In the 300 Area, human-made features (e.g., pond dikes) dominate the topography. There is a steep embankment at the Columbia River along the eastern edge of the 300 Area, with about a 12-m (40-ft) drop to the river. Combined with low precipitation, high evapotranspiration, and coarse surface soils, there is very little surface runoff to the river.

2.2.2 Geology

The 300 Area is situated at the south end of the Cold Creek syncline. The geologic units significant to the 300-FF-5 Operable Unit include (from oldest to the youngest) (1) Saddle Mountains Basalt, (2) Ringold Formation, (3) Hanford formation, and (4) Holocene surficial deposits. The uppermost basalt flow in the area of the 300-FF-5 Operable Unit is the Ice Harbor Member of the Saddle Mountains Basalt Formation, which forms the bedrock in the area. Overlying the bedrock is the Ringold Formation, an approximately 29 to 44 m (95 to 145 ft) thick deposit of mixed sediments of fluvial, overbank, and lacustrine origin. Above the Ringold Formation is the Hanford formation, which comprises predominantly sand and pebble to boulder gravels of proglacial and fluvial origin that range in thickness from 9 to 20 m (30 to 60 ft). Holocene surficial deposits in the 300-FF-5 Operable Unit area consist dominantly of eolian silts and fine grained sands. These deposits are found in thin sheets and thicker dunes (0 to 5 m [0 to 15 ft]) over the site. The basalt and suprabasalt stratigraphy of the Hanford Site region is depicted in Figure 2-4. Figure 2-5 depicts the generalized stratigraphy of the 300-FF-5 Operable Unit. Geologic cross-sections through the operable unit are shown in Figures 2-6 to 2-9. The location of all monitoring wells within the operable unit is shown in Figure 2-2.

Installation of the new groundwater wells provided additional stratigraphic information that expanded the areal extent of geologic information available for the 300 Area depicted in the geologic cross sections. It also provided additional details that refined the understanding of the lateral extent of specific lithologies that may influence contaminant transport. Information obtained helped to define the lateral and vertical extent and distribution of contaminants in the unsaturated (vadose zone) and saturated sediments in the aquifers underlying the 300 Area. It also helped to determine upgradient sources of contamination that are influencing the groundwater in the 300-FF-5 Operable Unit.

2.2.3 Hydrogeology

The unconfined aquifer beneath the 300-FF-5 Operable Unit is composed of two hydrogeologically distinct formations, locally referred to as the Hanford and the Ringold formations. The Hanford formation is dominated by pebble to boulder gravels with sandy dominated facies present locally. Excluding eolian deposits, the vadose zone is composed of the Hanford sands and gravels. The open framework structure of this formation yields very high hydraulic conductivities ranging between 3,600 m/day (12,000 ft/day) to 10,000 m/day (32,800 ft/day) (Table 2-6). The formation generally has a high porosity and drains rapidly. Though mounding beneath operating ditches and ponds was observed in the past no such mounding is known to exist today. Saturated Hanford formation underlies the North and South Process Ponds and the Process Trenches within the 300-FF-5 Operable Unit and varies between 1.5 to 7.6 m (5 to 25 ft) in thickness. Table 2-7 lists the saturated thickness of the Hanford formation beneath and in the vicinity of the waste units, based on data from wells in the area. The saturated Hanford formation generally thickens near the Columbia River and thins to the west. The partially indurated Ringold formation underlies the Hanford formation and completely contains the unconfined aquifer on the western edge of the operable unit. There is evidence of several erosional lows in the top of the Ringold Formation that generally extend from west to east across the formation (Table 2-7). The Phase I RI (DOE-RL 1994d) attempted to use geophysical techniques to define these channels but these techniques yielded inconclusive results (Kunk et al. 1993). The Ringold formation possesses a much lower ability to transmit and has conductivities ranging from 50 m/day (160 ft/day) to 150 m/day (500 ft/day) (Table 2-6).

The uppermost confined aquifer occurs in the lower sand and gravel units of the Ringold Formation and is separated from the unconfined system by the Ringold lower mud unit. An upward gradient exists between the confined and the unconfined aquifers, indicative that the mud unit is locally extensive. The average groundwater elevation for wells in the 300-FF-5 Operable Unit are given in Table 2-7.

Flow in the unconfined system is generally toward the Columbia River (Figure 2-10a). However, river stage strongly influences groundwater flow and contaminant exchange rates between the aquifer and the river. Not unexpectedly this effect is most pronounced near the river but is also observed throughout the operable unit. Gradient reversals, causing flow to move from the river into the 300-FF-5 Operable Unit, are a common occurrence and are facilitated by the high transmissivities measured in the Hanford formation (Figure 2-10b). Daily river stage variations of 1 to 3 ft are common with seasonal (long term) changes of 4 ft observed. Preferential groundwater flow paths, indicated by rapid changes in groundwater elevations due to changing river stage, have been observed (Campbell et al. 1993).

The groundwater flow system has a significant impact on the contaminant distribution observed in the aquifer. Higher groundwater pore velocities, associated with the saturated Hanford formation found along the river, can be expected to quickly flush and naturally dilute contamination introduced into the aquifer and facilitate it's remediation. Contaminants, whose movement are only slightly chemically retarded, can be expected to decrease with time once potential sources are removed or contained. The interchange of groundwater with river water can also be expected to facilitate remediation.

2.2.4 Surface Water

The Columbia River is the most significant surface water body in the region. Other surface waters would not be affected by the remedy for the 300-FF-5 Operable Unit. A more complete description of regional and local surface water hydrology is presented in the Phase I RI (DOE-RL 1994d).

The Columbia River is used as a source of drinking water, industrial process water, crop irrigation and for a variety of recreational activities including fishing, hunting, boating, water skiing, and swimming. Regional flooding within the Columbia and Yakima Rivers is controlled by hydroelectric power dams and irrigation structures (Skaggs and Walters, 1981). The distribution of flooded areas during the probable maximum flood is shown in Figure 2-11. As shown in extreme flooding scenarios, flooding in either river is not anticipated to inundate the 300 Area source operable units. However, assuming a 50% breach scenario at Grand Coulee Dam, located on the Columbia River approximately 300 km (180 mi) upstream from Priest Rapids Dam, the Columbia River would inundate the 300 Area, 3000 Area, 1100 Area, city of Richland, and the Yakima River channel upstream to Horn Rapids Dam (Skaggs and Walters, 1981). This flood is of lower expected frequency than the probable maximum flood.

Water quality of the Columbia River in the vicinity of the 300-FF-5 Operable Unit is classified as Class A, Excellent, according to the state of Washington. Class A waters are essentially suitable for all uses, including raw drinking water, recreation, and wildlife habitat. State and federal drinking water standards apply to the Columbia River and are currently being met (Cushing 1994). Water samples were collected from various locations in the Columbia River during 1993 to determine Hanford Site compliance with applicable regulatory standards.

Results of the surface water investigation for the 300-FF-5 Operable Unit confirmed the presence of seeps or springs that are discharging groundwater into the Columbia River. Depending on the river stage, which can vary up to 2 or 3 ft daily, the flow of groundwater is either directly into the river or directed in a southerly direction until it ultimately discharges into the river at the southern end of the 300 Area. Samples of river water at various distances from the springs indicate a rapid dilution of any contaminants that enter the river.

Results of the radiological analyses of Columbia River water samples collected at Priest Rapids Dam, the 300 Area, and the Richland Pumphouse during 1993 are reported by Bisping (1994) and summarized in Table 2-8. Radionuclides consistently detected in river water during 1993 were ^{3}H, ^{90}Sr, ^{129}I, ^{234}U, ^{238}U. In addition, ^{60}Co, ^{99}Tc, ^{137}Cs, ^{235}U, and $^{239,240}Pu$ were occasionally measured above analytical detection levels during the year (<50% of samples). Tritium and ^{90}Sr exist in worldwide fallout, as well as in effluent from Hanford facilities. Uranium, and ^{3}H occur naturally in the environment in and are present in Hanford Site effluent (Dirkes et al. 1994).

The 1993 average concentrations in Columbia River water at Priest Rapids Dam, the 300 Area, and the Richland Pumphouse were approximately 5% or less of the applicable Drinking Water Standard of 15 pCi/L alpha and 50 pCi/L beta. Statistical analyses of alpha and beta concentrations at Priest Rapids Dam and the Richland Pumphouse indicated the differences were not significant (Dirkes et al. 1994).

Annual average ^3H concentrations at Priest Rapids Dam and the Richland Pumphouse during 1993 were 40 pCi/L $\pm$5% and 96 pCi/L $\pm$ 19%, respectively. Declines in ^3H concentrations in river water noted during the late 1980's remains evident at Priest Rapids Dam and the Richland Pumphouse. All ^3H concentrations were less than 1% of the state of Washington and EPA Drinking Water Standard of 20,000 pCi/L (Dirkes et al. 1994).

Annual average uranium concentrations in river water during 1993 were slightly higher at the 300 Area (0.83 pCi/L $\pm$ 28%), and the Richland Pumphouse (0.51 pCi/L $\pm$ 10%), than at Priest Rapids Dam (0.45 pCi/L $\pm$ 7%). Annual average uranium concentrations at the Richland Pumphouse and Priest Rapids Dam for 1988 through 1993 are shown in Figure 2-12. Uranium concentrations during 1993 were similar to those observed during recent years and were well below the proposed drinking water standard of 20 μg/L (equivalent to 30 pCi/L) (Dirkes et al. 1994).

2.2.5 Meteorology

The most extensive data on meteorology at the Hanford Site have been collected at the Hanford Meteorologic Station in the Hanford Site 200 Area plateau about 32 km (20 mi) northwest of the 300 Area and approximately 16 km (10 mi) west of the Columbia River (Figure 2-13). A large compilation of meteorological data from this station was assembled by Stone et al. (1983) for the period from 1946 to 1980, and forms the primary basis for this discussion. Wind velocities (i.e., wind speed and direction) for the 300-FF-5 Operable Unit were obtained from a monitoring station at the 300 Area.

Precipitation. Average annual precipitation is 16 cm/yr (6.3 in./yr). Most precipitation occurs in winter. January is typically the wettest month, with an average of 23 mm (0.92 in.), and July is the driest month with an average of only 3.8 mm (0.15 in.). Precipitation intensity is greatest in the summer months. Approximately 38% of precipitation during the months of December through February in the form of snow. The average annual snowfall is 33 cm (13.2 in.). Complete snow melt generally occurs within a month of a snowstorm.

Temperature. The summer months at the Hanford Site are typically hot and dry, and winters are moderately cold. July is the warmest month of the year with an average temperature of 24.7°C (76.4°F), and January is the coolest month with an average temperature of -1.5°C (29.3°F). Historical extreme temperature readings of 45°C (113°F) and -31°C (-24°F) have been recorded. Because of low humidity the diurnal temperature range is substantial. The diurnal temperature range is approximately 15°C (27°F) in summer and approximately 8°C (14°F) in winter (DOE-RL 1990c).

Wind. Prevailing wind directions and frequencies at the Hanford Site are shown in Figure 2-13. In the 300 Area, the wind direction tends to parallel the Columbia River. Daily average wind speed at the 300 Area ranges from 8 km/h (5 mi/h) to 16 km/h (10 mi/h). The wind tends to be southerly in the fall and winter and northerly in the spring and summer. A strong diurnal effect occurs from March through August, when wind speed tends to increase 7 to 10 km/h (4 to 6 mi/h) during the afternoon and evening hours. The strongest winds are generally southwesterly, with speeds up to 130 km/h (80 mi/h). Greater than 90% of the southwesterly winds exceed 30 km/h (18 mi/h).

Hanford Site Air Quality. Air quality in the vicinity of the Hanford Site is considered good because there are only a few industrial sources of air pollutants in the area. The Benton-Franklin Counties Clean Air Authority routinely compiles emission inventories for permitted major sources of pollutants. In areas where the National Ambient Air Quality Standards (NAAQS) have been achieved, the EPA has established the Prevention of Significant Deterioration (PSD) program to protect existing ambient air quality. The Hanford Site operates under a PSD permit issued by the EPA in 1980. The permit provides specific limits for emissions of oxides of nitrogen from the Plutonium Uranium Extraction (PUREX) and Uranium Oxide (UO_3) plants (Cushing 1994). In addition, the permit requires additional actions if other criteria pollutants limits are exceeded or if new construction occurs, as defined by the Clean Air Act and Amendments.

Eleven air samples were collected for volatile organic compound (VOC) analysis in 1992. These samples were analyzed for benzene, alkylbenzene, halogenated alkanes and alkenes. All the VOC concentrations measured were well within the maximum allowable concentrations of air contaminants established in 29 CFR 1910 (Cushing 1994).

Limited ambient air quality monitoring has been performed in the vicinity of the Hanford Site for total suspended solids and particulates less than 10 microns in diameter (PM-10). Monitoring for total suspended particulates (TSP) and PM-10 was conducted in three communities surrounding the Hanford Site during 1992 (Figure 2-14). The Washington State 24-hour standard, 150 $\mu g/m^3$, was exceeded six times during the year at Sunnyside and seven times at Wallula. PM-10 was monitored at three locations: Columbia Center in Kennewick, Wallula, and the Walla Walla fire department. The 24-hour PM-10 standard established by the state of Washington, 150 $\mu g/m^3$, was exceeded twice at the Columbia Center monitoring location; the maximum 24-hour concentration at Columbia Center was 596 $\mu g/m^3$. No site exceeded the annual primary standard of 50 $\mu g/m^3$ during 1992 (Cushing 1994).

Airborne particulate concentrations may reach relatively high levels in eastern Washington resulting from exceptional natural events such as high winds and brush fires. In addition, elevated particulate levels have been associated with wheat farming. Ambient air quality standards do not consider "rural fugitive dust" from exceptional natural events or agriculture when estimating maximum background concentrations or when considering enforcement of air quality standards and permit applications. For any activity on the Hanford Site, which may have a potential to emit fugitive dust, site contractors use reasonable available control technology or reasonable precautions to mitigate release of fugitive emissions.

2.2.6 Human Resources

2.2.6.1 Land Use.

Regional Land Use. Land use in the areas surrounding the Hanford Site includes urban and industrial development, irrigated and dry-land farming, grazing, and designated wildlife refuges. The region consists of the incorporated cities of Richland, West Richland, Pasco, and Kennewick (Tri-Cities) and surrounding communities in Benton and Franklin counties. Industries in the Tri-Cities are mainly related to agriculture and energy production. Wheat, corn, alfalfa, hay, barley, and grapes are the major crops in Benton and Franklin counties.

Hanford Site Land Use. The Hanford Site encompasses 1,450 km^2 (560 mi^2) and includes several DOE operational areas. The major areas are as follows:

- The entire Hanford Site has been designated a National Environmental Research Park (Cushing 1994) as it relates to the Arid Lands Ecology Reserve and other portions of the site where ecological studies may be conducted.

- The 100 Areas, bordering on the south shore of the Columbia River, are the sites of the eight retired plutonium production reactors and the N Reactor (also for plutonium production), which was recently shut down. The 100 Areas occupy about 11 km^2 (4 mi^2).

- The 200 West and 200 East Areas are located on a plateau about 8 and 11 km (5 and 7 mi), respectively, from the Columbia River. These areas have been dedicated to waste management and disposal activities. The 200 Areas cover about 16 km^2 (6.2 mi^2).

- The 300 Area, located just north of the city of Richland, is the site of nuclear research and development. This area covers 1.5 km^2 (0.6 mi^2).

- The 400 Area is about 8 km (5 mi) north of the 300 Area and is the site of the Fast Flux Test Facility (FFTF) used in the testing of breeder reactor systems. As ordered by the Secretary of Energy in December 1993, the FFTF is in the process of being shut down. The goal is to reach radiologically and industrially safe shutdown in approximately 5 years. Also included in this area is the Fuels and Materials Examination Facility (Cushing 1994).

- The 600 Area includes all of the Hanford Site not occupied by the 100, 200, 300, or 400 Areas. Land uses within the 600 Area include the Arid Land Ecology Reserve (ALE), a U.S. Fish and Wildlife Service wildlife refuge, support facilities for controlled access areas, and other lands leased to Washington State and the Washington Public Power Supply System (Supply System) (Cushing 1994).

- The 1100 Area includes the 3000 Area and the Horns Rapids Landfill. It is used for Hanford Site support services.

300 Area Land Use. Existing land use in the 300 Area is divided among the following land use categories: facilities support, research and development, waste management, and undeveloped. Facilities support activities are primarily located in the central portion of the 300 Area and include a powerhouse and water treatment facility. Other facilities provide support services to research and development programs, reactor, programs and historically to nuclear fuel manufacture. Nuclear research and development programs are also located in the central and southern sections of the 300 Area. Most waste management operations are located in the northern sections of the 300 Area, primarily in the 300-FF-5 Operable Unit adjacent to the Columbia River. Additional waste management units are located within the 300-FF-2 Operable Unit adjacent to the south and west boundaries of the 300-FF-5 Operable Unit. Undeveloped land in the 300 Area is located in the southern and northern extremities. These areas are the least disturbed and contain minimal infrastructure or facility development.

2.2.6.2 Water Use.

Surface Water. The primary source of water for the Hanford Site and Tri-Cities is diversion of surface water. The Columbia River is the most significant surface-water body in the region. It is used as a source of drinking water, industrial process water, crop irrigation, and for a variety of recreational activities. Approximately 11.78 billion gallons were withdrawn in 1993, primarily by Richland, Pasco, and Kennewick city water supply systems (Cushing 1994). Recreational use of the Columbia River is discussed in Section 2.2.6.8, and ecology is presented in Section 2.2.7.

River water intakes include the Ringold Fish Hatchery intake, the Ringold Flats irrigation intakes, the Taylor Flats irrigation intakes, the Supply System intake, the 300 Area process and drinking water intake, the Battelle Farm Operations irrigation intake, and the Washington State University Center irrigation intake. The city of Richland drinking water intake is approximately 3.25 km (2.75 mi) south of the 300-FF-5 Operable Unit.

Groundwater. Groundwater accounts for less than 10% of water use in the Pasco Basin. The Pasco Basin includes the Hanford Site and adjacent areas north and east of the Columbia River in Grant, Adams, and Franklin Counties. Approximately 50% of the wells in the Pasco Basin are for domestic use and are generally less than 150 m (500 ft). Agricultural wells, used for irrigation and stock supply, make up the second-largest category of well use, about 24% for the Pasco Basin. Industrial users account for only about 3% of the wells (DOE 1988). The principal user of groundwater within the Hanford Site is the FFTF, which used 142,000 m^3 (37 million gallons) in 1988 from two wells in the unconfined aquifer.

Private drinking water wells are located on the east side of the Columbia River across from the 300 Area. The city of Richland operates a well field and recharge system south of the 300 Area. Other 300 Area vicinity wells include an irrigation well operated by Battelle Farm Operations and a well operated at the Hanford Patrol Training Center (DOE-RL 1990c).

2.2.6.3 Historical, Archaeological, and Cultural Resources. The Hanford Site contains numerous well-preserved archaeological sites representing both the prehistoric and historical periods. Management of Hanford's cultural resources follows the Hanford Cultural Resources Management Plan (Chatters 1989) and is conducted by the Hanford Cultural Resources Laboratory (HCRL). Unless specifically stated, the information in this section is obtained from Cushing (1994).

To date approximately 6% of the Hanford Site has been surveyed for archaeological resources. Cultural resource reviews are conducted when projects are proposed for areas not previously reviewed. About 100 to 120 surveys were conducted annually through 1991, and this figure rose to more than 400 reviews during 1993. A large number of new archaeological sites were discovered during surveys conducted in the 100 Areas of the Hanford Site. These reviews ensure that known historic and archaeological sites are not adversely impacted by proposed projects, especially if any site is found to be eligible for listing on the National Register of Historic Places. Cultural reviews are also important if the potential exists for the discovery of human remains. Such a discovery is likely to result in a stop work order as required by the Native American Graves Protection and Repatriation Act (Public Law 101-601).

Hanford Site Archaeological Resources. The Hanford Site contains an extensive record of past human and animal life, the latter beginning as long as 7 million years ago. The Ringold

Formation, which underlies the White Bluffs east of the Columbia River, contains one of the most extensive deposits of Pliocene vertebrate fossils in the state of Washington. In beds of conglomerate and river-deposited clay, the remains of extinct camel, horse, rhinoceros, sloth, deer, sabertooth cat, and mastodon are found along with bones of still living turtle and fish species. Mammoth bones are common in the late Pleistocene silts of the Hanford formation, which covers most western portions of the Hanford Site. Small mammal remains are abundant in the Pleistocene and Holocene loess deposits throughout the Hanford Site (Chatters 1989).

More than 10,000 years of prehistoric human activity in the Middle Columbia River region have left extensive archaeological deposits along the river shores (Leonhardy and Rice, 1970; Greengo 1982; and Chatters 1989). Well-watered areas inland from the river show evidence of concentrated human activity (Chatters 1982, 1989; Daugherty 1952; Greene 1975; Leonhardy and Rice 1970; and Rice 1980), and recent surveys have indicated extensive, although dispersed, use of arid lowlands for hunting. Graves are common in various settings, and spirit quest monuments (rock cairns) may still be found on summits of the mountains and buttes (Rice 1968a). Because of the limited public access to the Hanford Site, some of the archaeological deposits found in the Hanford Reach of the Columbia River and on adjacent plateaus have been preserved.

There are currently 248 prehistoric archaeological sites recorded in the files of the HCRL. Forty-seven of these sites are included on the National Register of Historic Places (National Register), two as single sites (45BN121, Hanford Island Site; 45GR137, Paris Site) and the remainder in seven archaeological districts. In addition, a nomination has been prepared for one cultural district (Gable Mountain/Gable Butte), and renomination for two additional archaeological districts is pending (Wahluke, Coyote Rapids). Four other sites are considered eligible for the National Register. Archaeological sites include remains of numerous pithouse villages, various types of open campsites, and cemeteries along the river banks (Rice 1968a, 1980), spirit quest monuments, hunting camps, game drive complexes, quarries in mountains and rocky bluffs, hunting/kill sites in lowland stabilized dunes, and small temporary camps near perennial sources of water located away from the river (Rice 1968b). Little excavation has been conducted at any of the sites (Cushing 1994).

Native American Cultural Resources. In prehistoric and early historic times, the Hanford Reach of the Columbia river was populated by Native American peoples of Shahaptian stock. The predominant people in the area were the Wanapum Band, although peoples of various bands and tribal affiliations, including Nez Perce, Walla Walla, Umatilla, Palus, Yakama, and Chamnapum made use of the resources of the area. Although many of the Wanapum people were incorporated into the Confederated Tribes and Bands of the Yakama Indian Nation and the Confederated Tribes of the Umatilla Reservation, a remnant population continued to live in the Hanford area until they agreed to relocate in an agreement with Col. Mathias of the U.S. Army Manhattan Engineering District in 1943 (Relander 1956). Descendants of these people continue to live at Priest Rapids, near the site of a historical Wanapum village.

The area now comprising the Hanford Site is of great significance in the traditional religion shared by Native Americans in this region. Many of the landforms have religious and historical significance, and there are many burial grounds and traditional use areas along the Columbia River. Additionally, many traditional foods and medicines are found on the Hanford Site. Burial grounds and fishing sites are known to be located in proximity to the 300 Area.

Historic Resources. A total of 202 historic archaeological sites and historic properties have been recorded at the Hanford Site. Properties from the Pre-Hanford era include the Hanford Irrigation and Power Company's Pumping Plant at Coyote Rapids, the Hanford Irrigation Ditch, the Hanford townsite, Wahluke Ferry, the White Bluffs townsite, the Richmond Ferry, Arrowsmith townsite, a cabin at East White Bluffs ferry landing, the White Bluffs road, the old Hanford High School, and the Cobblestone Warehouse at Riverland (Rice 1980). Archaeological sites include the East White Bluffs townsite and associated ferry landings and an assortment of trash scatters and dumps. Thirty-eight additional sites including homesteads, corrals, and dumps have been recorded by the HCRL since 1987. In addition to the recorded sites, there are numerous areas of gold mine tailings along the river bank, the remains of homesteads, farm fields, and ranches. Abandoned Army installations are also scattered over the entire Hanford Site.

More recent sites are the defense reactors and associated materials processing facilities, including many of the 300 Area facilities constructed in 1943 as part of the Manhattan Project. Plutonium for the first atomic explosion and the bomb that destroyed Nagasaki at the end of World War II were produced in the 100-B Facility. Additional reactors and processing facilities were constructed after World War II, during the Cold War. All reactor containment buildings still stand, although many ancillary structures have been removed. The 100-B Reactor has been listed on the National Register of Historic Places. Until a full evaluation of all Manhattan Project and Cold War buildings and facilities has been conducted, statements about their National Register status cannot be made (Cushing 1994).

300 Area Archaeological and Historic Resources. The 300 Area is located adjacent to the Columbia River, an area typically associated with high cultural resource potential (Figure 2-3). Several cultural resource surface surveys have been conducted within and 0.8 km (0.5 mi) outside of the 300-FF-5 Operable Unit. Surveys have been limited in scope and represent only a portion of the operable unit. Five prehistoric, five historic, and one site containing both historic and prehistoric components are known to be located within the operable unit. There are four prehistoric and three historic sites known to be located within 0.8 km (0.5 mi) of the 300-FF-5 Operable Unit. One site located within the operable unit is eligible for placement on the National Register of Historic Places. According to Section 106 of the National Historic Preservation Act, an eligible site is provided the same level of protection and associated requirements as a site listed on the National Register of Historic Places. Human remains were also discovered during construction of a sewer line. The site was left undisturbed and was capped with additional soil; the pipeline was constructed aboveground over the archaeological site. Three additional prehistoric and two historic isolates have been identified within the operable unit. Discretion is required in order to protect these cultural resources; therefore, specific locations of the sites are not presented in this FS.

2.2.6.4 Socioeconomics. The Hanford Site plays a dominant role in the socioeconomics of the Tri-Cities (Richland, Pasco, and Kennewick) and other parts of Benton and Franklin counties. The agricultural community also has a significant effect on the local economy. Major changes in Hanford activity and employment would potentially affect the Tri-Cities and other areas of Benton and Franklin counties.

Employment and Income. Three major sectors are currently the principal driving forces of the economy in the Tri-Cities: (1) the DOE and its contractors operating the Hanford Site; (2) the Supply System; and (3) the agricultural community, including a substantial food processing component. Most of the goods and services produced by these sectors are exported outside the

Tri-Cities. In addition to the direct employment and payrolls, these major sectors also support a sizable number of jobs in the local economy through their procurement of equipment, supplies, and business services. Three other components are contributors to the economic base of the Tri-Cities: other major employers, tourism, and retired persons.

The unemployment rate fluctuates seasonally because of the agricultural sector. The 1993 average unemployment for the Tri-Cities was 8.1% (Washington State Employment Security Department 1993). Average unemployment in Benton and Franklin Counties in 1992 was 7.6% and 11.9%, respectively. The unemployment rate in Franklin County was higher because of the larger agricultural sector in Franklin County (Washington State Department of Employment Security 1993).

Hanford and the Local and State Economy. In 1993, Hanford employment accounted directly for 25% of total nonagricultural employment in Benton and Franklin counties and slightly more than 0.6% of all nonagricultural statewide jobs. In 1993, Hanford Site payroll was estimated at $740,557,781, which accounted for an estimated 45% of the payroll dollars earned in the area (Cushing 1994). At the end of fiscal year 1993, over 2,700 people worked in the 300 Area. Of those personnel, 1,325 worked for PNL, 1,189 for WHC, and 258 for Kaiser Engineering (Daly 1994). The majority of workers are office and laboratory personnel.

Demography. Estimated population totals for Benton and Franklin counties for 1993 were 122,800 and 41,100, respectively (Washington State Office of Financial Management 1993). When compared to the 1990 census data in which Benton County had 112,560 residents and Franklin County's population totaled 37,473, the 1993 census figures reflect the current growth occurring in these two counties. Within each county, the 1993 estimates distribute the Tri-Cities population as follows: Richland, 34,080; Kennewick, 45,110; and Pasco, 21,370. The combined populations of Benton City, Prosser, and West Richland totaled 11,000 in 1993. The unincorporated population of Benton County was 32,610. In Franklin County, incorporated areas other than Pasco have a total population of 2,890. The unincorporated population of Franklin County was 16,840 (Cushing 1994).

Housing. In 1993, nearly 94% of all housing (of 40,344 total units) in the Tri-Cities was occupied. Single-unit housing represented nearly 58% of the total housing units and had a 97% occupancy rate throughout the Tri-Cities. Multiple-unit housing, defined as housing with two or more units, had an occupancy rate of nearly 94%, a 13% increase from 1990. Pasco has the lowest occupancy rate, 92%, in all categories of housing; followed by Kennewick, 95%, and Richland, 96%. Representing 9% of the housing unit types, mobile homes had the lowest occupancy rate, 90% (Washington State Office of Financial Management 1993; Cushing 1994).

2.2.6.5 Transportation.

Tri-Cities Area. The Tri-Cities serve as a regional transportation and distribution center with major air, land, and river connections. The Tri-Cities are linked to the region by five major highways: Route 395, Route 240, Interstate 84, Interstate 82, and Route 14 (Cushing 1994). The Tri-Cities have rail services that connect the area to more than 35 states. Docking facilities at the Ports of Benton, Kennewick, and Pasco are located on the 525-km-long (326-mi-long) commercial waterway, which comprises the Snake and Columbia Rivers. Daily air passenger and freight services connect the area with most major cities through the Tri-Cities Airport, located in Pasco. The airport is currently served by one national and two commuter regional airlines.

Hanford Site Transportation. The transportation network for the Hanford Site is shown in Figure 2-15. Route 4 (Stevens Drive) is the primary roadway connecting Hanford Site locations to the city of Richland. South of the wye Barricade, Route 4 is a four-lane roadway (two lanes each direciton); north of the wye Barricade it is two lanes. Route 4 is considered to be at its maximum capacity and considered in need of major repairs (draft DOE-RL 1994b). Highway improvements necessary to support projected Hanford Site activities, including remediation projects, are being considered by DOE. Construction of the 240 Access Road connecting State Route 240 to the 200 West Area is underway, with completion anticipated in December 1994. The road is expected to help reduce traffic loads on Route 4. Average daily traffic on Route 4 just north of the intersection with State Route 240 is approximately 25,000 vehicles. An estimated 17,000 vehicles per day travel the section of Route 4 located between the 1100 Area and the 300 Area. Between the north end of the 300 Area and the Wye barricade, the average daily traffic load drops to approximately 11,000 vehicles. Between the Wye barricade and the 200 East Area, average daily traffic is approximately 7,000 vehicles (WHC Vehicle Safety 1994).

The Hanford Site railroad system extends from the west side of Richland, Washington, throughout the Hanford Site. The DOE controls the rail access into the Hanford Site; the agency trackage ties in with the Union Pacific Railroad tracks southeast of the Richland "Y" area near the U.S. Highway 12 and Route 240 interchange. The DOE tracks serving the Hanford Site are installed parallel to the Route 240 bypass around the Richland, Washington urban area (DOE 1986). The primary Hanford Site railroad tracks from the 1100 Area to the 200 Area are located just west of the 300 Area. The tracks are used an average of 3 day/wk to transport materials from the 1100 Area to the 200 Areas using an average of 10 to 15 railcars. DOE has two operating 1500 horsepower engines, with a maximum load of 550,000 kg (250,000 lb). The Hanford Rail system is required by DOE orders to comply with U.S. Department of Transportation (DOT) rail regulations (for example, 49 CFR 213). Active railroad tracks are in good shape and meet or exceed DOT requirements.

300 Area Transportation. The existing transportation network in the 300 Area is shown in Figure 2-16. The main access road to the 300 Area, both north from the city of Richland and south from other areas of the Hanford Site, is Route 4 (Stevens Drive). George Washington Way provides access north from the city of Richland. Cypress Street, Apple Street, and the George Washington Way extension provide access into the 300 Area. These roads are considered in fair to good condition (Daly et al. 1991).

Roads within the central portion of the 300 Area are laid out in a broken grid pattern. These roads are of limited length, and structures commonly encroach on right-of-ways in the north end of the area. Access to roads in this area is limited, and many of the roadways are used for pedestrian traffic because of the lack of sidewalks. Public parking for the northern area is located outside the limited area fence. Private parking in the south end is provided at each facility. In general, roadways within the central 300 Area are in need of resurfacing and are considered in fair to poor shape (Daly et al. 1991).

Approximately 3.4 km (2.1 mi) of railroad track is within the 300 Area. The rail system is used to transport equipment for R&D programs and liquid wastes from the 340 Complex to 200 Area waste management facilities. The 300 Area rail system is only used one to two times a month. The railroad system tracks are generally sound and well maintained (Daly et al. 1991).

The submarine reactor compartment road travels diagonally across the southern end of the 300 Area. This roadway was constructed specifically to provide access from the Port of Benton to the low-level burial grounds located in the 200 East Area. The road is gravel surfaced and capable of handling the special heavy duty trailers used to haul the submarine reactor compartments (Daly et al. 1991).

2.2.6.6 Health Care and Human Services. The Tri-Cities have three major hospitals and five minor emergency centers. All three hospitals offer general medical services and include a 24-hour emergency room, basic surgical services, intensive care, and neonatal care (Cushing 1994).

The Tri-Cities offer a broad range of social services. State human service offices in the Tri-Cities include the Job Services office of the Employment Security Department; Food Stamp offices; the Division of Developmental Disabilities; Financial and Medical Assistance; the Child Protective Service; emergency medical service; a senior companion program; and vocational rehabilitation (Cushing 1994).

2.2.6.7 Police and Fire Protection. Police protection in Benton and Franklin counties is provided by Benton and Franklin counties' sheriff departments, local municipal police departments, and the Washington State Patrol Division headquarters in Kennewick. The Kennewick, Richland, and Pasco municipal departments maintain the largest staffs of commissioned officers, with 58, 44, and 39, respectively (Cushing 1994). The Hanford Patrol historically has patrolled the Hanford Site. The duties of the Hanford Patrol have now largely been relegated to the Benton County Sheriff's Department.

There were 134 paid firefighters in the Tri-Cities in 1994. In addition, there are 126 firefighters in the Hanford Site Fire Patrol, all trained to dispose of hazardous/dangerous waste and to fight chemical fires. Each Hanford Site station has access to a Hazardous Material Response Vehicle that is equipped with chemical fire extinguishing equipment; an attack truck that carries foam, halon, and Purple-K dry chemical; a mobile air truck that provides air for gasmasks; and a transport tanker that supplies water to six brush trucks (Cushing 1994).

2.2.6.8 Recreation and Aesthetics. The convergence of the Columbia, Snake, and Yakima Rivers offers the residents of the Tri-Cities a variety of recreational opportunities. The Lower Snake River Project provides boating, camping, and picnicking facilities in nearly a dozen areas along the Snake River. The Columbia River also provides ample water recreational opportunities on the lakes formed by the dams and along the Hanford Reach. The Hanford Reach is a popular recreational sport fishing area. Anadromous salmonids represent the majority of the sport fish harvested. Other significant sport catches include white sturgeon (*Acipenser transmontanus*), smallmouth bass (*Micropterus dolomieui*) and walleye (*Stizostedion vitreum*) (DOE-RL 1990a). Lake Wallula, formed by McNary Dam, offers a large variety of parks and activities, which attracted more than 3 million visitors in 1986. Swimming and water skiing are popular recreational activities as well. The public swimming area nearest to the 300 Area is located at Leslie R. Groves Park, approximately 0.8 km (0.5 mi) downstream from the city water intake (DOE-RL 1990a).

The Columbia Basin is a popular recreational hunting area, where deer, rabbits, waterfowl, and upland game birds are harvested. Furbearing mammals are also trapped in this area (DOE-RL 1990c). However, no hunting is allowed on the Hanford Site except within the Wahluke Slope Wildlife Area, located north of the Columbia River.

Aesthetics and Visual Resources. The land in the vicinity of the Hanford Site is generally flat with little relief. Rattlesnake Mountain, rising to 1,060 m (3,478 ft) above mean sea level, forms the western boundary of the site, and Gable Mountain and Gable Butte are the highest land forms within the site. Both the Columbia River, flowing across the northern part of the site and forming the eastern boundary, and the spring- and fall-blooming desert flowers provide a visual source of enjoyment to people. The White Bluffs, steep bluffs above the northern boundary of the river just north of the 300 Area, are also an aesthetic feature of the landscape (Cushing 1994).

Most of the buildings within the 300 Area are government research and fabrication facilities constructed during the late 1940's, 1950's, and 1960's. There is no unifying style, design, or organization plan associated with the area, and the use of landscaping and other aesthetic amenities are minimal. The facilities are served by a network of overhead power lines that crisscross the 300 Area and give an industrial character to the 300 Area.

2.2.6.9 Utilities.

Water. The principal source of water in the Tri-Cities and the Hanford Site is the Columbia River. The water systems of Richland, Pasco, and Kennewick drew a large portion of the 11.78 billion gallons used in 1993. Each city operates its own supply and treatment system (Cushing 1994). More information on water use is presented in Section 2.2.6.2.

The major incorporated areas of Benton and Franklin counties are served by municipal wastewater treatment systems, whereas the unincorporated areas are served by onsite septic systems. The city of Richland wastewater treatment system is designed to treat a total capacity of 27 million m^3/yr (7,100 million gal/yr). In 1991, the system processed 18 million L/day (4.8 million gal/day) (Cushing 1994).

Electricity. In the Tri-Cities, electricity is provided by the Benton County Public Utility District, Benton Rural Electrical Association, Franklin County Public Utility District, and city of Richland Energy Services Department. All the power that these utilities provide is purchased from the Bonneville Power Administration (BPA), a federal power marketing agency. Natural gas, provided by the Cascade Natural Gas Corporation, serves a small portion of residents, with 5,800 residential customers in December 1993 (Cushing 1994).

Electrical power for the Hanford Site is purchased wholesale from BPA. Energy requirements for the Hanford Site during fiscal year 1988 exceeded 550 average MW (Cushing 1994). The Hanford electrical distribution system is used to distribute power to the bulk of the Hanford Site. The city of Richland distributes power to the 700, 1100, and 3000 Areas, which constitute approximately 2% of the total Hanford Site usage (DOE-RL 1994b).

300 Area Utilities. Water is delivered to the 300 Area from an intake on the Columbia River located within the 300 Area. About 50% of the raw water is used for process and laboratory requirements, and the other 50% is filtered at the 315 Filtered Water Plant. Filtered water is used for sanitary purposes, fire protection, and potable water. The water treatment plant capacity is 12 m^3/min (3,200 gal/min). The 300 Area water system is reported in poor but serviceable condition (Daly et al. 1991).

Electricity in the 300 Area is provided by two BPA 11-kV transmission lines. Power from these lines is delivered to the 300 Area through a substation located in the north end of the 300-FF-2 Operable Unit (Daly et al. 1991).

The 384 Power House Building currently uses three backup oil-fired boilers to provide steam for building heating. The three main coal-fired boilers are shut down because of problems with the coal handling systems. Steam is distributed to facilities via both under- and above-ground lines.

Four sewer systems are located in the 300 Area: a sanitary sewer, a process sewer, a radioactive liquid waste sewer, and a retention process waste sewer. The retention process sewer serves facilities that have the potential to introduce radioactive wastes into the process sewer. Flow from these facilities is routed to the 307 Retention Basin (300-FF-2 Operable Unit) and monitored for radioactivity. Radioactive wastes from this system are retained in the retention basins. The radioactive liquid waste sewer provides for the collection and load-out of low-level radioactive liquid wastes. The system primarily serves PNL buildings. The system is in need of repair. The radioactive liquid waste sewer system will be remediated as part of the operable units in which it is located. The process sewer runs throughout the 300 Area and currently delivers effluent to the process trenches in the 300-FF-5 Operable Unit. The 300 Area Treated Effluent Disposal Facility (TEDF) located north of the operable unit is currently under construction. The facility is designed to treat 300 Area laboratory waste, and startup is expected in December 1994 (DOE-RL 1994b).

The sanitary sewer consists of a network of pipelines that carry wastes to two septic tanks that discharge to the sanitary trenches located in the 300-FF-5 Operable Unit. It is planned to connect the sanitary sewer system to the city of Richland sewer system by the end of 1994, when discharge to the sanitary sewer trenches will cease.

2.2.6.10 Noise. Studies at Hanford of the propagation of noise have been concerned primarily with occupational noise at work sites. Environmental noise levels have not been extensively evaluated because of the remoteness of most Hanford Site activities and isolation from receptors that are covered by federal or state statutes.

Environmental noise measurements were made in 1981 during site characterization of the Skagit/Hanford Nuclear Power Plant Site (PSPL 1982). Fifteen sites were monitored and noise levels ranged from 30 to 60.5 dBA (Leq). The values for isolated areas ranged from 30 to 38.8 dBA. Measurements taken around the sites where the Supply System was constructing nuclear power plants (WNP-1, WNP-2, and WNP-4) ranged from 50.6 to 64 dBA. Measurements taken along the Columbia River near the intake structures for WNP-2 were 47.7 and 52.1 dBA compared to more remote river noise levels of 45.9 dBA (measured about 5 km [3 mi] upstream of the intake structures). Community noise levels in North Richland (3000 Area at Horn Rapids Road and the Bypass Highway) were 60.5 dBA (Cushing 1994).

Baseline traffic noise levels were determined for two locations: State Route 24, leading from the Hanford Site west toward Yakima, and State Route 240, south of the Hanford Site and west of Richland where the maximum volume of traffic occurs (DOE 1991). Traffic volumes were predicted based on an operational work force and a construction work force. Both peak (rush hour) and off peak hours were modeled. The modeling predicted a maximum dBA increase in noise to a receptor located 24 km (15 mi) from the State Route 240 location. An increase of 5 dBA or less over background would not be expected to cause an adverse community response (Cushing 1994).

Site characterization studies performed in 1987 included measurement of background environmental noise levels at five sites on the Hanford Site. Noise levels are expressed as equivalent sound levels for 24 hours (Leq-24). Wind was identified as the primary contributor to background noise levels, with winds exceeding 19 km/hr (12 mi/hr) significantly affecting noise levels. Hanford Site background noise levels in undeveloped areas are described as a mean Leq-24 of 24 to 36 dBA. Periods of high wind, which normally occur in the spring, would elevate background noise levels (Cushing 1994).

The Hanford Environmental Health Foundation has monitored noise levels resulting from several routine operations performed at Hanford. Occupational sources of noise propagated in the field are summarized in Table 2-9. These levels are reported here because operations such as well sampling are conducted in the field away from established industrial areas and have the potential for disturbing sensitive wildlife.

2.2.7 Ecology

2.2.7.1 Hanford Site Ecology. The Hanford Site is a relatively large, undisturbed area [1,450 km^2 (~560 mi^2)] of shrub-steppe habitat that contains numerous plant and animal species adapted to the region's semiarid environment. The relatively undisturbed native sagebrush-steppe habitat, riparian habitat, sand dunes and unique habitats associated with canyons, basalt outcrops and cliffs, promote biodiversity and support ecologically important species. Important species include plant species of medicinal and dye value, commercial and recreational wildlife including state- and federal-listed and candidate threatened or endangered species, as well as species that make up critical habitat used by listed and candidate species. The site consists of mostly undeveloped land with widely spaced clusters of industrial buildings located along the western shoreline of the Columbia River and at several locations in the interior of the site. The industrial buildings are interconnected by roads, railroads, and electrical transmission lines. The major facilities and activities occupy about 6% of the total available land area, and their impact on the surrounding ecosystems is minimal. Most of the Hanford Site has not experienced tillage or livestock grazing since the early 1940's.

The Columbia River flows through the Hanford Site, and although the river flow is not directly impeded by artificial dams within the Hanford Site, the historical daily and seasonal water fluctuations have been changed by dams upstream and downstream of the site (Rickard and Watson, 1985). The Columbia River and other water bodies on the Hanford Site provide habitat for aquatic organisms. The largest wetland habitat found on the Hanford Site is located within the riparian zone of the Columbia River (Cushing 1994). The Columbia River is also accessible for public recreational use and commercial navigation.

Additional information on Hanford Site ecology is provided in the 300-FF-5 Phase I RI (DOE-RL 1994d).

2.2.7.2 300 Area Ecology.

Vegetation. The non-riparian plant communities in the vicinity of the operable unit is characterized as shrubsteppe consisting of antelope bitterbrush/Sandberg's bluegrass. Diversity in the non-riparian habitat is lower than in the riparian zone. The shoreline (riparian) vegetation along the Columbia River in the vicinity of the 300-FF-5 Operable Unit consists mostly of a narrow zone of

perennial herbs with a few scattered deciduous trees and shrubs. The dominant riparian vegetation in the operable unit included white mulberry and peachleaf willow, reed canarygrass and bulbous bluegrass, and a large variety of forbs. Columbia yellowcress was the only protected species found during the riparian surveys. A total of 18 separate groups of columbia yellowcress were discovered in the operable unit and vicinity (Brandt et al. 1993a).

Fauna. The fauna of the operable unit is typical of the Hanford Site shrub-steppe plant community, with additional diversity resulting from the ecotonal influence of the Columbia River. The most abundant fauna are the grasshopper (Ornithoptera), horned lark (*Eremophila alpestris*), western meadowlark (*Sturnella neglecta*), Great Basin pocket mouse (*Perognathus parvus*), cottontail rabbit (*Sylvilagus nuttallii*), and jackrabbit (*Lepus spp.*).

Fifty-three species of birds were documented on the summer and winter surveys conducted in the operable unit. The most abundant birds during the summer surveys were ring-billed and California gulls, which nest on Johnson Island (Island 17) and Island 18 (Figure 2-1). These birds forage primarily on fish and flying insects but are also opportunistic feeders. Bank swallows were the second most abundant bird noted. They are insectivorous and nest in shallow burrows excavated into the walls of the bluffs along the Columbia River. Forster's terns, the third most common species, consume primarily fish; they nest on Islands 17 and 18. A number of ducks and Canada geese use the operable unit habitat, some as permanent nesting residents (e.g., the mallard and Canada goose), others as over-winter migrants (e.g., bufflehead). Fish-eating waterfowl observed using the operable unit habitat include the common merganser and the eared grebe (Brandt et al. 1993a).

Mammal species observed, or identified by tracks or burrows, during surveys include the cottontail rabbit (*Sylvilagus nuttallii*), black-tailed hare (*Lepus californicus*), raccoon (*Procyon lotor*), coyote (*Canis latrans*), mule deer (*Odocoileus hemionus*), badger (*Taxidea taxus*), Great Basin pocket mouse (*Perognathus parvus*), deer mouse (*Peromyscus maniculatus*), Townsend's ground squirrel (*Spermophilus townsendii*), and western harvest mouse (*Reithrodontomys megalotis*). The northern grasshopper mouse (*Onychomys leucogaster*), deer mouse (*Peromyscus maniculatus*), house mouse (*Mus musculus*), long-tailed weasel (*Mustela frenata*) and beaver (*Castor canadensis*) were also identified within the operable unit during field surveys (Brandt et al. 1993a).

Reptiles expected to occur within the 300-FF-5 Operable Unit include the western yellow-bellied racer (*Coluber constrictor*), the gopher snake (*Pituophis melanoleucus*), the side-blotched lizard (*Uta stansburiana*), and the sagebrush lizard (*Sceloporus graciosus*) (Fitzner et al. 1979). Amphibians occurring in the riparian zone of the Columbia River are the Great Basin spadefoot (*Spea intermontanus*), the western toad (*Bufo boreas*), Woodhouse toad (*Bufo woodhouseii*), the bullfrog (*Rana catesbeiana*), and the Pacific treefrog (*Hyla regilla*) (Fitzner et al. 1979). None of the amphibians are abundant in the region. The occurrence within the 300-FF-5 Operable Unit of Woodhouse toads and western toads was noted during the biological surveys of the operable unit.

Four species of ants (*Solenopsis molesta, Formica manni, Formica subpolita*, and *Pogonomyrmex owyheei*) occupied the 618-7 burial ground and are likely present elsewhere in the 300-FF-5 Operable Unit according to a study conducted by Fitzner et al. (1979). Thiede (1992) conducted a study on harvester ant *(Pogonomyrmex owyheei)* colony densities near the 300 Area burial grounds. Harvester ant colony densities ranged from 11 to 53 colonies per 100 m^2 (330 ft^2) (Thiede 1992).

Aquatic Ecology. Phytoplankton species identified from the Hanford Reach include diatoms, golden or yellow-brown algae, green algae, blue-green algae, red algae, and dinoflagellates. Diatoms are the dominant algae in the Columbia River and make up more than 90% of the phytoplankton biomass. The main genera include *Asterionella, Cyclotella, Fragillaria, Melosira, Stephanodiscus*, and *Synedra* (Neitzel et al. 1982). Many of these originate in upstream reservoirs. A number of algae found as free-floating species in the Hanford Reach are derived from benthic flora detached by currents and water level fluctuations. The peak concentration of phytoplankton is observed in April and May, and minimum numbers occur in December and January. Green algae (Chlorophyta) and blue-green algae (Cyanophyta), occur in the phytoplankton community during warmer months, but in substantially fewer numbers than the diatoms (Brandt et al. 1993a).

Macrophytes are sparse in the Columbia River because of its strong currents, rocky bottom, and frequently fluctuating water levels. Macrophytes are present along gently sloping shorelines that are subject to flooding during the spring freshet and daily fluctuating river levels. Aquatic plants include duckweed (*Lemna*), pondweed (*Potamogeton*), waterweed (*Elodea*), and watermilfoil (*Myriophyllum*). Macrophytes were sampled at five locations within the 300-FF-5 Operable Unit. Plants were abundant in backwater areas where the current slackens and sediments accumulate. Watermilfoil was the most abundant species found, and it occurred at all sites. A small population of *Potamogeton* was found within the milfoil bed at one site (Brandt et al. 1993a).

The zooplankton populations in the Hanford Reach are generally sparse. In open-water regions, crustacean zooplanktons are dominant. Dominant genera are *Bosmina*, *Diaptomus*, and *Cyclops*. Densities are lowest in winter and highest in summer.

All major fresh-water benthic taxa are represented in the Columbia River. Insect larvae such as caddisflies (Trichoptera), midge flies (Chironomidae), and black flies (Simuliidae) are dominant. Other benthic organisms include limpets, snails, sponges, and crayfish. Two invertebrate candidates are being considered for inclusion on the threatened and endangered species list: the shortfaced lanx (*Fisherola nuttalli*) (Washington State list), and the Columbia pebble snail (*Fulminacola columbiana*) (federal and state lists).

A total of 43 fish species have been identified in the Hanford Reach (Cushing 1994). Of these 44 species, the chinook salmon (*Oncorhynchus tsawytscha*), sockeye salmon (*Oncorhynchus nerka*), coho salmon (*Oncorhynchus kisutch*), and steelhead trout (*Oncorhynchus mykiss*), use the river as a migration route to and from upstream spawning areas. The fall chinook salmon and steelhead trout also spawn in the Hanford Reach. However, the river adjacent to the 300-FF-5 Operable Unit is not used as a salmon spawning area (Brandt et al. 1993a). The American shad (*Alosa sapidissima)*, another anadromous species, also may spawn in the Hanford Reach. Other fish species identified include whitefish (*Coregonus clueaformis*), sturgeon (*Acipenser transmontanus*), smallmouth bass (*Micropterus dolomieui*), crappie (*Pomoxis annularsis*) and *nigromaculatus*), catfish (*Ictalurus punctatus*), walleye (*Stizostedion vitreum*), perch (*Perca flavescens*), carp (*Cyprinus carpio*), shiners (*Richardsonius balteatus*), suckers (*Catostomus macrocheilus*), and squawfish (*Ptychocheilus oregonensis*).

2.2.8 Species of Special Concern at the 300-FF-5 Operable Unit

Threatened and endangered plants and animals (including candidates) identified on the Hanford Site, as listed by the Federal government (50 CFR 17), Washington State Natural Heritage Program (1994) and Washington State Department of Fish and Wildlife, are shown in Tables 2-10 and 2-11. No plants or mammals on the Federal list of endangered and threatened wildlife and plants are known to occur within the 300-FF-5 Operable Unit. There are, however, several species of both plants and animals that are of concern or are under consideration for formal listing by the Federal Government and Washington State. Washington State designations, in all cases, are as strict as or stricter than the corresponding federal designations.

The columbia yellowcress (*Rorippa columbiae)* is listed as a Washington State endangered species and has been found in the riparian zone along the Columbia River within the 300-FF-5 Operable Unit (Brandt et al. 1993a). Two additional plant species that may occur within the 300-FF-5 Operable Unit boundaries are listed as Washington State threatened species. These species are Hoover's desert parsley (*Lomatium tuberosum)* and Columbia River milkvetch (*Astragalus columbianus)*. Thompson's sandwort (*Arenaria franklinii var. thompsonii)*, previously identified as a protected species, currently has no protected status. It was removed from the Washington State list of threatened species because of taxonomic issues related to its legitimacy as a variety.

Four bird species of concern are noted to occur in the vicinity of the operable unit. These species include Swainson's hawk (*Buteo swainsoni)*, Forster's tern (*Sterna forsteri*), long-billed curlew (*Numenius americanus*), and burrowing owl (*Athene cunicularia*). Of these special animals, the Washington State Department of Fish and Wildlife classifies the Swainson's hawk and burrowing owl as "State Candidate" species, and Forster's tern and long-billed curlew as "State Monitor" wildlife species. The long-billed curlew, the only federally listed species, is designated a Federal Candidate species.

2.2.9 300 Area Sensitive Environments

No sensitive environments, as defined in 40 CFR 300 Appendix A, are found near the 300 Area because much of the land has been disturbed. Undisturbed shrub-steppe habitat has been designated priority habitat by the Washington State Department of Wildlife because of its relative scarcity in the state and its importance as nesting, breeding, and foraging habitat for state- and federal listed or candidate sensitive species. This designation is a proactive measure to prevent species from becoming threatened or endangered. However, the shrub-steppe plant community in the 300-FF-5 Operable Unit has been extensively disturbed by human activities in the central portions of the operable unit. The bitterbrush-Sandberg's bluegrass community located along the western and northern margins of the 300-FF-5 Operable Unit has received the least human-induced disturbance.

Floodplains/wetlands, historic or culturally important properties, specially designated areas such as wildlife refuges, national parks, and wild and scenic rivers, prime agricultural land, federally listed or proposed and state listed or proposed threatened or endangered species or their habitat, and special sources of water are considered environmentally sensitive areas under the DOE NEPA implementing procedures in 10 CFR 1021.410 Appendix B of Subpart D, B(4). As discussed in Section 2.2.6.3 of this document, archaeological resources, including one site eligible for inclusion on the National Register of Historic Places, are present in the operable unit. Because some of the waste

management units and associated structures date from inception of the "Manhattan Project," the potential exists that facilities or structures within the operable unit could also be determined eligible for listing on the National Register of Historic Places. The Columbia River may be considered a sensitive environment because of its religious importance to Native American peoples.

The section of the Columbia River referred to as the Hanford Reach forms the eastern boundary of the operable unit. The Hanford Reach is the only portion of the Columbia River upstream of the Bonneville Dam that is not impounded by a dam. The Hanford Reach provides habitat, at least seasonally, for several endangered or threatened species; e.g., the riparian columbia yellowcress (*Rorippa columbiae)*, the American white pelican *(Pelecanus erythrorhynchos)* and bald eagle *(Haliaeetus leucocephalus)*. This reach is classified as a Class A (excellent) surface water by the state of Washington (WAC 173-201A-080). This designation requires protection of the water quality that will support the following uses: domestic, industrial, and agricultural water supplies; fish migration; fish and shellfish rearing, spawning and harvesting; wildlife habitat; recreation; and commerce and navigation.

The Hanford Reach is under consideration for designation as a Wild and Scenic River, which would impose restrictions on dams, navigation, or channelization of the reach. Public Law 100-605 authorized a study of the Hanford Reach. The purpose was to identify and evaluate the outstanding features of the Hanford Reach and immediate environment, and to examine alternatives for their preservation. The *Hanford Reach of the Columbia River, Comprehensive River Conservation Study and Environmental Impact Statement* identifies the study area as located from river mile 345 (McNary Pool) to river mile 396 (1 mi below the Priest Rapids Dam). During the study, the downstream boundary was moved to river mile 346.5, hence the 300-FF-5 Operable Unit is outside, but adjacent to, the study area. The report recommends that Congress designate the Hanford Reach a wildlife refuge and a Wild and Scenic River (NPS 1994). The final report was published in July 1994.

2.2.10 Wildlife Refuges

Several national and state wildlife refuges are located on or adjacent to the Hanford Site. These refuges are shown in Figure 2-17. As discussed in Section 2.2.8.5, the Hanford Reach has been recommended by the National Park Service for designation as a wildlife refuge and Wild and Scenic River (NPS 1994).

2.3 NATURE AND EXTENT OF CONTAMINATION

The chemical and radiological contaminants that potentially pose risk to human health and the environment are termed the contaminants of potential concern (CsOPC) for the operable unit. CsOPC were identified through a step-wise screening process that considered laboratory and field blank data, background concentrations, appropriate regulatory criteria, and media-specific risk-based benchmark screening concentrations. The CsOPC represent a list of contaminants that were retained for later use in the baseline risk assessment. All compounds that were eliminated by the screening process were dropped from further consideration in the baseline risk assessment. This subsection summarizes the chemical and contaminant characteristics of the operable unit that resulted from this screening process. Table 2-12 lists the CsOPC for each of the exposure scenarios and the maximum concentrations detected in each medium. Table 2-12 also lists the total number of results and detects

for each CsOPC, as well as the chemical-specific MCLs. The constituents listed in Table 2-12 were further screened in the baseline risk assessment to arrive at the list of contaminants of concern (Section 2.5).

2.3.1 Sources of Contaminants

As discussed in Chapter 1.0, sources of groundwater contaminants in the 300-FF-5 groundwater operable unit are not addressed in this RI/FS. Sources of contamination include the two source area operable units above the water table (300-FF-1 and 300-FF-2), groundwater contamination upgradient (to the north and west) of the 300 Area, and groundwater contamination from the vicinity of the 1100 Area. The primary 300 Area sources of groundwater contamination are believed to include the 316-5 process trenches and the 316-1 (south) and -2 (north) process ponds. The locations of these facilities are shown in Figure 1-3.

2.3.2 Groundwater

For groundwater, the identified contaminants of potential concern were:

- Total coliform bacteria, 1,2-DCE (total and trans), TCE, chloroform, nitrate, ^{90}Sr, ^{99}Tc, tritium, total uranium, ^{234}U, ^{235}U, ^{238}U, nickel, and copper.

As explained in the RI (DOE-RL 1994d), three screening scenarios were performed for groundwater:

- Results from all wells
- Results from the existing production well (399-4-12)
- Results from wells in the tritium plume.

Table 2-12 summarizes the CsOPC and the associated maximum concentrations for the three groundwater screening scenarios.

All of the groundwater contaminants of potential concern were associated only with the unconfined aquifer. The contaminants of potential concern that were identified for the confined aquifer were eliminated because of low frequency of detection, inconsistent detection, and/or suspected problems with poor well construction at well 399-1-16C. Groundwater elevation monitoring at the 399-1-16C well cluster, review of well construction records, and other calculations presented in the Phase I RI (DOE-RL 1994d) resulted in the conclusion that leakage was occurring through the well's annular seal, and possibly from casing joints. As such, the well underwent remediation during the summer of 1993, and monitoring results since have indicated that the effort was successful.

Although there are no toxicity values available from which to calculate risk-based screening concentrations, total coliform bacteria was retained as a potential contaminant of concern based on regulatory standards.

Groundwater contamination at the 300-FF-5 Operable Unit generally consists of three main plumes (Figure 2-18). The primary plume, and the only one of the three that is derived from 300 Area operations, is centered beneath the 300-FF-5 Operable Unit. Contaminants associated with this plume are total coliform bacteria, chloroform, DCE, TCE, nickel, copper, ^{90}Sr, and the uranium isotopes. Although the distribution of each contaminant varies somewhat because of differing transport properties and sources, maximum concentrations occur primarily in the vicinity of the 316-5 process trenches and the 316-2 (north) and 316-1 (south) process ponds (Figure 1-3).

A second plume, consisting of tritium, is present throughout the north and eastern portions of the 300-FF-5 Operable Unit (Figure 2-18). This plume is derived from operations in the 200 Area and is migrating into the 300-FF-5 Operable Unit from the north. At the time of the Phase I RI sampling, maximum tritium concentrations (approximately 12,000 pCi/L) occurred in the northern portions of the operable unit and declined to the south. The minimum detected concentrations (approximately 1,000 pCi/L) occurred approximately 400 m (1,300 ft) south of the 300-FF-5 Operable Unit.

The third plume, consisting of ^{99}Tc and nitrate, is migrating from the vicinity of the 1100-EM-1 Operable Unit located approximately 1.6 km (1 mi) west of the southern portion of the 300-FF-5 Operable Unit (Figures 1-2 and 2-17). Figure 2-10 presents groundwater gradients and flow in the 300 Area operable unit. TCE is also present in groundwater at the 1100-EM-1 Operable Unit (DOE-RL 1990a and 1992c).

The extent of groundwater contamination detected in the unconfined aquifer was presented in a series of plume maps prepared for compounds that displayed well-defined plume areas (i.e., compounds that were consistently detected throughout the operable unit). The plume maps were presented in Appendix K of the RI (DOE-RL 1994d) for the following compounds:

gross alpha	^{235}U
gross beta	^{238}U
^{90}Sr	chloroform
^{99}Tc	trichloroethene
total U	nickel
tritium	copper
^{234}U	

2.3.3 Sediment

Sediment samples were collected at four spring sites during low river stage levels. Hanford Site-specific background concentrations in river sediments (Weiss 1993) were available and were compared to detected compounds in 300 Area sediments. Compounds in the sediment detected above background concentrations were used during the risk-based and regulatory screening performed in the RI report (DOE-RL 1994d). No compounds were identified in sediments at concentrations that exceeded risk-based or regulatory screening. Therefore, there were no contaminants of potential concern in the Columbia River sediments that were retained for use in the risk assessment, and the sediment pathway was eliminated in the risk assessment as a human exposure pathway.

2.3.4 Surface Water

Contaminants of potential concern in surface water for the 300-FF-5 Operable Unit were: TCE, ^{99}Tc, tritium, ^{234}U, ^{235}U, and ^{238}U. Maximum values for these CsOPC are summarized in Table 2-12. Concentrations generally were observed to be highest close to the riverbank and lowest away from the riverbank. The maximum concentrations were all associated with the sample collected 1 m (3 ft) from the bank. Concentrations generally increased toward the downstream end of the 300-FF-5 Operable Unit. The maximum river concentrations of the uranium isotopes, tritium, TCE, and ^{99}Tc all occurred at the SP-11 sampling location (Figure 2-1).

2.3.5 Biota

A biotic uptake assessment was performed to determine if constituents of concern could be transported from contaminated groundwater and soil into the foodchain. Brandt et al. (1993b) considered several biological components, including riparian vegetation, small mammals, and aquatic vegetation. The study measured contaminant concentrations in the 300-FF-5 Operable Unit (terrestrial riparian habitats and the Columbia River) and in similar habitats immediately upriver.

Riparian Zone Vegetation. Aluminum, copper, iron, manganese, nickel, and uranium were statistically higher in reed canarygrass samples from the operable unit than from upriver samples. Uranium and copper were higher in operable unit samples of mulberry than in upriver samples. The highest concentrations were generally found in plants from the vicinity of the 300-FF-1 waste ponds. Uranium concentrations were highest near the process trenches. These differences were found to be similar to that observed in groundwater data. For further details see Brandt et al. (1993b)

Concentrations of most of the metals found in vegetation from the operable unit, however, were below concentrations regarded as toxic to plants. Exceptions were iron and nickel, which were found in a few samples at concentrations in the range considered to produce toxic effects in vegetation. The nickel result was not likely to be biologically significant, however, because of over-estimation of the concentration due to laboratory quality control problems. Quality control procedures that compared reported concentrations vs certified standard concentrations indicated that nickel was over-reported. A single sample of reed canarygrasss contained uranium concentrations outside the range considered to be normal even when corrected for possible over-reporting. No data on toxic ranges of this element have been reported.

Small Mammals. Brandt et al. (1993b) analyzed carcass and skin homogenates of house mice and Great Basin pocket mice obtained from an upriver control site and from within the 300-FF-5 Operable Unit. Carcass tissues of Great Basin pocket mice showed significant differences in manganese and uranium concentrations among sampling stations, with the highest manganese concentrations observed in mice captured at the southernmost sampling station. The highest uranium concentrations were observed at the trap site located near the process ponds. No significant differences were observed in tissue concentrations of any metal in house mice For discussions regarding the statistical design of the sampling program see Brandt et al. (1993b).

Great Basin pocket mice sampled from the southernmost sampling station had significantly enlarged livers relative to their body weight in comparison to pocket mice trapped farther upriver. Liver enlargement is a possible symptom of exposure to organic and metal contaminants, including

manganese. A number of factors, however, could contribute to these observed liver weight differences, such as dietary differences, age differences, and reproductive differences, as well as exposure to stressors not measured in the study. Both dietary differences and exposure to other contaminants remain unknown.

Aquatic Vegetation. Brandt et al. (1993b) also analyzed contaminants in periphyton and macrophyte communities above and within the operable unit. The results for periphyton samples showed that although the highest concentrations for most contaminants were found at the farthest downstream station, there was little evidence of a downstream trend in contaminant levels, and there was no evidence of stress in these organisms. Macrophyte samples, however, did show higher concentrations of aluminum, cadmium, chromium, copper, iron, lead, manganese, nickel, zinc, and uranium in samples from the operable unit compared to samples from upriver.

Samples of whitefish and carp have been collected routinely from the Columbia River and analyzed for radionuclides. The results of the analyses are reported in the yearly Hanford Site Environmental Reports. There are no data from fish adjacent to the 300 Area; however, no difference in fish tissue constituent concentrations is apparent upstream and downstream of the Hanford Site (Jaquish and Bryce, 1990).

2.4 CONTAMINANT FATE AND TRANSPORT

The contaminant fate and transport analyses serve as a bridge between the contaminant screening analysis and the baseline risk assessment. Contaminant fate and transport was discussed in the Phase I RI as it relates to the environmental media of subsurface water, surface water, and biota. The purpose of the analyses was to provide reasonably conservative estimates of future contaminant concentrations at points of potential receptor exposure. These concentrations served as input to the future exposure scenarios of the baseline risk assessment.

2.4.1 Subsurface Water Transport Analysis

The subsurface water transport pathway included in the 300-FF-5 Operable Unit consisted of the saturated zone only. The 300-FF-1 and 300-FF-2 source operable unit RI/FS studies address potential risks associated with the 300 Area unsaturated zone.

The purpose of the saturated transport pathway analysis performed in the Phase I RI was to calculate maximum future concentrations of 300-FF-5 Operable Unit CsOPC in operable unit groundwater. Maximum concentrations were calculated for the year 2018, the earliest time at which current institutional controls over groundwater use may be relaxed by DOE at Hanford. Maximum groundwater concentrations were assumed not to increase in the future. This assumption was considered valid for contaminants for which the surface or vadose zone source either is declining in strength, is removed, or is contained by source control measures.

No transport analysis was performed for total coliform, nitrate, ^{99}Tc, or tritium. Future coliform concentrations were assumed equal to those currently measured because total coliform is associated with sewage disposal which was expected to continue into the future for industrial land uses. Nitrate, ^{99}Tc and tritium migrate as plumes into the 300-FF-5 Operable Unit from sources

outside of the 300 Area. Transport modeling of both nitrate and ^{99}Tc is addressed in the 1100-EM-1 Operable Unit Phase I and II RI reports (DOE-RL 1990a and 1992c). Modeling of the tritium plume was considered beyond the scope of the 300-FF-5 Operable Unit RI/FS study, so future concentrations were assumed equal to present concentrations. The large areal extent of the tritium plume, its multiple sources located outside the 300-FF-5 Operable Unit, and the lack of any commercially available treatment technology poses a difficult remediation problem that is being addressed under the *Hanford Site Groundwater Remediation Strategy* (DOE-RL 1994c)

Because of uncertainty regarding the nature of the TCE/DCE source in groundwater, no transport analysis was performed for TCE or DCE. Therefore, it is not possible to model future concentrations of TCE and DCE in groundwater at the operable unit. Based on trend data, it was conservatively assumed that the concentrations of the compounds will remain constant through 2018. It is possible, however, that the TCE and DCE concentrations could decrease below MCLs before year 2018.

Numerical modeling of uranium in the saturated pathway was performed by WHC using the PORFLO-3 computer code (Runchel et al. 1992). Uranium was recognized as the only 300-FF-5 Operable Unit CsOPC that posed the greatest risk and was therefore selected to be run via the numerical model. Due to the size and complexity of the model (greater than 137,000 nodes) efforts were concentrated on uranium only. All other 300-FF-5 Operable Unit CsOPC were modeled analytically by solving an approximate analytical solution to the equation describing groundwater flow and contaminant transport in saturated porous media. The analytical model was benchmarked by comparing uranium modeling results with the numerical model. Both models predicted very nearly identical maximum uranium concentrations for the year 2018. Further information regarding the models can be found in Section 5.2 and Appendix D of the Phase I RI report (DOE-RL 1994d).

Table 2-13 summarizes the maximum concentrations measured in 1992 and predicted in 2018 for the groundwater CsOPC that were modeled.

Predictions of uranium concentration in the groundwater at and beyond the year 2018 have much uncertainty. Uranium migration and fate in the aquifer is dependent on its partitioning coefficient (K_d) between the aquifer water and soil matrix. Uranium K_d values are moderate and are usually published between 1 and 10 ml/g (Appendix I, DOE-RL 1994d). Observations of uranium concentrations in aquifer soils and adjacent groundwater in the 300 Area indicate K_d's could be as high as 25 ml/g (Tyler 1992). Both numeric and analytic modeling was conducted for uranium using K_d's between 1 and 25 ml/g. Assuming a K_d of 1 ml/g, uranium contaminants were flushed out of the unconfined aquifer by the year 2018. Assuming a K_d of 25 ml/g, remaining concentrations of total uranium ranged from about 10 to 20 pCi/L in the aquifer by the year 2018.

The fate and migration of uranium in the aquifer might also be dependent on kinetic or equilibrium solubility constraints. The possibility exists that uranium flow that was discharged to the 300 Area process trenches and possibly other waste management units in the 300 Area could have migrated as a solid phase or floc to the water table. This is possible because of the open framework gravels in the area and the high flux of percolating waste effluents to the water table after discharge. It is also possible that uranium saturated the aquifer and precipitated as a solid. Measured soil concentrations, used to calculate K_d's as high as 25 ml/g, may actually represent secondary sources of uranium floc in the aquifer matrix that is slowly dissolving and not associated with K_d equilibrium. Given the potential mass of uranium floc (based on maximum aquifer soil samples), the estimated flux

of groundwater in the impacted area, and the observed groundwater concentrations of uranium, modeling of uranium as a dissolving floc indicated that this secondary source could be dissolved by the year 2002. Uranium would then migrate through the aquifer into the Columbia River subject to K_d dominated mechanisms. Therefore, if secondary sources of uranium exist in the aquifer, they were predicted to add only about 10 years to the results of the K_d modeled results.

Results of the modeling for the other CsOPC (Table 2-13) demonstrate that chloroform was projected to move out of the unconfined aquifer and into the Columbia River in several years after disposal of discharge effluent to the 316-5 process trenches had hypothetically ceased (ceasing discharge to the process trenches is a Tri-Party Agreement milestone scheduled for December 1994). The maximum concentration of copper was projected to decrease from 11.6 μg/L (9.68×10^{-8} lb/gal) to 1.5 μg/L (1.3×10^{-8} lb/gal) between the years 1992 and 2018, and nickel decreased from 118 to 50 μg/L (9.85×10^{-7} to 4.2×10^{-7} lb/gal) during the same period. The reduction in maximum concentration for ^{90}Sr between the years 1992 and 2018 was 4.57 to 0.24 pCi/L.

2.4.2 Surface Water Transport Analysis

Columbia River transport of contaminated groundwater that discharges to the river along the boundary of the 300-FF-5 Operable Unit is the only surface water pathway for the operable unit. The purpose of the surface water transport analysis was to estimate future concentrations of 300-FF-5 Operable Unit CsOPC in the Columbia River resulting from discharge of operable unit contaminated groundwater. Contaminant concentrations in the Columbia River were estimated at two potential receptor locations. The first location was near the southern boundary of the 300-FF-5 Operable Unit, where contaminant concentrations in the Columbia River adjacent to the 300 Area are generally greatest. The second receptor location was downstream of the 300 Area at the city of Richland river intake/pumphouse.

Future Columbia River concentrations were not estimated at either receptor location for total coliform, nitrate, ^{99}Tc, and tritium. Disposal of coliform bacteria is ongoing and was expected to continue indefinitely. The maximum future concentration of total coliform in the Columbia River was therefore assumed to be equal to the maximum river concentration measured during the year 1992 [30 colony forming units (cfu)/100 mL]. The 300-FF-5 impacts of nitrate, ^{99}Tc, and tritium are associated with plumes originating from sources outside the 300 Area. Impacts to the Columbia River from the nitrate and ^{99}Tc plumes were modeled for the 1100-EM-1 Operable Unit Phase I and II RI Reports (DOE-RL 1990a and 1992c). Modeling the tritium plume was beyond the scope of this effort (because the source originates from outside of this operable unit), so it was assumed that concentrations of this contaminant would remain constant beyond the year 2018.

Calculating future contaminant concentrations in the Columbia River adjacent to the 300 Area was accomplished by first calculating an average and maximum "proportionality factor" representing the current flux of groundwater contaminants entering the river to observed average and maximum river concentrations (Sections 5.2.2 DOE-RL 1994d). These proportionality factors were then multiplied by the contaminant mass flux estimated to enter the river in the future. At low river stages (maximum observed concentrations in river water), 1,2-DCE (total and trans) was not detected in river water which prevented calculating a proportionality factor for this contaminant. The maximum future Columbia River concentrations of 1,2-DCE (total and trans) were therefore assumed to be at or near zero. Using the aforementioned method, the average and maximum future Columbia River

concentrations were calculated and are shown in Table 2-14. With the possible exception of copper and nickel, the maximum future mass flux into the Columbia River for all 300-FF-5 Operable Unit contaminants of potential concern is approximately equal to or less than the current mass flux into the river. Concentrations of 300-FF-5 Operable Unit CsOPC were, therefore, generally not expected to increase at the city of Richland pumphouse as a result of discharge of contaminated groundwater from the operable unit into the Columbia River.

2.4.3 Biotic Transport Analysis

The 300-FF-5 Operable Unit includes both the riparian zone along the Columbia River shoreline and the terrestrial mature sagebrush and bitterbrush habitat along the north boundary of the operable unit. The riparian zone includes wetlands protected under the Clean Water Act, and the terrestrial habitat is used by a number of rare and protected species. The Columbia River was also included as part of the biotic transport analysis because of the potential impact of the 300-FF-5 Operable Unit on river biota.

Uptake of contaminants from soil via contaminated groundwater by vegetation serves as the basic source of entry into the riparian food chain. The herbivore component, represented as insects and birds, act as the primary conduit between contaminants in vegetation and contaminants in carnivores. Primary carnivores prey almost entirely on herbivores while secondary carnivores prey on other carnivores as well as herbivores. An example of a riparian zone food web centered on cheatgrass is shown in Figure 2-19.

The aquatic food web assumes the source of contamination to the river are the springs located along the 300 Area shoreline. Once groundwater enters the river, contaminants present in the groundwater are available for biological uptake. The base of the aquatic ecosystem consists of the water and dissolved nutrients which nourish the primary producers, or photosynthetic organisms, in the river. Plants constitute the primary producer level of the aquatic ecosystem. The rest of the ecosystem consists of herbivores and carnivores typically found in this environment. More details can be found in Section 5.2.3 of the Phase I RI report (DOE-RL 1994d) or Cushing (1994).

Twenty-one birds listed as threatened, endangered, or candidates for listing by the state of Washington or the Federal Government have been observed near the 300-FF-5 Operable Unit. These birds included the loggerhead shrike, burrowing owl, common loon, and sage sparrow. No listed mammals have been observed or documented in the vicinity of the 300-FF-5 Operable Unit. There were two species of mollusk found in the Columbia River listed as candidates for protection under the Endangered Species Act. These were the shortfaced lanx *(Fisherola nuttalli)* a Washington State candidate species and the Columbia pebblesnail *(Fluminicolla colombiana)* both a federal and state candidate species. Although not threatened or endangered, species of economic importance in the Columbia River were chinook salmon, sockeye salmon, coho salmon, and steelhead trout (Cushing 1994).

2.5 BASELINE RISK ASSESSMENT

The Hanford Site Risk Assessment Methodology (HSRAM) (DOE-RL 1993e) has been developed to guide human health and ecological evaluations of risk at the Hanford Site. This methodology is intended to make Hanford Site risk assessments consistent with current regulations and guidance, and to provide direction on flexible, ambiguous, or undefined aspects of the guidance. The HSRAM identifies risk assessment considerations specific to the Hanford Site and integrates them with established approaches for evaluating human health and ecological risk. The methodology has multiple risk assessment applications within the environmental restoration program, such as baseline risk assessments, qualitative risk assessments, and evaluation of the risks from remedial alternatives.

The Phase I RI baseline risk assessment contained both human health and ecological components. Two human health evaluations were performed. First, the 300-FF-5 Operable Unit was evaluated based on current as well as future groundwater and surface water contaminant conditions. Second, the impact of 300-FF-1 soils on groundwater in the future (2018) was also evaluated. These assessments were performed separately because each assessment had very different implications in terms of possible remediation efforts. The human health evaluation of the 300-FF-5 Operable Unit impact on groundwater is not presented here because those results are addressed in the FS report for the 300-FF-5 Operable Unit (DOE-RL 1994f). The ecological risk assessment is based on current contaminant conditions.

Under CERCLA and the NCP, acceptable incremental carcinogenic risk is considered to be between 10^{-4} and 10^{-6}. The MTCA specifies 10^{-5} as the maximum allowable for industrial sites. Consistent with these regulations, the baseline risk assessment summarized below uses a 10^{-6} risk level as the "point of departure" for evaluating pathways and contaminants of concern, because this represents the minimum level of risk that can be considered unacceptable and is therefore conservative. However, use of a 10^{-6} screening level for risk does not preclude use of higher risk levels in setting remedial action objectives and remediation goals.

2.5.1 Human Health Assessment - 300-FF-5 Contaminants

To assess human health impacts, 300-FF-5 Operable Unit CsOPC were evaluated under four exposure scenarios (industrial, residential, recreational, and agricultural), three locations (300 Area, on Hanford Site, and off Hanford Site), and for current and future conditions. The "on Hanford Site" scenario consists of receptors located on the Hanford Site but outside the 300 Area. The "off Hanford Site" scenario includes receptors located off the Hanford Site. The source of exposures for these receptors is the Columbia River at Richland (for off Hanford Site) and the Columbia River adjacent to the 300 Area (for on Hanford Site). Table 2-15 indicates the locations and times for which each of the exposure scenarios was evaluated. Table 2-16 and Figure 2-20 (current), and Table 2-17 and Figure 2-21 (future) indicate the media and exposure points through which receptors may become exposed to contaminants.

Nonradioactive contaminants were evaluated for both non-carcinogenic and carcinogenic effects, as appropriate. Radioactive contaminants were evaluated only for their carcinogenic potential.

The largest hazard quotient (HQ) (an indicator of non-carcinogenic human health impacts) was 0.2 (DOE-RL 1994d). Since this value is nearly an order of magnitude less than 1, no current or future systemic toxic effects were expected to occur as a result of exposure to contaminants at the operable unit.

2.5.1.1 Current Conditions. A summary of lifetime incremental cancer risks (ICR) associated with CsOPC under current conditions is provided in Table 2-18. The only current scenario that exceeded a 10^{-6} risk was the industrial scenario with receptors on the 300 Area (2×10^{-5}) (current risks were estimated for industrial exposure to groundwater in the 300 Area and for residential, agricultural, recreational, and industrial exposure to surface water off the Hanford Site). However, this risk resulted primarily from chloroform in groundwater, which was attributable to water chlorination. By excluding chloroform from the assessment, the groundwater risk dropped to 1×10^{-6}. The surface water risk for industrial receptors (based on actual average contaminant concentrations in the 300 Area water intake) was 9×10^{-8}. Therefore, the total risk to industrial receptors on the 300 Area was 1×10^{-6} (excluding the contribution from chloroform). A list of the contaminants of concern (for current exposure scenarios), and their associated pathway-specific risks is provided in Table 2-19.

A major current downstream user of Columbia River water is the city of Richland, which supplies the municipality with drinking water from the Columbia River. This water supply is routinely analyzed. Based on available data, the ICR from the water supply system for all uses was below 10^{-6}. The future risk to the city of Richland river water supply from 300-FF-5 contaminants will be less than estimated for today, because the discharges of contaminants to the river decrease with time.

The greatest current risk to humans (ICR of 2×10^{-5}) exists from inhalation of chloroform from the industrial onsite well 399-4-12 (Table 2-19). All other current risk levels for the scenarios evaluated for exposure to humans were at or below an ICR of 3×10^{-6}. Well 399-4-12 is the only well in 300-FF-5 extracting and using groundwater, and it is located outside of the highest concentrations of most contaminants in the aquifer. Chloroform is generated in the chlorination of river water obtained from the 300 Area intake. Chlorination of this water results in the formation of chloroform, which is present in the potable water supplies in the 300 Area. In comparison, concentrations of chloroform in finished drinking water collected in 1988 from 35 sites across the United States ranged from 9.6 to 15 μg/L (SRC 1991), which were higher than the maximum detected chloroform (8 μg/L) in groundwater from well 399-4-12. It is unreasonable to identify chloroform as a primary current risk driver at a nuclear fuel processing facility at Hanford when it is at concentrations below or comparable to acceptable levels typically found in drinking water supplies. Therefore, chloroform was not considered a contaminant of concern for the 300-FF-5 Operable Unit.

2.5.1.2 Predicted Future Conditions. Contaminants in the 300-FF-5 groundwater were predicted to either remain the same or decrease in the future (except for the ^{99}Tc and nitrate plume originating near 1100-EM-1 Operable Unit which is migrating into the 300 Area. This plume is addressed through natural attenuation as described in the 1100 Area ROD [Ecology et al. 1993]). This prediction assumed that source control measures will be implemented in 300-FF-1 and 300-FF-2 sources if potential groundwater impacts are unacceptable. A summary of ICRs for future 300-FF-5 Operable Unit exposure scenarios is provided in Table 2-20. Table 2-21 presents the ICRs associated with individual contaminants of concern under future conditions. Based on the use of predicted groundwater contaminant concentrations, the only future scenario that exceeded a 10^{-6} risk was the industrial scenario with receptors on the 300 Area (7×10^{-6}). Approximately half of this risk

was associated with the tritium plume from the 200 Area. The remaining risk driver (TCE) had an ICR of 3 x 10^{-6}, which was based on the conservative assumption that current TCE groundwater concentrations will remain constant beyond 2018. If the source of TCE is depleted before the year 2018 (Section 2.4.1), then the total industrial scenario risk (on the 300 Area) is reduced to 1x10^{-6} (excluding the contribution from tritium). The risk associated with TCE under future conditions has increased to 3 x 10^{-6} from current conditions (1 x 10^{-6}) despite the assumption that current TCE concentrations remain constant in the future. This is due to changes in assumptions regarding land use and exposure points (any well being used versus just 399-4-12) and exposure scenarios (ingestion now included in addition to inhalation).

Because of the availability of current data and the uncertainty in predicting future contaminant concentrations in the Columbia River, future predictions of risk were analyzed for average and maximum potential future impacts to the river. A summary of average and maximum ICRs associated with contaminants of concern under future river conditions is provided in Table 2-21. Based on the use of predicted average river contaminant concentrations, ICRs were all less than 10^{-6}. If the predicted maximum river concentrations were used to represent surface water in the 300 Area, then the risk to industrial receptors on the 300 Area became 2 x 10^{-5}. In addition, the risks to industrial, residential, and agricultural receptors on the Hanford Site exceeded 10^{-6} (8 x 10^{-6} [industrial], 2 x 10^{-5} [residential and agricultural]). However, these risk estimates included contributions from contaminants (i.e., chloroform and tritium) not associated with past practices at the 300 Area. In addition, many other conservative assumptions (in accordance with HSRAM [DOE-RL 1993e]) were built into these risk estimates such that they were considered bounding estimates that tend to overestimate the actual risks. A list of the contaminants of concern (for future exposure scenarios), and their associated pathway-specific risks, is provided in Table 2-21.

Although neither an HQ nor an ICR could not be calculated for coliform bacteria, portions of the aquifer (mainly between the sanitary trenches and the Columbia River) contain coliform bacteria. Current plans are to connect the 300 Area sanitary sewer system to the city of Richland sewage treatment plant. However, because the connection has not yet occurred, and the future land use was not anticipated to change from industrial, sanitary discharges were assumed to continue into the future for purposes of the Phase I RI. Thus, impacts to local portions of the aquifer by coliform bacteria were also assumed to continue. Coliform bacteria is a relatively common problem in natural water supply systems, and the usual abatement is chlorination of the water before distribution and use. Unacceptable health risks may result from future potable use of groundwater impacted by coliform bacteria if used without routine chlorination.

2.5.2 Ecological Risk Assessment

The purpose of the ecological risk assessment was to estimate the potential present and future baseline ecological risks for the 300-FF-5 Operable Unit contaminants to ecological receptors. These receptors include all organisms, except humans and domestic animals, potentially exposed to site contaminants.

The 300-FF-5 Operable Unit includes both a riparian and a river ecosystem. Both ecosystems are potentially affected by the constituents of concern and were evaluated in the risk characterization; however, the major focus of the risk assessment was the aquatic ecosystem, because the riparian ecosystem is relatively small.

The conceptual model used in the risk assessment included uptake of contaminants by vegetation through contact with contaminated groundwater as the pathway of contaminant entry into the riparian food chain as shown in Figure 2-18. Organisms potentially exposed to contaminated vegetation are mice and other wildlife that consume plants, and secondary predatroy species (e.g., Swainson's hawk) that consume herbivores. For the aquatic food chain, groundwater springs entering the Columbia River are the sources of aquatic contamination. Aquatic receptors of concern are fish and benthic organisms such as crustaceans and other animals potentially inhabiting the Columbia River area; e.g., raccoon and geese.

The available analytical data used in the risk assessment included measured wildlife concentrations for radionuclides and chemicals in mice and vegetation in the riparian zone (Brandt et al. 1993b) and groundwater source terms. The actual tissue concentrations measured in mice and vegetation were used as the source terms for riparian ecosystems. Source terms for the aquatic animals consisted of the groundwater constituent concentrations.

The results of the risk assessment indicated the following.

- For aquatic organisms, the calculated dose from radionuclides was less than the DOE Order 5400.5 limit of 1 rad/day. Therefore, no risk is indicated from ionizing radiation. However, lowest observable adverse effect levels (LOEL) were predicted to be exceeded in the river for copper and nickel. This was based on the use of maximum detected concentrations in groundwater and the very conservative assumption that these values are representative of river concentrations. The calculated radiological dose values to aquatic organisms are summarized in Table 2-22. Table 2-23 summarizes the toxicity value comparisons for aquatic organisms.

- For riparian systems, comparison of dose rate to avian no observable effect level (NOELs) show manganese to exceed the NOEL for the Swainson's hawk and loggerhead shrike (DOE-RL 1994d). The source of the manganese is ingestion of Great Basin pocket mice. Canada geese feeding on reed canarygrass also exceeded the NOEL for manganese.

There was considerable uncertainty in these risk characterizations, and the values are considered to represent bounding estimates that probably overestimate actual risks. For aquatic organisms, for example, maximum concentrations detected in groundwater were used as the source terms to represent Columbia River concentrations. In fact, the groundwater will be highly diluted upon entering the Columbia River. Measured contaminant concentrations in river water are at background levels in the river (except in nearshore water under extreme low flow conditions). For riparian receptors, maximum contaminant concentrations measured in mice and reed canarygrass were used also, and it was assumed that mice in the 300 Area riparian zone were the complete diet of the Swainson's hawk and loggerhead shrike and reed canarygrass along the 300 Area was the complete diet for Canada geese, which is an overestimate of potential foodchain exposure. Therefore, the risk assessment has overestimated the real risk because of the conservative exposure scenarios employed. No reported evidence exists to indicate any observable problems for riparian and aquatic organisms.

2.6 CONCLUSIONS AND RECOMMENDATIONS

The results of the RI for the 300-FF-5 Operable Unit, as summarized above in Sections 2.1 through 2.5, were used to develop recommendations for conducting and focusing further hazardous substance response activities needed to comply with the terms of CERCLA, NCP, and the Tri-Party Agreement. Section 2.6.1 provides recommendations for expedited response actions in accordance with the guidelines of 40 CFR 300. Section 2.6.2 provides recommendations for the supplemental RI activities, in terms of additional operable unit characterization. The need for treatability studies during the continued RI activities is addressed in the Phase I/II FS.

2.6.1 Recommended Expedited Response Actions

At the time of the completion of the RI, it was appropriate to conduct an expedited response action (ERA) evaluation in accordance with 40 CFR 300.410. The RI report was used, in part, to document such an evaluation for the 300-FF-5 Operable Unit. Taking into account factors specified in 40 CFR 300.415(b) (2), this section was used to recommend appropriate removal actions consistent with the guidelines provided in 40 CFR 300.415(d). An evaluation of the NCP guidelines referenced above indicated that ERAs at the 300-FF-5 Operable Unit were not necessary at the time of completion of the Phase I RI.

Therefore, it was recommended that no ERAs be implemented for the 300-FF-5 Operable Unit. It was recommended, however, that this evaluation be repeated once representative data are obtained regarding average shoreline river water concentrations and at other appropriate points in the remedial response process.

2.6.2 Recommended Additional Investigative Activities

For additional investigations, and in support of the 300-FF-5 Operable Unit FS, the following data collection activities were proposed in the Phase I RI (DOE-RL 1994d).

Columbia River Sampling to Determine Average Concentration of 300-FF-5 Contaminants of Concern in the River. Human and ecological risks from the Columbia River may be unacceptable using maximum detected river concentrations that were obtained during extreme low river stages during this RI. Such low river stages occur infrequently and do not represent a time averaged exposure. To more accurately determine risks from surface water pathways, a better understanding of the time weighted average concentrations of 300-FF-5 contaminants of concern is required. Additional sampling and analysis of near shore Columbia River water both seasonally and at various river stages was recommended to obtain empirical data for risk evaluations.

Continued Monitoring of the TCE and DCE Plumes in the 300-FF-5 Operable Unit. Because of difficulty in characterizing the nature of the TCE/DCE source in the unconfined aquifer, there is uncertainty as to the time required for the two compounds to reach acceptable levels in groundwater. Continued monitoring of the plume in site groundwater was therefore suggested. Trend analysis can be conducted on the results to extrapolate predictions based on empirical data. Historical groundwater quality data may be reviewed for validity and quality and, if adequate, used in the evaluation.

Determination of Uranium Fate and Transport. A better understanding of the fate and transport of uranium would provide more accurate predictions of future risk from groundwater and is important to more accurately predict the time necessary for uranium removal from the aquifer by extraction systems.

It was recommended that groundwater samples in the uranium plume be tested for differences in uranium concentrations with filtered and unfiltered split samples. This information would be used to better understand the representativeness of the monitoring data that is unfiltered and the transport mode of uranium in the groundwater system.

In addition, determination of whether uranium exists in the aquifer as a precipitate was recommended, particularly from aquifer soil samples near the 300 Area process trenches. The equilibrium solubility concentration of the precipitate should be determined, along with the time necessary to reach equilibrium.

Collecting information related to the mobility of uranium solutes in the aquifer was also recommended. Information of the groundwater chemistry (such as oxidation potential Eh) is pertinent to uranium solubility indices using filtered samples. In addition, the distribution coefficient (K_d) and the linearity of the Freundlich isotherm could be empirically determined using actual filtered samples of uranium-impacted groundwater at various concentrations and clean native aquifer soils. Adsorption and desorption tests were recommended for evaluation of the reversibility of the reactions.

Some of the investigative activities recommended in the Phase I RI for uranium fate and transport were considered unnecessary for this Supplemental RI and were therefore not performed. These activities included the work items related to uranium solubility, presence of a uranium floc in aquifer soils near the process trenches, determination of the Freundlich isotherm, and evaluation of the reversibility of the uranium sorption/desorption reaction. Work conducted included uranium analyses on filtered and unfiltered groundwater samples and evaluations of uranium sorption tendencies in soil. The latter, as discussed in Section 3.3.2, was performed as part of the 300-FF-1 Phase III FS. Some of the work items were not performed because they were not considered necessary from the standpoint of reducing uncertainties in fate and transport of uranium in groundwater, which was the overall aim of the uranium fate and transport recommended work. These uncertainties could be adequately addressed with a more limited scope of investigative activities. In addition, one of the work items (determination of the presence of uranium precipitate in the aquifer soils) could be evaluated by other means (i.e., continued groundwater monitoring) as discussed in Section 4.3.

Determination of the Valence State of Chromium in 300-FF-1 Sources. In the 300-FF-5 Phase I RI (DOE-RL 1994d), estimates were made of future concentrations in groundwater resulting from 300-FF-1 soil contaminants. In this calculation, the valence state of total chromium present in 300-FF-1 soils was conservatively assumed to be hexavalent. Hexavalent chromium is not only more mobile than trivalent chromium, but also much more toxic. Chromium would be a major risk driver for 300-FF-1 source impacts to groundwater if all chromium were hexavalent; it would not be a contaminant of concern if the trivalent state dominated. Determination of the valence state of chromium in 300-FF-1 sources was recommended to quantify risks from chromium impacting the underlying aquifer. Chromium was subsequently evaluated in the 300-FF-1 FS (DOE-RL 1994f). For reasons discussed in the 300-FF-1 FS, chromium in source materials was found to not be a

groundwater concern. Further investigation of chromium was therefore not necessary for the 300-FF-5 RI.

The supplemental RI conducted to obtain these data is described in Chapter 3.0 of this report. The data are evaluated to refine the baseline risk assessment in Chapter 4.0.

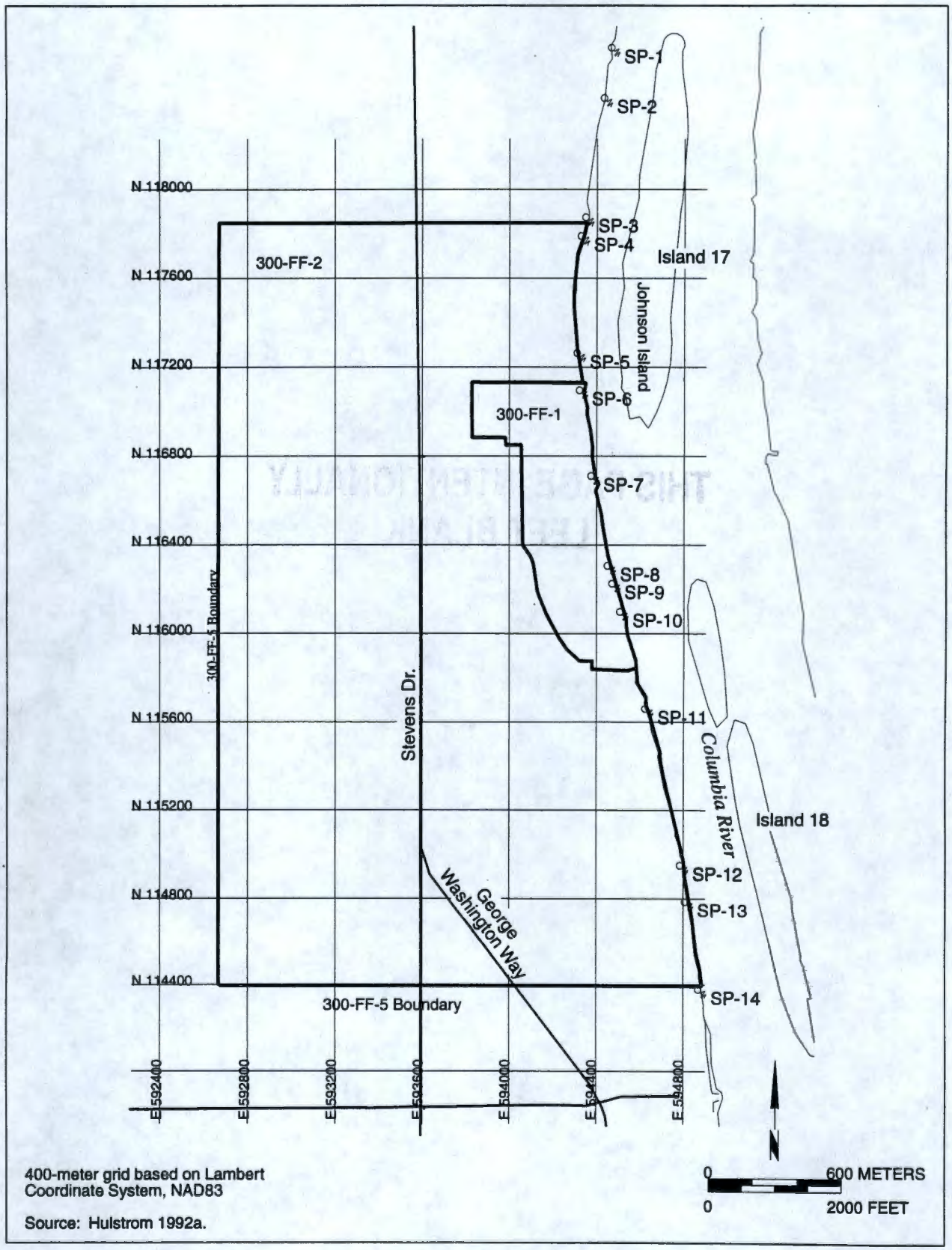

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Figure 2-1. Location of Springs and Seeps Along West Bank of Columbia River Adjacent to 300-FF-5 Operable Unit.

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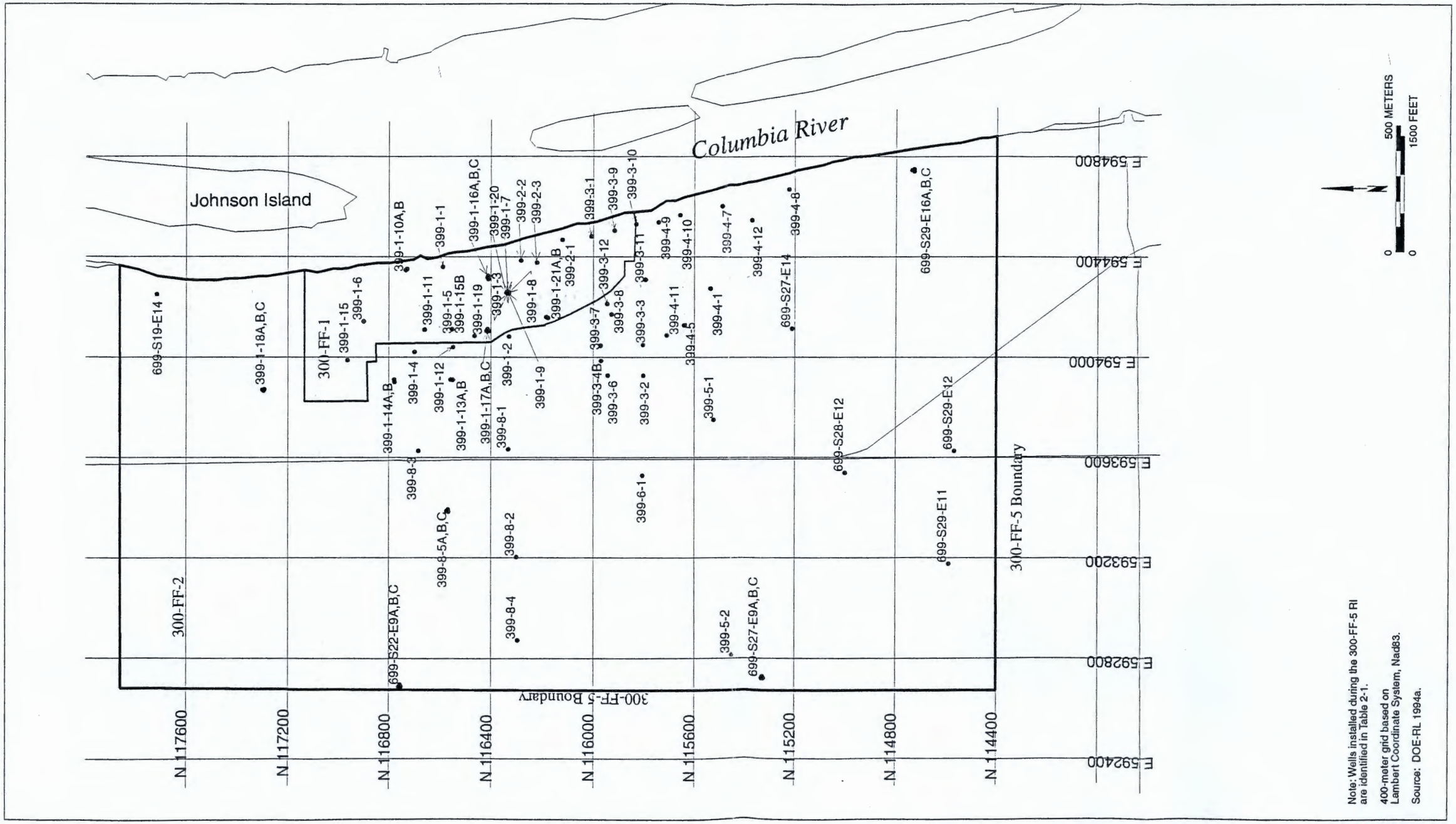

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Figure 2-2. Location of Monitoring Wells in the 300-FF-5 Operable Unit.

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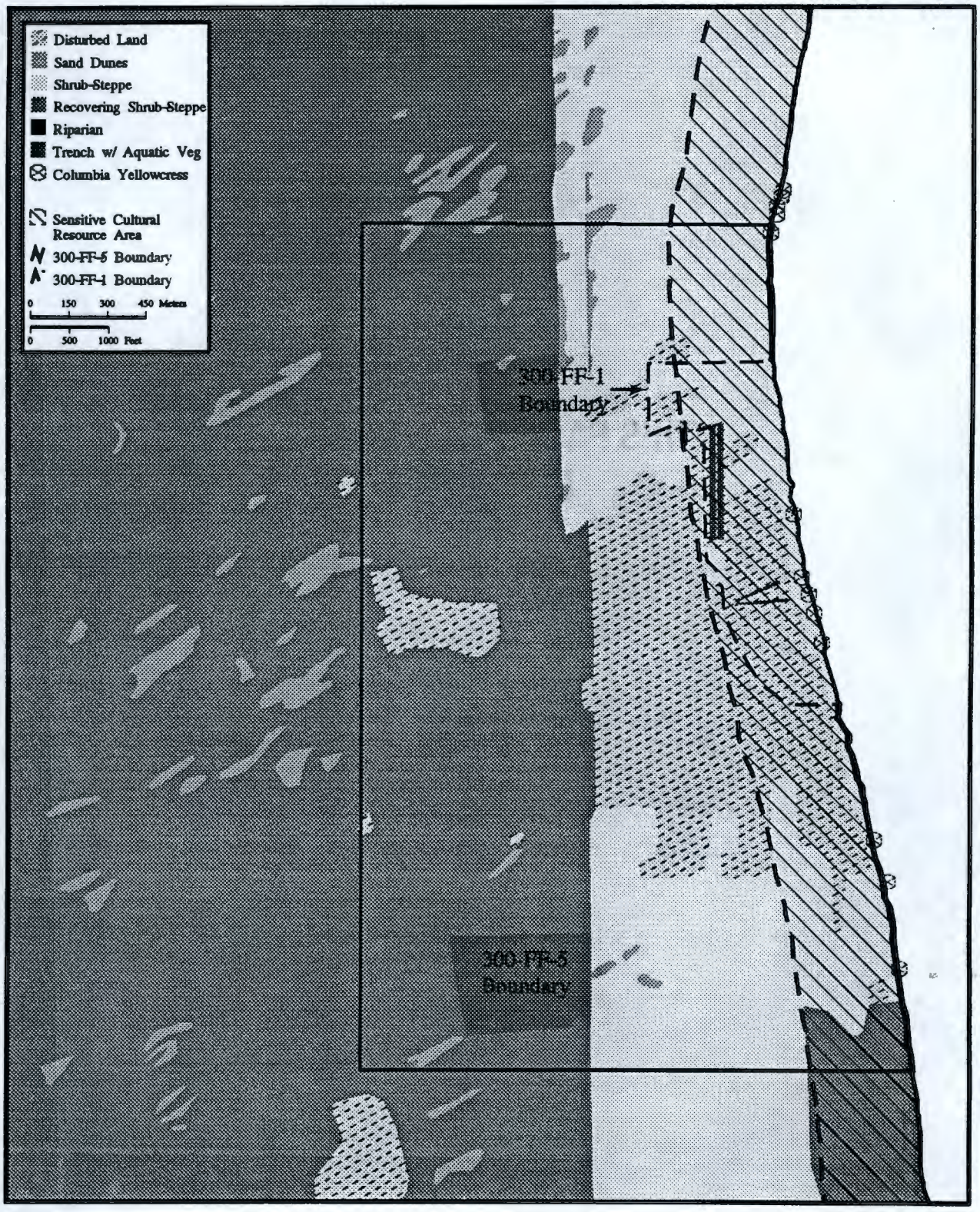

Figure 2-3. 300-FF-5 Operable Unit Vegetation Communities and Riverine Area of Potential Cultural Resources.

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Period	Epoch	Group	Formation	Isotopic Age Dates Years x 10 6	Member (Formal and Informal)	Sediment Stratigraphy or Basalt Flows	
QUATERNARY	Holocene				Surficial Units	Loess, Sand Dunes, Alluvium and Alluvial Fans, Land Slides, Talus, Colluvium	
	Pleistocene		Hanford Formation				
			Plio-Pleistocene/early Palouse/pre-Missoula Interval				
TERTIARY	Pliocene		Ringold Formation				
	Miocene	Columbia River Basalt Group	Saddle Mountains Basalt	8.5	Ice Harbor Member	basalt of Goose Island	Ellensburg Formation
						basalt of Martindale	
						basalt of Basin City	
						Levey interbed	
				10.5	Elephant Mountain Member	basalt of Ward Gap	
						basalt of Elephant Mountain	
						Rattlesnake Ridge interbed	
				12.0	Pomona Member	basalt of Pomona	
						Selah interbed	
					Esquatzel Member	basalt of Gable Mountain	
						Cold Creek interbed	
				13.5	Asotin Member	basalt of Huntzinger	
					Wilbur Creek Member	basalt of Lapwai	
						basalt of Wahluke	
					Umatilla Member	basalt of Silusi	
						basalt of Umatilla	
				14.5		Mabton interbed	
			Wanapum Basalt		Priest Rapids Member	basalt of Lolo	
						basalt of Rosalia	
						Quincy interbed	
					Roza Member	basalt of Roza	
						Squaw Creek interbed	
					Frenchman Springs Member	basalt of Lyons Ferry	
						basalt of Sentinel Gap	
						basalt of Sand Hollow	
						basalt of Silver Falls	
						basalt of Ginkgo	
						basalt of Palouse Falls	
				15.6		Vantage interbed	
			Grande Ronde Basalt*		N_2 Sentinel Bluffs Unit	basalt of Museum	
						basalt of Rocky Coulee	
						basalt of Levering	
						basalt of Cohassett	
						basalt of Birkett	
						basalt of McCoy Canyon	
				15.6	Umtanum Unit	basalt of Umtanum	
					Slack Canyon Unit		
					Ortley Unit	basalt of Benson Ranch	
					R_2 Grouse Creek Unit		
					Wapshilla Ridge Unit		
					Mt. Horrible Unit		
					N_1 China Creek Unit		
					R_1 Teepee Butte Unit		
					Buckhorn Springs Unit		
			Imnaha	16.5	Rock Creek Unit		
				17.5	American Bar Unit		

*The Grande Ronde Basalt consists of at least 120 major basalt flows. Only a few flows have been named.
N_2, R_2, N_1 and R_1 are magnetostratigraphic units.

Modified from: Gaylord and Poeter 1991.

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Figure 2-4. Basalt and Suprabasalt Stratigraphy at the Hanford Site, Washington.

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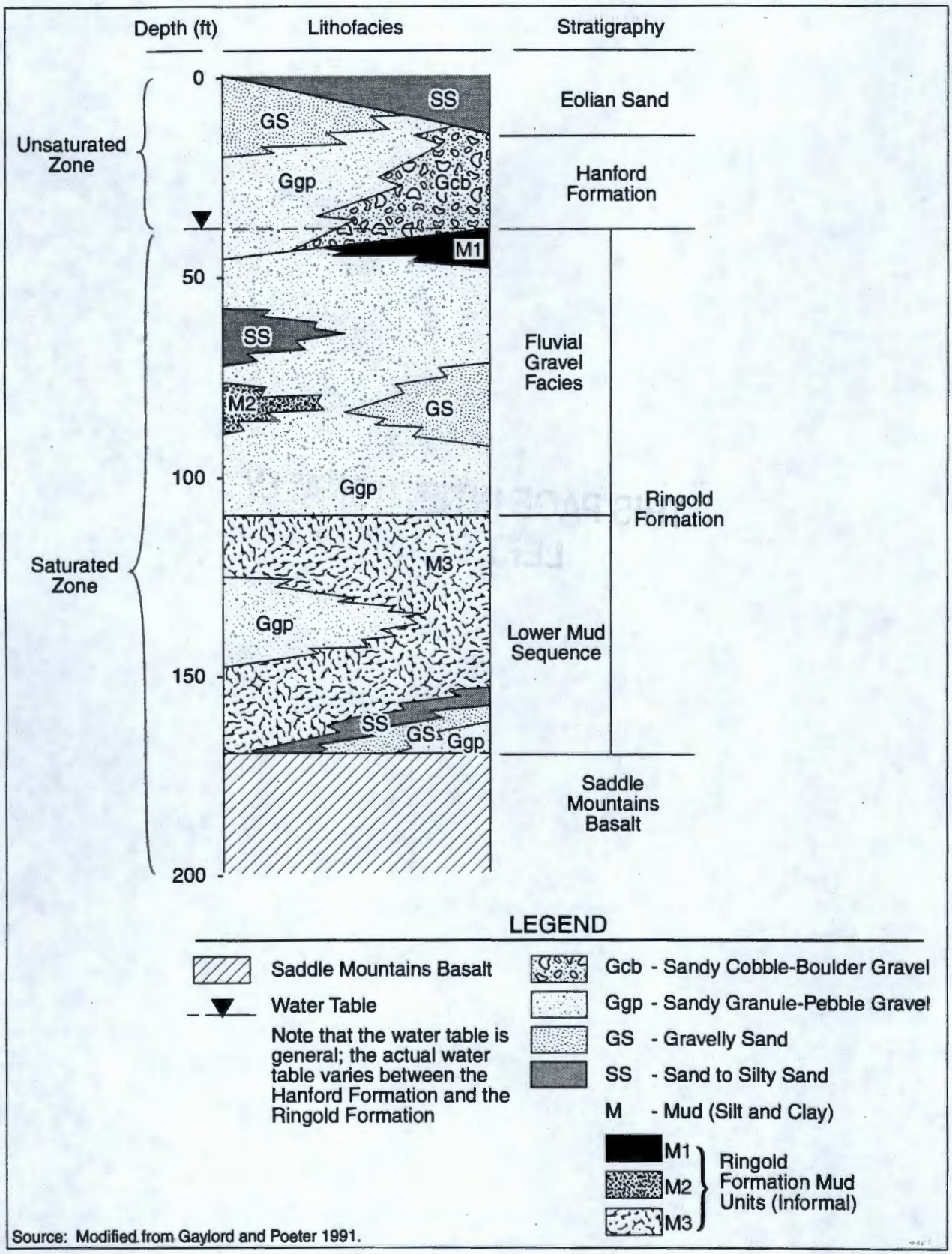

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Figure 2-5. Stratigraphy of Suprabasalt Strata Within and Near the 300 Area.

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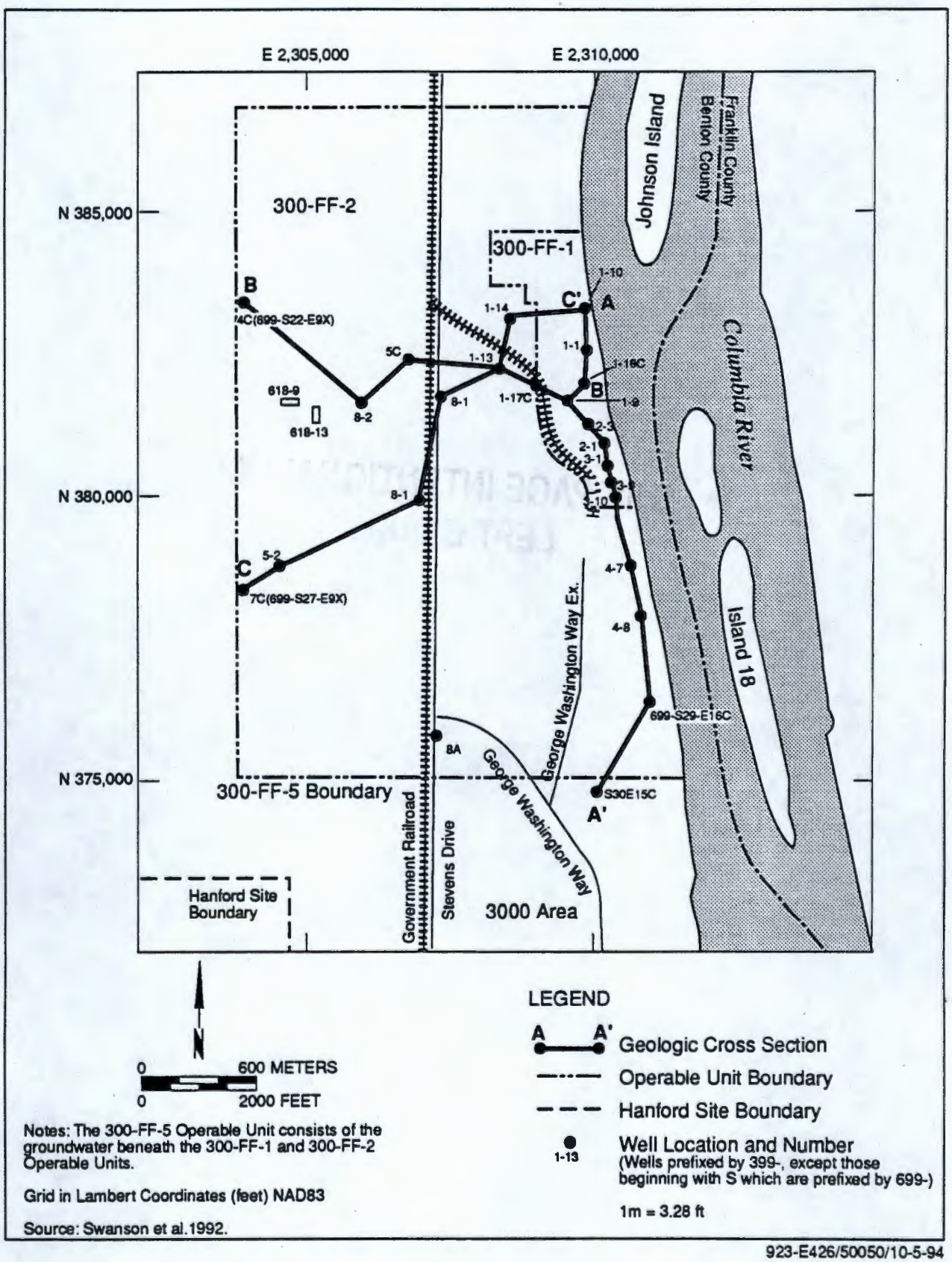

Notes: The 300-FF-5 Operable Unit consists of the groundwater beneath the 300-FF-1 and 300-FF-2 Operable Units.

Grid in Lambert Coordinates (feet) NAD83

Source: Swanson et al.1992.

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Figure 2-6. Location Map for Geologic Cross Sections.

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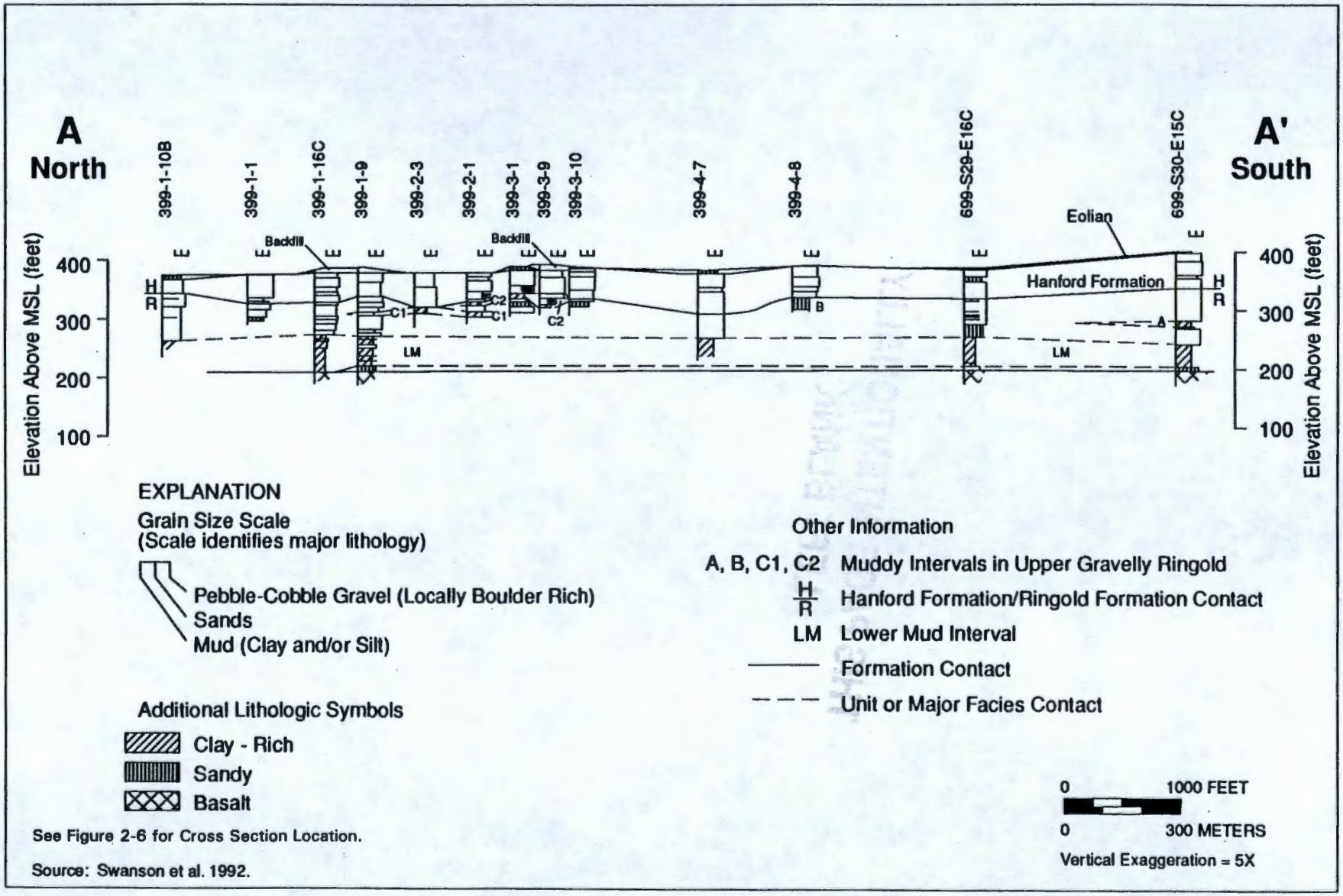

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Figure 2-7. Geologic Cross Section A-A'.

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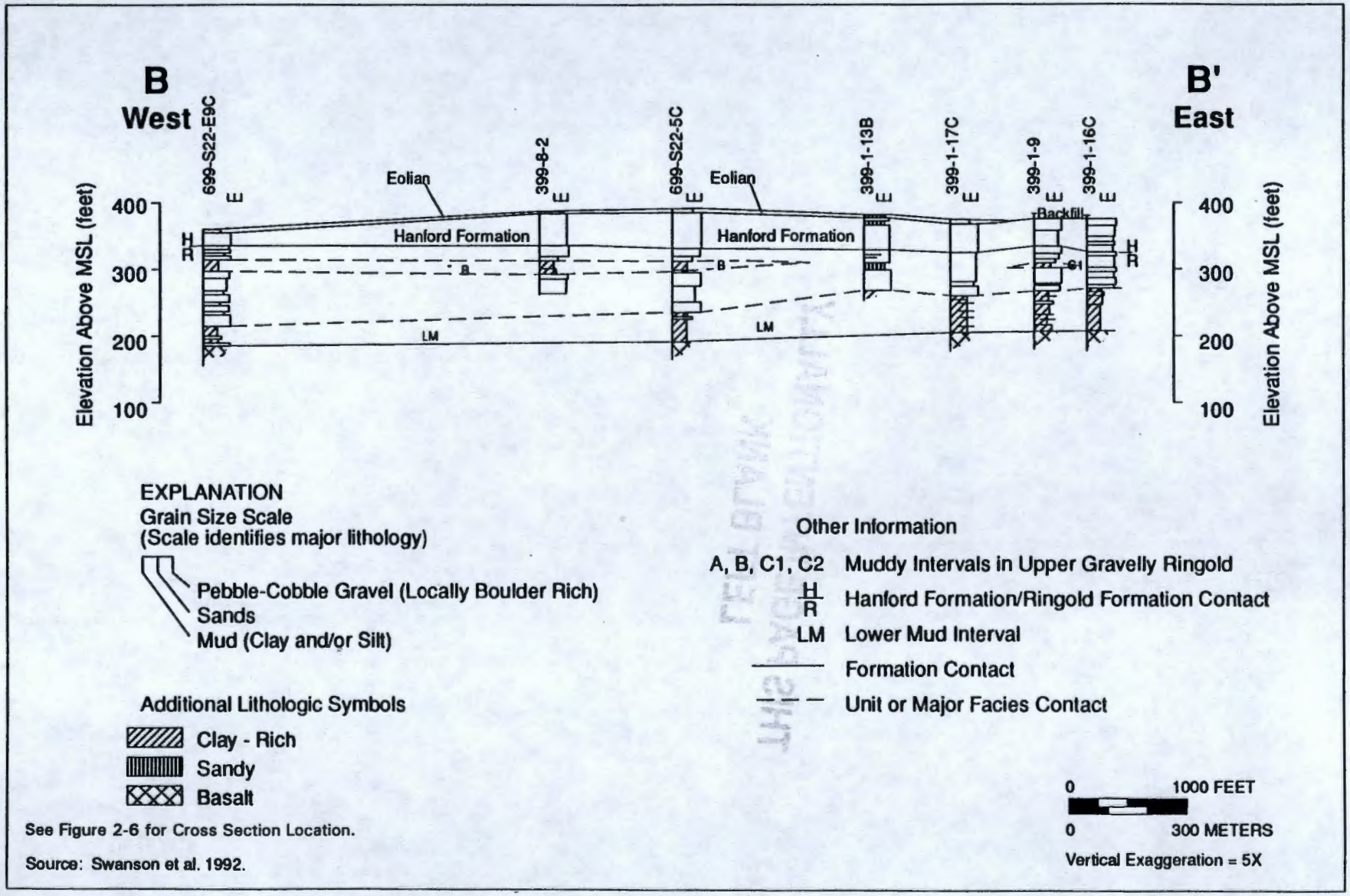

Figure 2-8. Geologic Cross Section B-B'.

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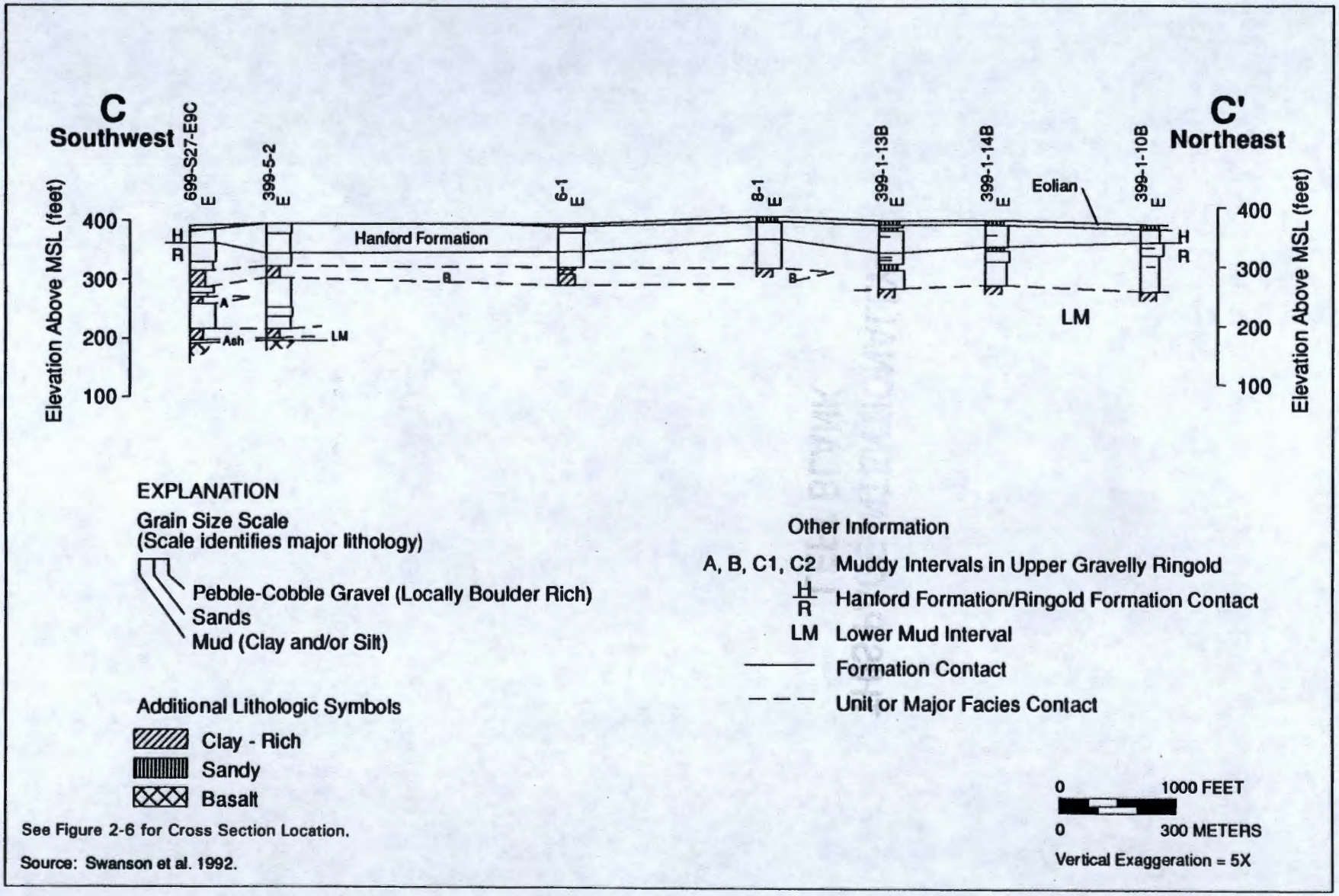

Figure 2-9. Geologic Cross Section C-C'.

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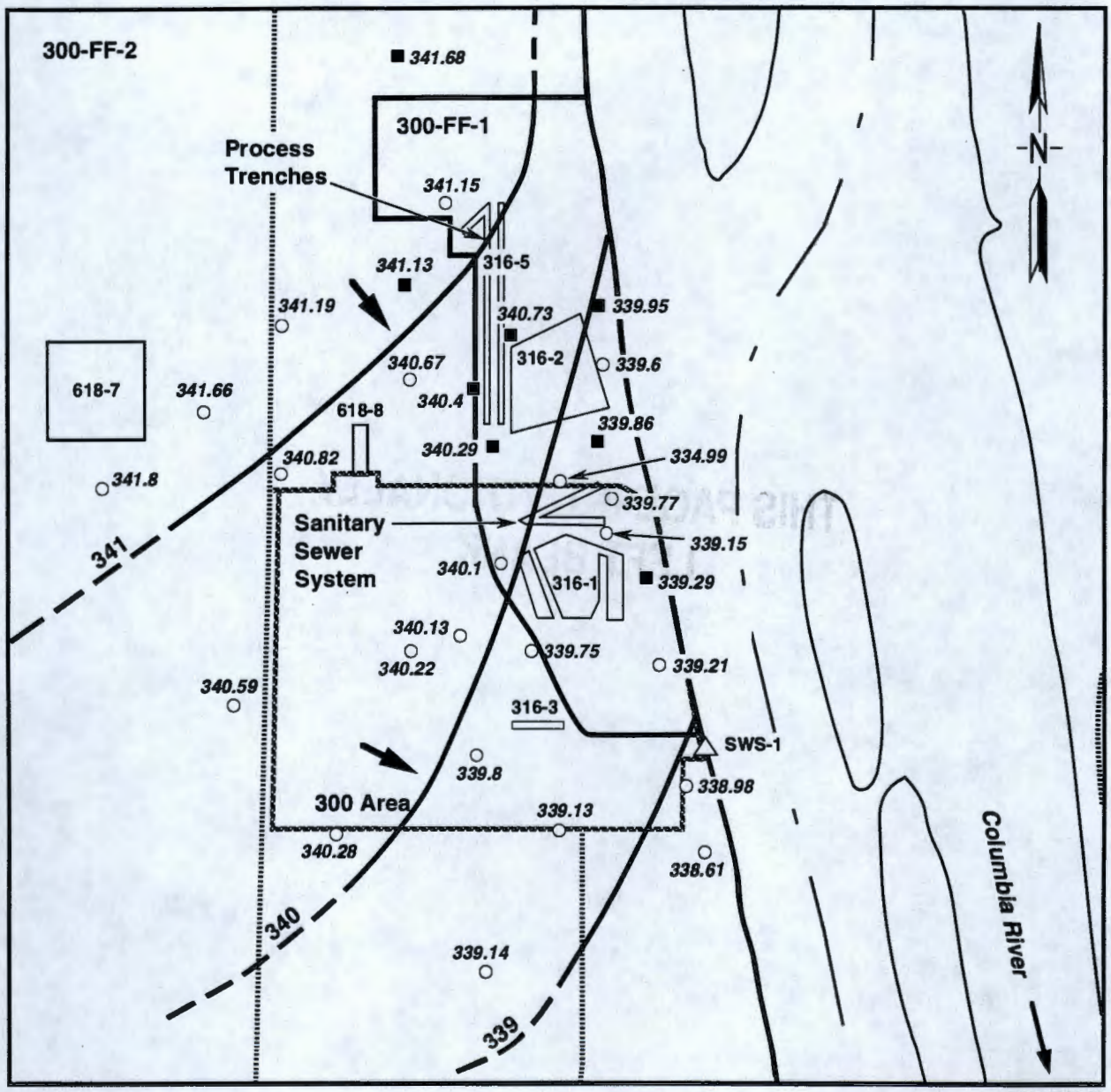

○ 1-12 **Well Location and Number**

■ 4-7 **Monitoring Network Well**

△ SWS-1 **Surface-Water Monitoring Station**

Roads

Generalized Flow Direction

Source: DOE/RL 1994a

Figure 2-10a. Water Table Elevation Map of the Unconfined Aquifer, 300 Area (Low River Stage), September 27, 1993.

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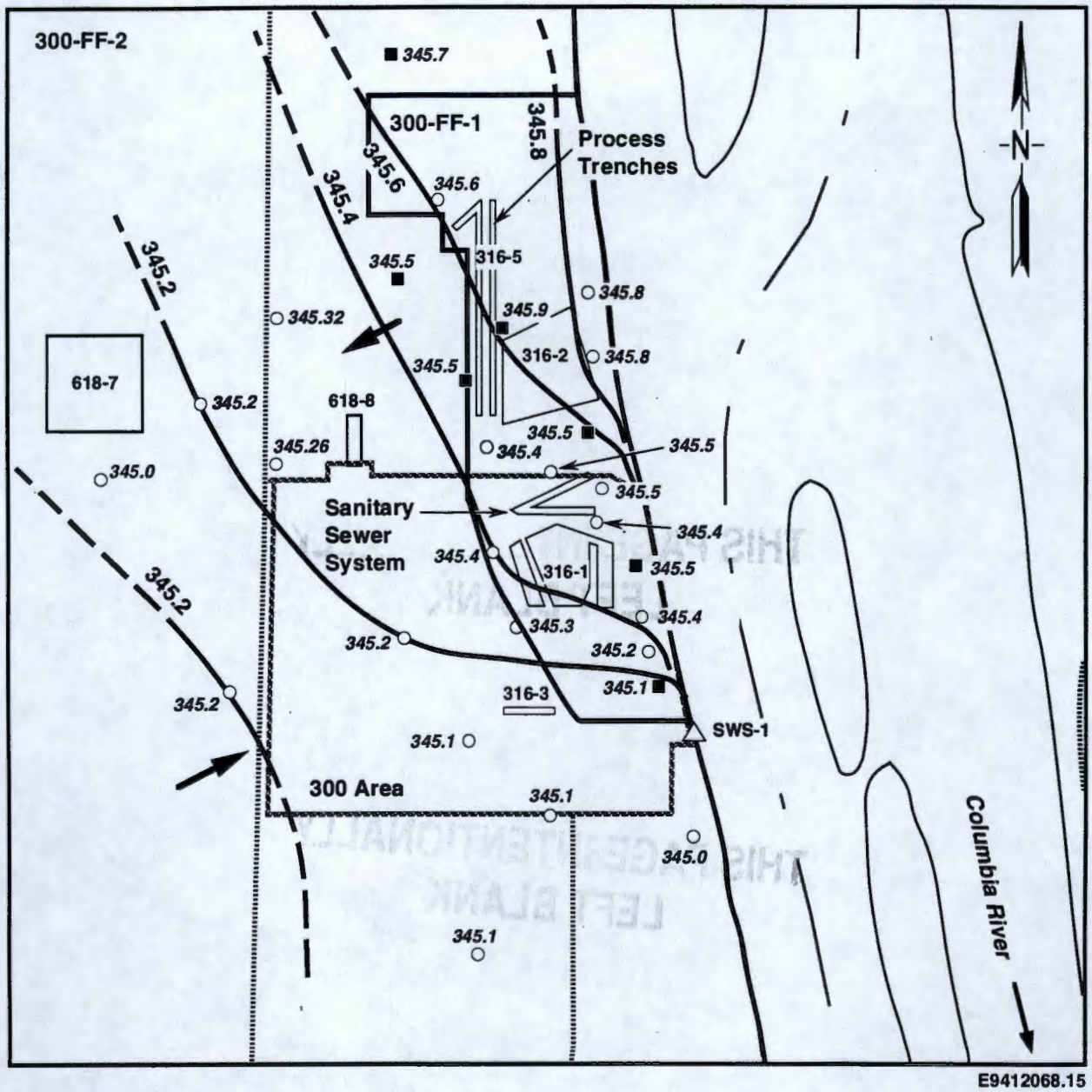

○ 1-12 **Well Location and Number**

■ 4-7 **Monitoring Network Well**

△ SWS-1 **Surface-Water Monitoring Station**

Roads

Generalized Flow Direction

Source: DOE/RL 1994a

Figure 2-10b. Water Table Elevation Map of the Unconfined Aquifer, 300 Area (High River Stage), May 26, 1993.

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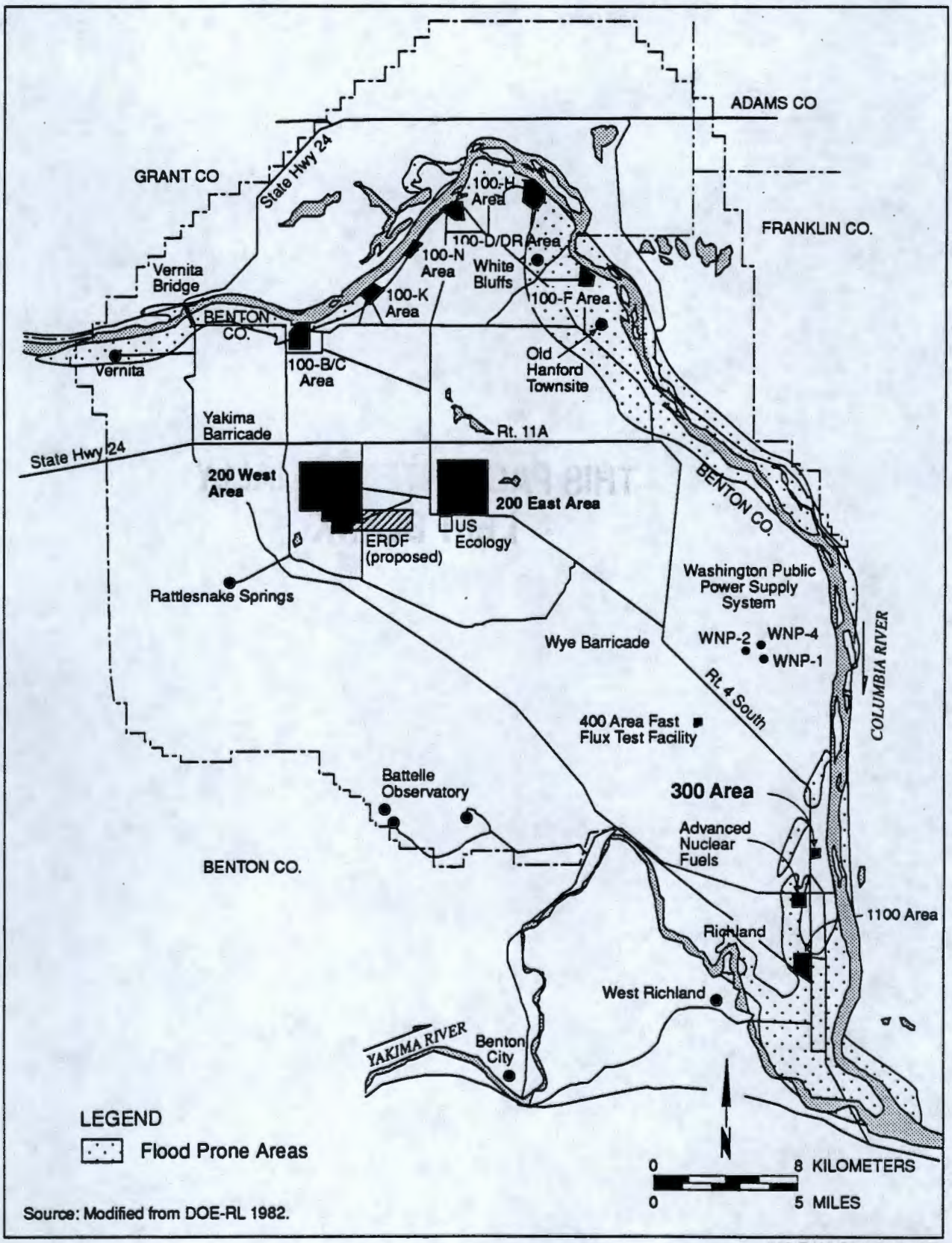

923 E426/53440/10-4-94

Figure 2-11. Probable Maximum Flood at the Hanford Site.

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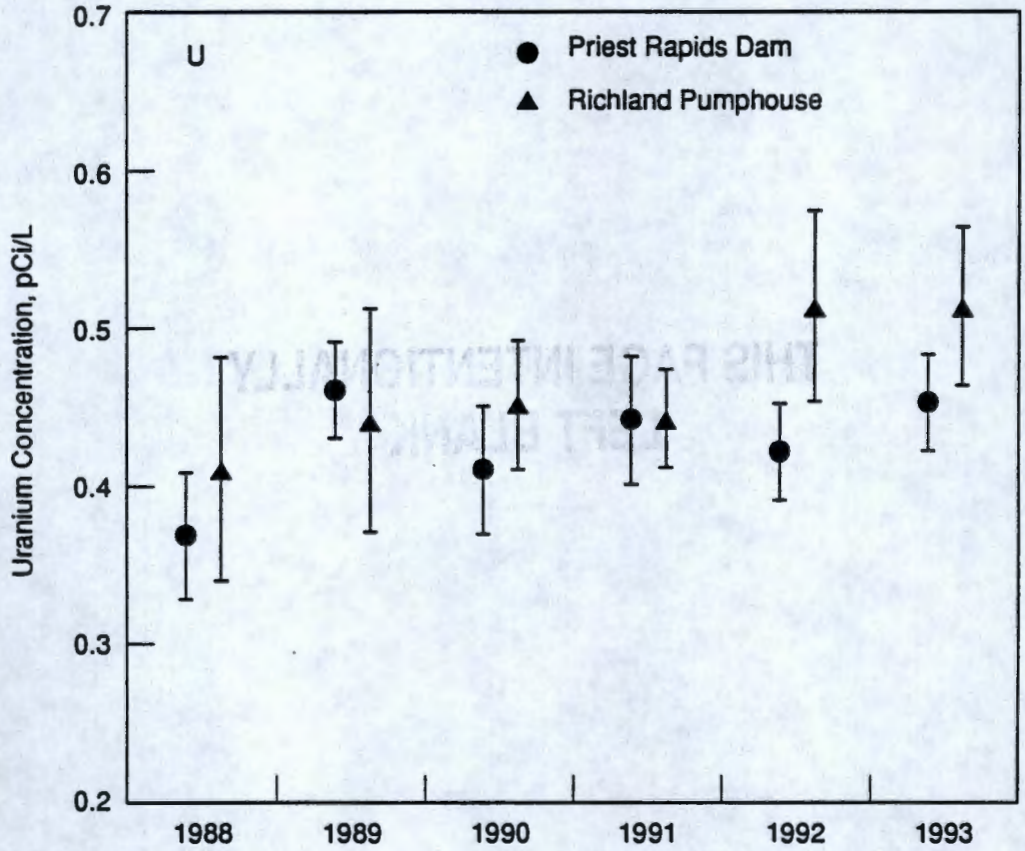

Source: Dirkes et al. 1994

923 E426/53543/10-19-94

Figure 2-12. Annual Average Uranium Concentrations (±2 SEM) in Columbia River Water, 1988 Through 1993.

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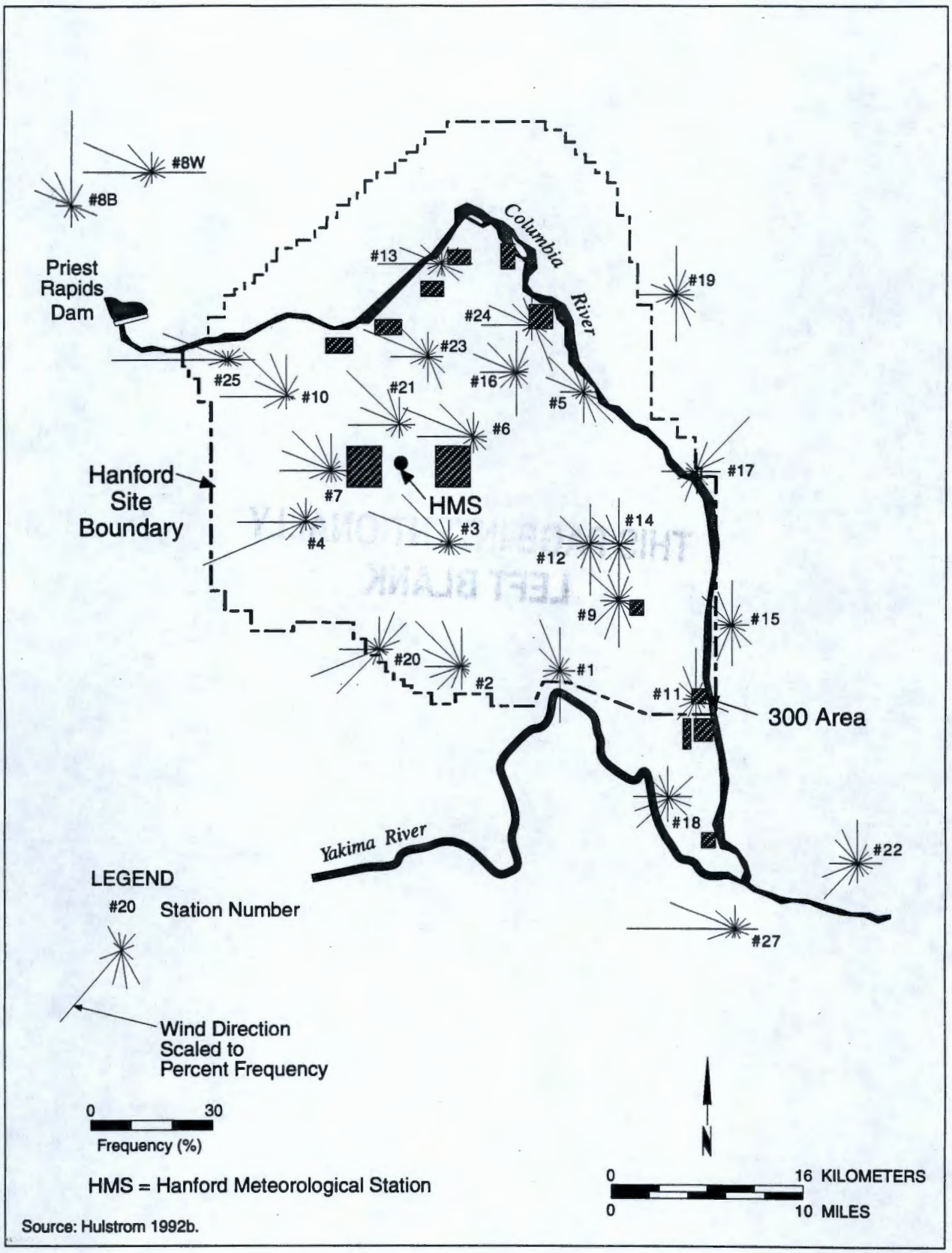

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Figure 2-13. Wind Roses for the Hanford Site.

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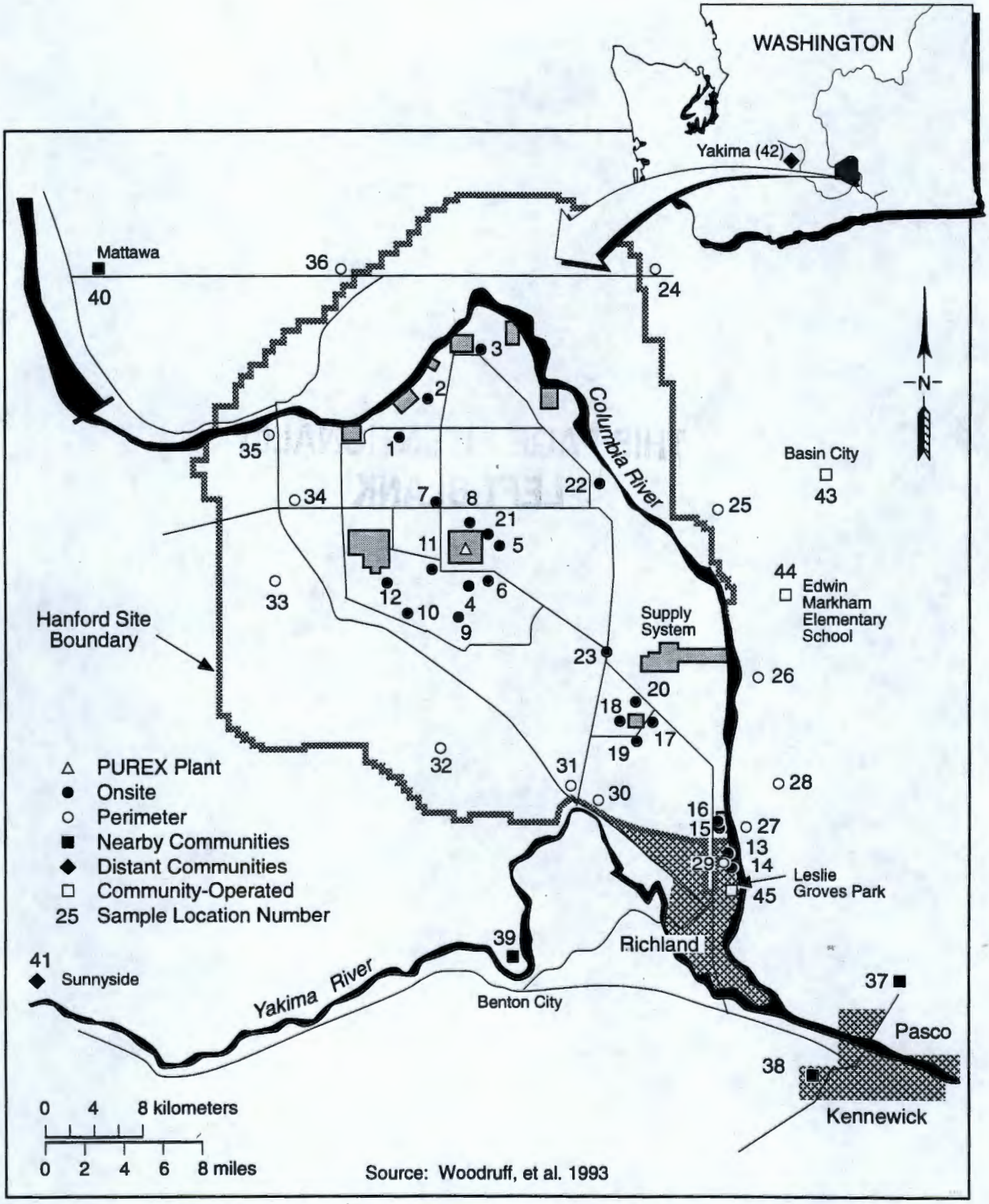
Figure 2-14. Air Sampling Locations, 1992.



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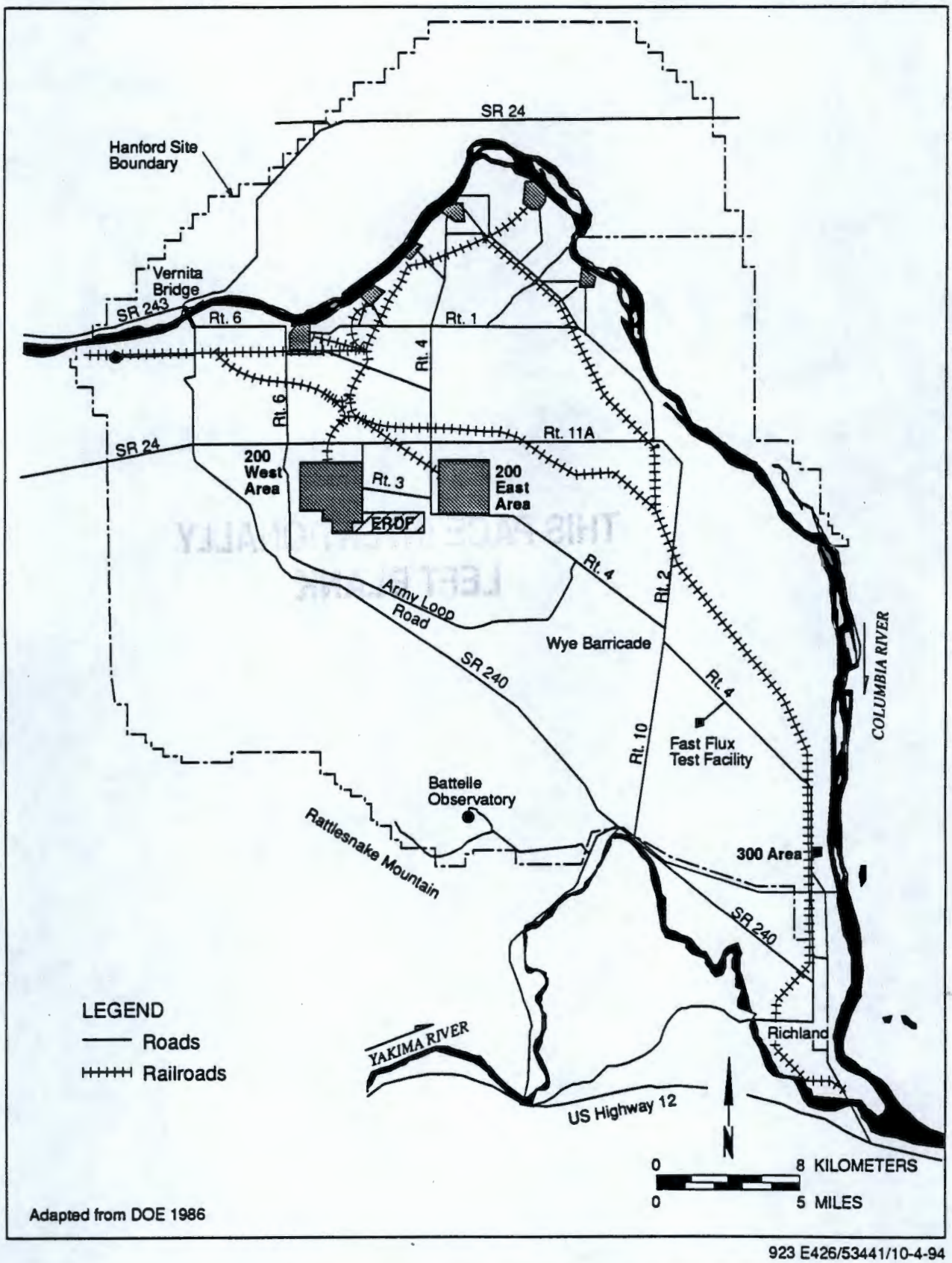

923 E426/53441/10-4-94

Figure 2-15. Existing Transportation Network Within the Hanford Site.

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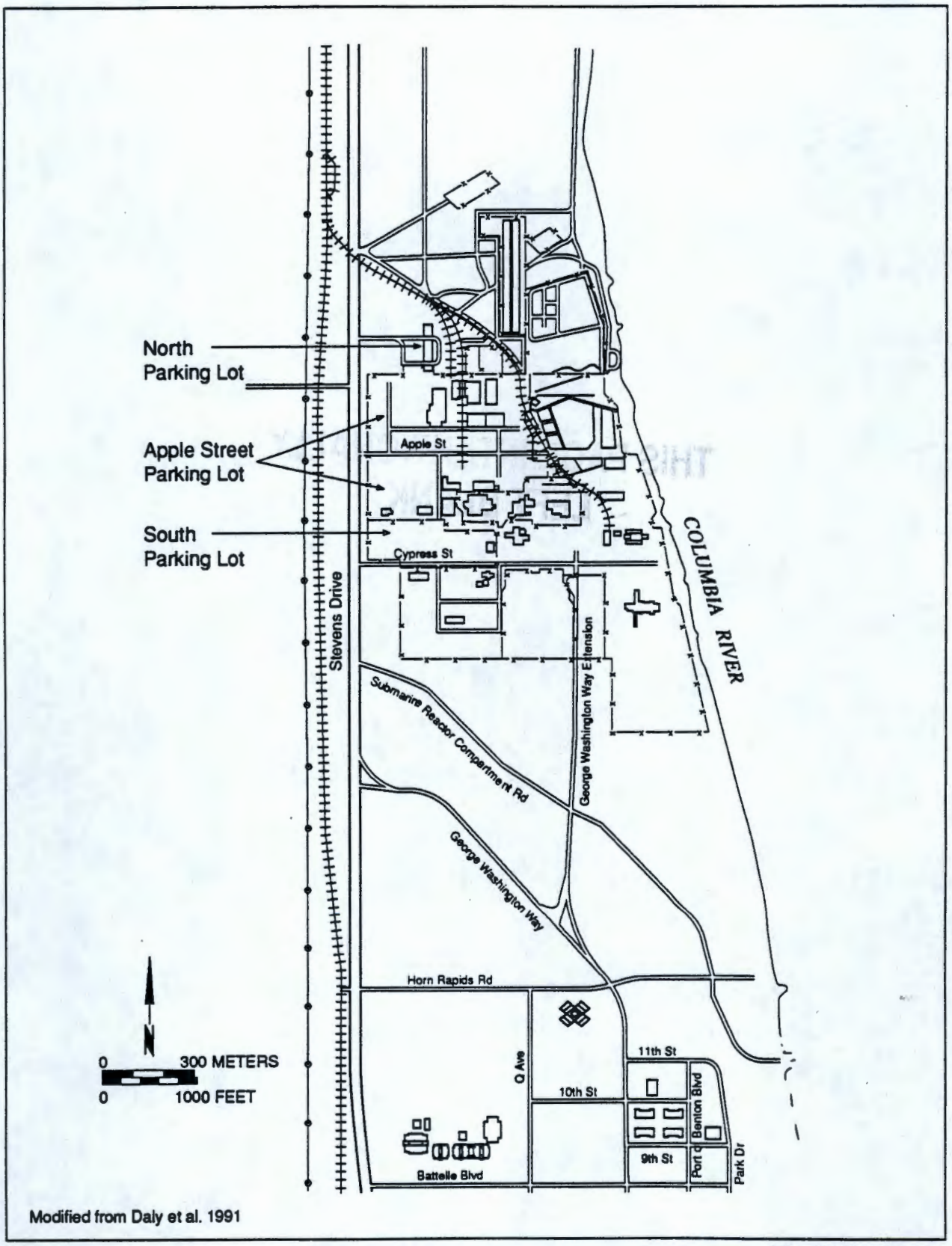

923 E426/53442/10-4-94

Figure 2-16. Existing 300 Area Roads.

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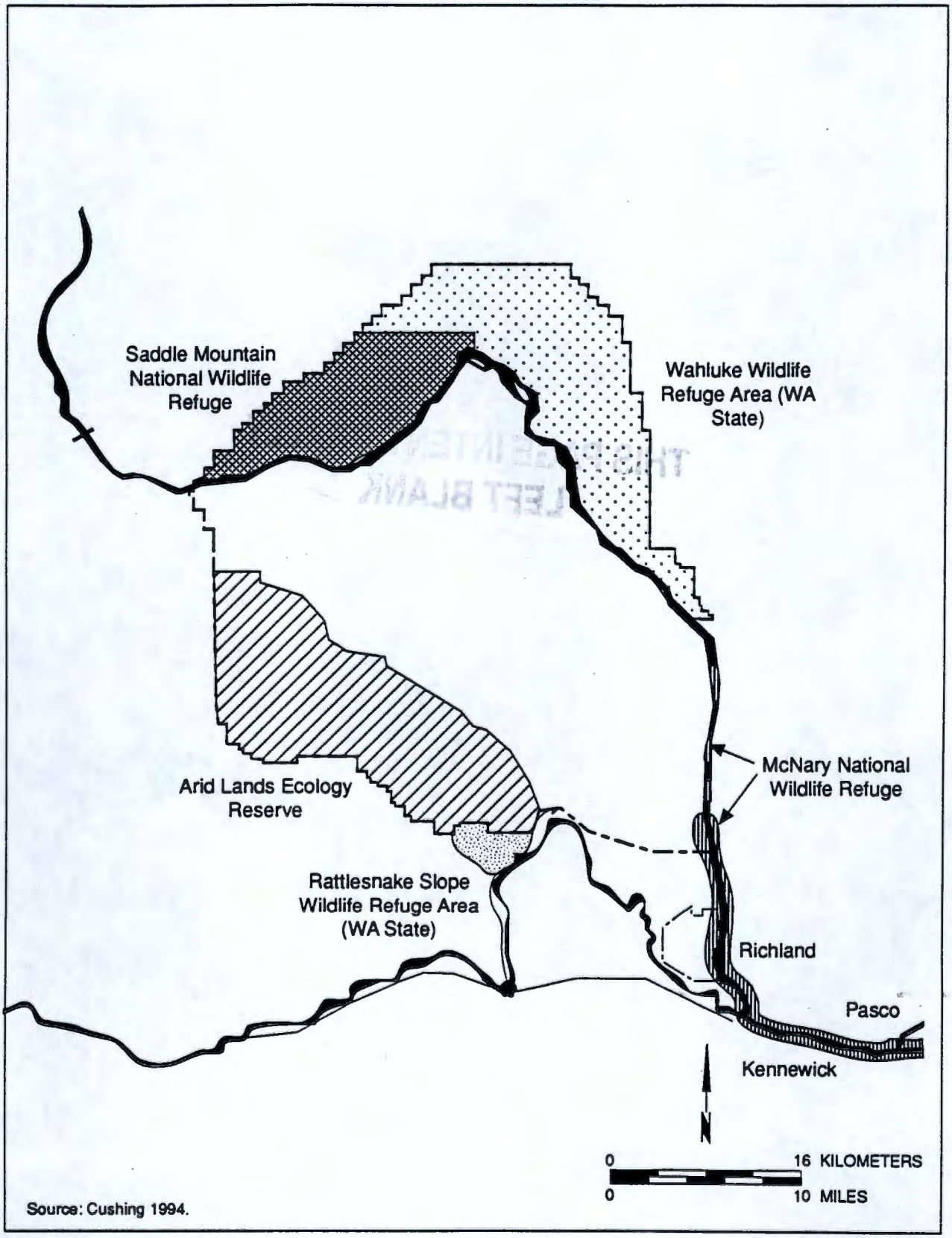

Source: Cushing 1994.

923 E426/53444/10-4-94

Figure 2-17. National and State Wildlife Refuges in the Vicinity of the Hanford Site.

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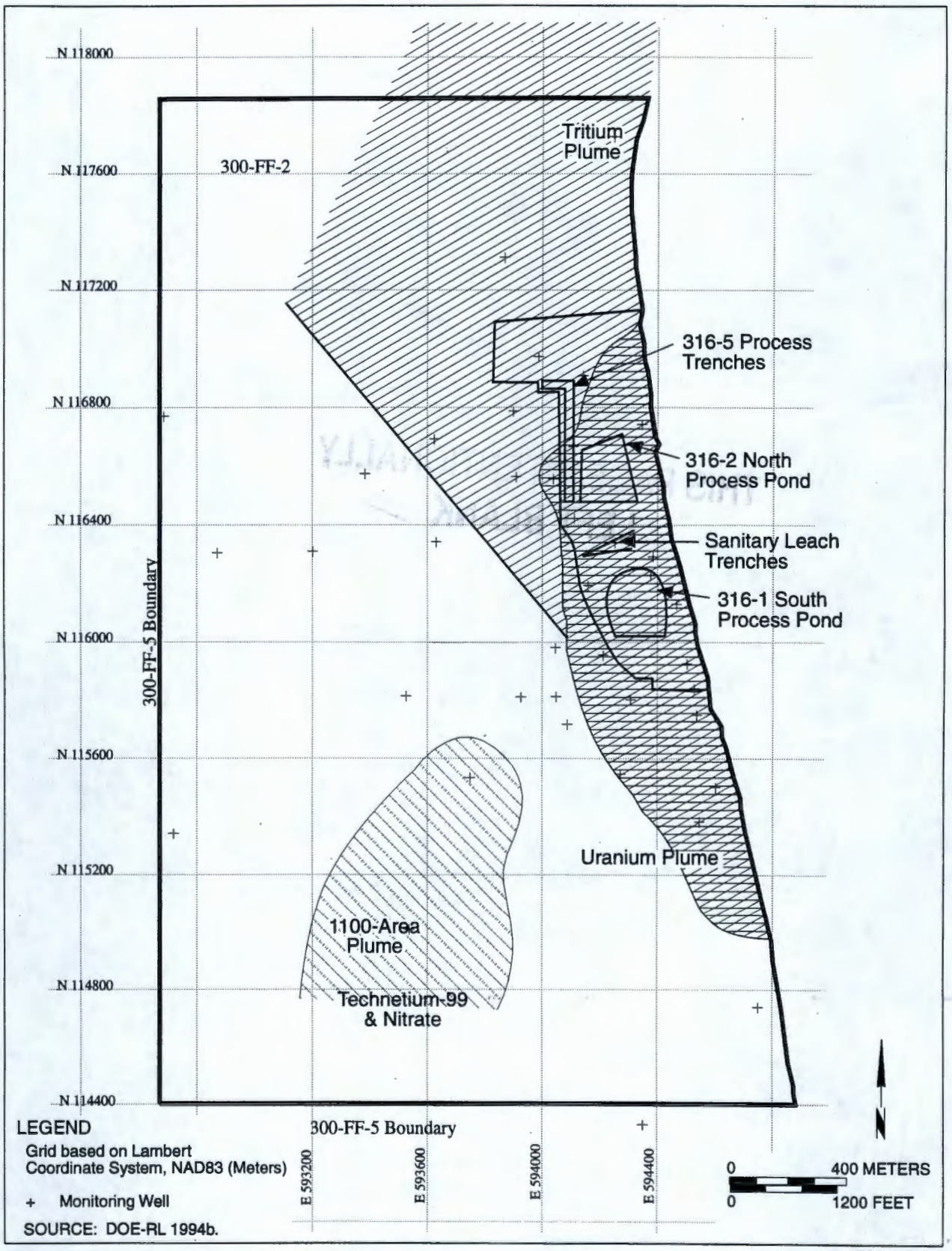

Figure 2-18. General Shape and Extent of 300 Area Plumes.

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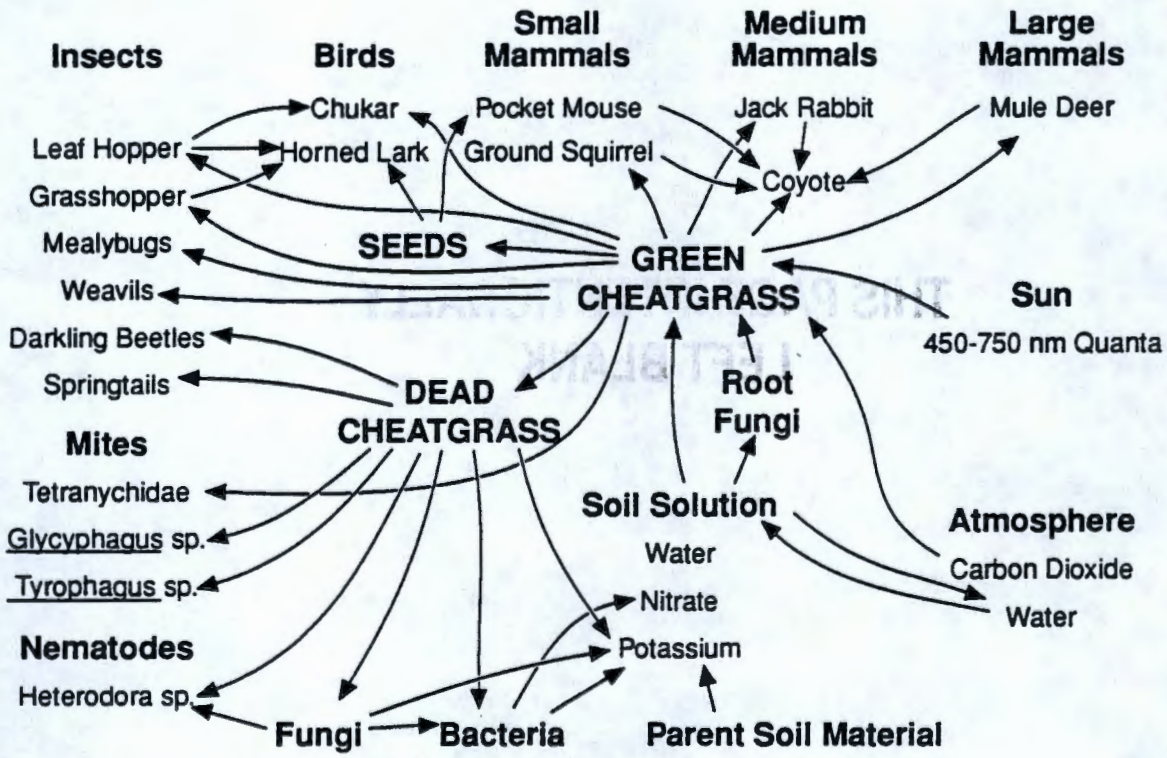

Source: Cushing 1994.

923 E426/53443/10-4-94

Figure 2-19. Food Web Centered on Cheatgrass (arrows indicate direction of energy and mass transfer).

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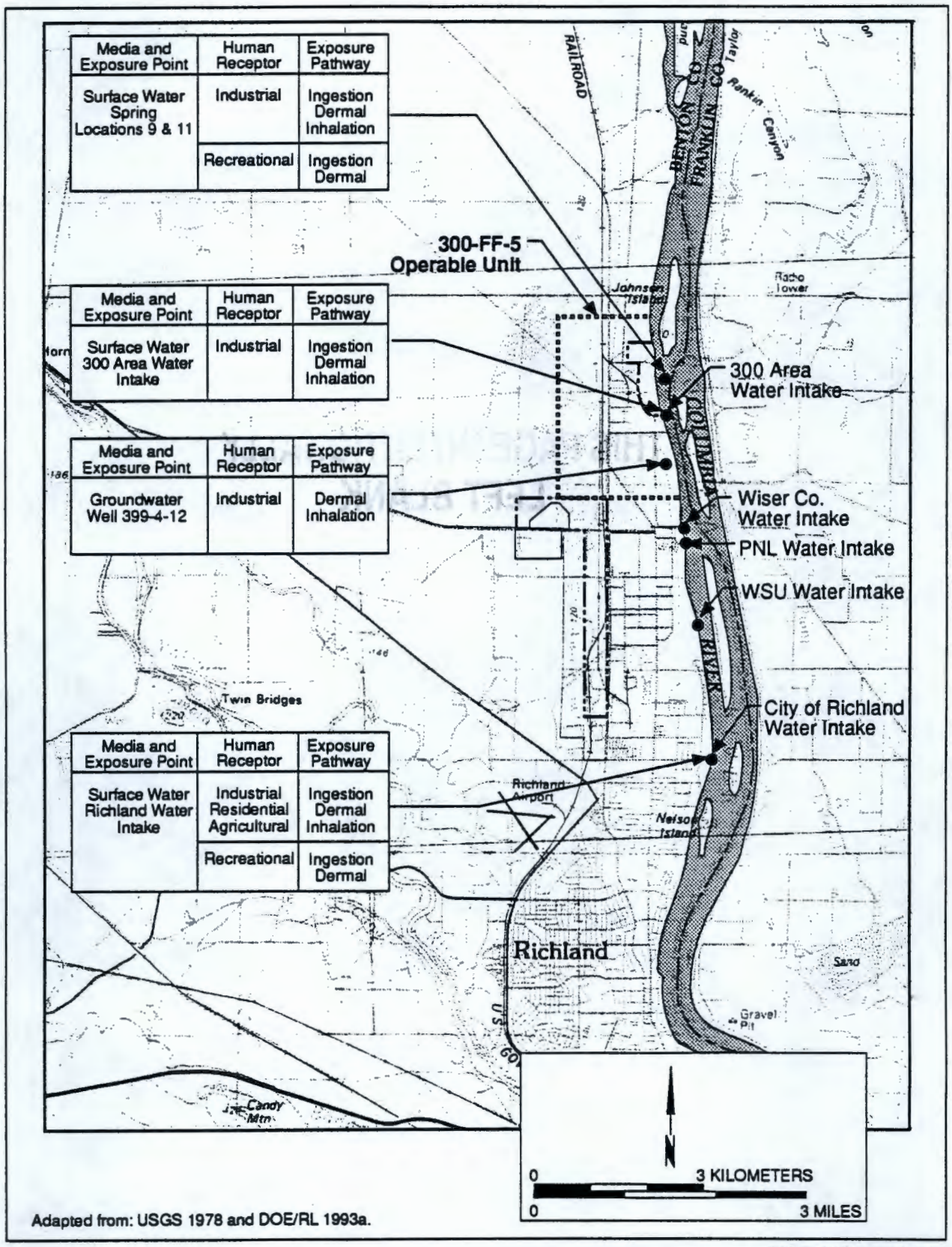

Adapted from: USGS 1978 and DOE/RL 1993a.

923-E426/50056/10-4-94

Figure 2-20. Current Exposure Points, Receptor Populations and Pathways.

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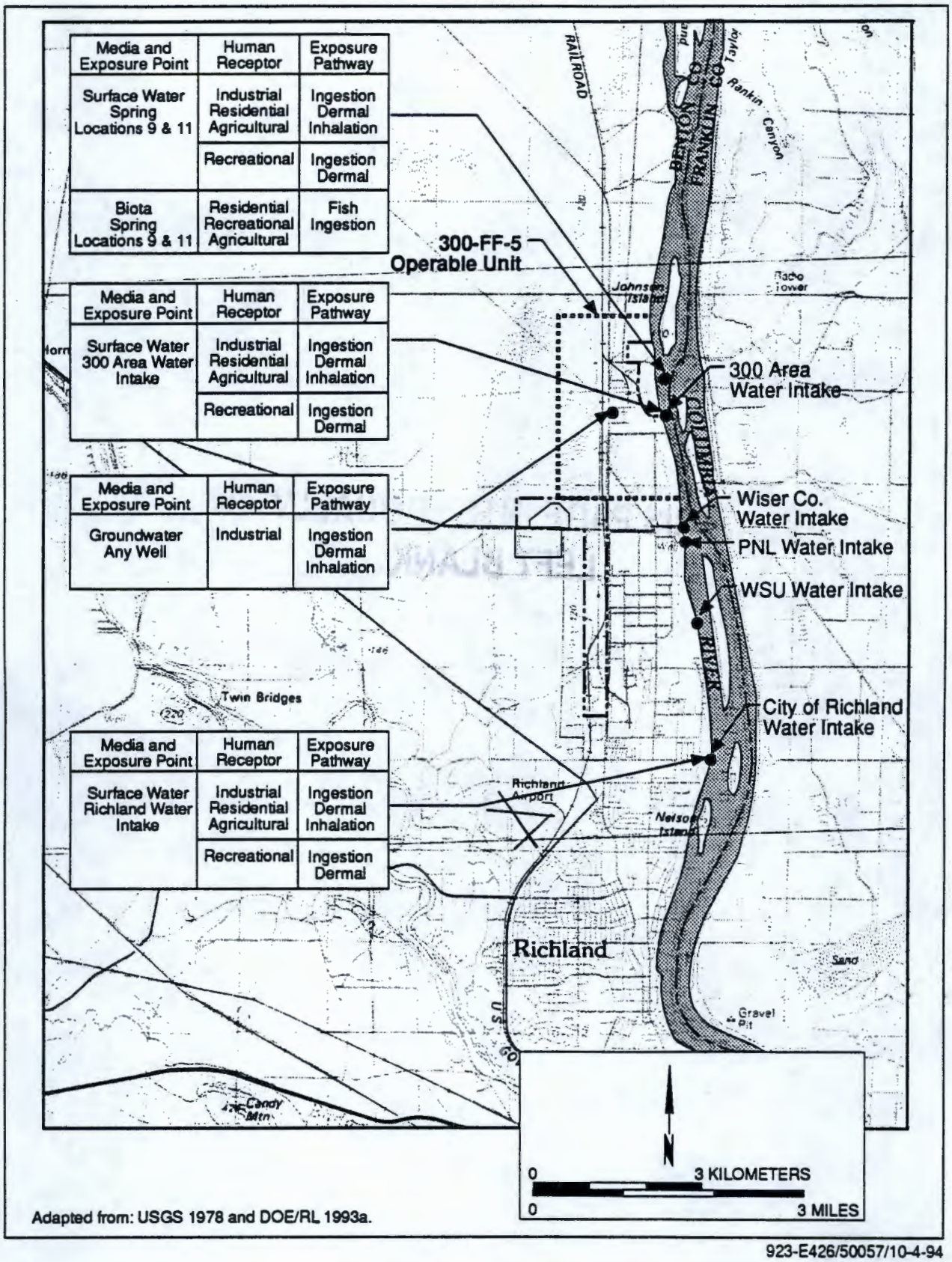

Adapted from: USGS 1978 and DOE/RL 1993a.

923-E426/50057/10-4-94

Figure 2-21. Future Exposure Points, Receptor Populations and Pathways.

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Table 2-1. Summary of 300-FF-5 Operable Unit Drill Hole Data.

Permanent Well number	Start Date	Completion Date	Total Depth (ft)	Depth to Water ft)	Elevation top of brass cap NGVD '29 (ft)	Screen interval (ft)	Sandpack interval (ft)	Coordinates (Lambert)	Number of chemical samples analyzed	Number of Physical samples analyzed	Number of archive samples in storage
699-S29-E16A	9/4/91	9/6/91	52.4	34.8	377.05	28-48	25-49.8	N:114,731.31 E:594,750.76	0	0	0
699-S29-E16B	8/8/91	9/21/91	118.5	33.2	377.19	94-104	88.8-105.9	N:114,739.01 E:594,747.01	5	2	2
699-S29-E16C	6/13/91	9/27/91	177.9	3.4	377.03	165.6-176	160.3-175.7	N:114,730.80 E:594,742.44	7	32	24
699-S19-E14	8/15/91	9/17/91	47	29.35	370.98	19.1-39.9	16.9-42.3	N:117,716.40 E:594,250.05	6	9	10
699-S22-E9A	9/11/91	9/23/91	44.7	27.7	371.70	22.6-37.6	19.7-41.9	N:116,761.88 E:592,688.32	0	0	0
699-S22-E9B	7/16/91	9/26/91	151	24.7	371.19	137.3-148.0	129.6-150	N:116,756.55 E:592,697.21	4	0	0
699-S22-E9C	6/3/91	9/18/91	181.6	+7.1	371.04	173.5-178.8	166.2-181.6	N:116,752.80 E:592,689.03	7	25	36
399-8-5A	10/8/91	11/12/91	72.05	55.3	398.03	50-70	46.1-71.3	N:116,565.80 E:593,384.44	0	0	0
399-8-5B	8/5/91	12/19/91	168	54.3	397.67	154.2-165	150.6-176.8	N:116,567.58 E:593,392.19	10	0	1
399-8-5C	6/20/91	12/31/91	208	28.4	397.62	190.06-205.86	180.9-207	N:116,573.92 E:593,386.92	7	28	32
399-1-21A	9/18/91	9/28/91	54.6	37.6	379.87	31.43-52.17	29.1-52.4	N:116,184.18 E:594,161.02	0	0	0
399-1-21B	10/22/91	9/25/91	115	44.3	380.44	102-112	95.2-115	N:116,177.11 E:594,157.43	5	19	20
699-S27-E9A	5/2/91	6/26/91	59	39.5	388.00	34.77-55	31.8-56.3	N:115,332.17 E:592,720.96	0	7	11
699-S27-E9B	7/15/91	9/19/91	178.7	40	387.95	164.95-175.62	163.3-178.7	N:115,328.55 E:592,727.64	7	0	0
699-S27-E9C	5/24/91	9/25/91	202	7.3	388.02	195-200.05	188.6-201	N:115,324.62 E:592,721.23	7	33	42
699-S28-E12	5/2/91	5/17/91	58	40.5	386.19	35.2-55.5	31.4-58	N:115,000.19 E:593,538.16	10	13	13
399-1-10B	9/6/91	11/21/91	119	39.5	372.47	104.5-114.5	99-115.3	N:116,729.06 E:594,351.09	6	20	26
399-1-13B	8/27/91	11/19/91	123.8	42	385.79	106.55-117.2	101.8-119	N:116,549.48 E:593,909.81	4	18	25
399-1-14B	8/27/91	11/15/91	114.5	38.1	379.99	99-109.7	97.5-111.5	N:116,779.38 E:593,991.10	4	21	16

Source: Swanson et al. 1992; NGVD '29 - National Geodetic Vertical Datum 1929; 1m = 3.28 ft.

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Table 2-2. 300-FF-5 Operable Unit RI Groundwater Well Sampling Dates. (2 sheets)

Location	Round 1	Round 2	Round 3	Round 4
399-1-10A	12/13/91	05/12/92	NS	NS
399-1-10B	12/13/91	04/27/92	9/9/92	NS
399-1-11	01/08/92	05/20/92	NS	NS
399-1-12	12/17/91	05/01/92	NS	NS
399-1-13A	12/13/91	04/30/92	NS	NS
399-1-13B	12/13/91	04/28/92	9/15/92	NS
399-1-14A	12/10/91	05/01/92	NS	NS
399-1-14B	12/10/91	04/28/92	09/15/92	NS
399-1-15	12/10/91	04/11/92	9/15/92	NS
399-1-16A	12/13/91	05/11/92	NS	NS
399-1-16B	12/16/91	05/11/92	NS	11/11/92
399-1-16C	12/16/91	05/12/92	NS	11/11/92
399-1-17A	12/16/91	05/11/92	10/6/92	11/11/92
399-1-17B	12/17/91	05/20/92	NS	NS
399-1-17C	12/17/91	05/11/92	NS	11/12/92
399-1-18A	12/06/91	04/29/92	9/11/92	NS
399-1-18B	12/06/91	04/29/92	NS	NS
399-1-18C	12/06/91	04/28/92	9/8/92	NS
399-1-19	NS	NS	9/9/92	NS
399-1-21A	12/10/91	04/30/92	NS	NS
399-1-21B	12/10/91	04/30/92	9/11/92	NS
399-1-5	01/08/92	05/20/92	9/11/92	NS
399-1-6	12/07/91	04/27/92	9/16/92	11/12/92
399-1-7	12/11/91	NS	NS	NS
399-1-8	12/11/91	04/24/92	9/16/92	12/10/92
399-1-9	12/11/91	04/27/92	9/15/92	NS
399-2-1	12/11/91	05/12/92	NS	12/03/92
399-2-2	12/12/91	05/12/92	9/11/92	11/12/92
399-2-3	12/12/91	04/28/92	9/11/92	11/14/92
399-3-10	12/09/91	05/13/92	NS	11/14/92
399-3-11	01/16/92	06/11/92	9/16/92	11/13/92
399-3-12	12/09/91	04/23/92	9/10/92	11/14/92
399-3-2	12/09/91	04/22/92	9/2/92	11/14/92
399-3-3	01/16/92	05/13/92	9/10/92	11/10/92
399-3-7	12/09/91	05/06/92	NS	11/12/92
399-3-9	12/12/91	05/13/92	NS	11/13/92
399-4-1	12/03/91	05/06/92	NS	11/14/92

Table 2-2. 300-FF-5 Operable Unit RI Groundwater Well Sampling Dates. (2 sheets)

Location	Round 1	Round 2	Round 3	Round 4
399-4-10	12/03/91	05/13/92	9/14/92	11/15/92
399-4-11	12/03/91	05/06/92	NS	11/12/92
399-4-12	01/06/92	04/22/92	9/9/92	11/14/92
399-4-7	12/03/91	05/13/92	NS	11/15/92
399-4-9	12/03/91	04/21/92	9/9/92	11/10/92
399-5-1	12/03/91	04/21/92	9/9/92	11/13/92
399-6-1	12/04/91	04/21/92	9/9/92	11/10/92
399-8-1	01/07/92	NS	NS	NS
399-8-2	01/07/92	05/06/92	9/10/92	NS
399-8-3	01/13/92	05/06/92	9/10/92	11/10/92
399-8-4	01/08/92	04/22/92	9/14/92	NS
399-8-5A	12/10/91	04/13/92	9/10/92	11/13/92
399-8-5B	01/13/92	04/18/92	9/2/92	NS
399-8-5C	01/13/92	04/18/92	9/2/92	NS
699-S27-E14	NS	NS	NS	11/11/92
699-S19-E14	01/06/92	04/20/92	9/9/92	NS
699-S22-E9A	12/02/91	04/24/92	9/11/92	NS
699-S22-E9B	12/02/91	04/24/92	9/11/92	NS
699-S22-E9C	12/02/91	04/24/92	9/14/92	NS
699-S27-E9A	12/05/91	04/23/92	9/10/92	NS
699-S27-E9B	12/05/91	04/20/92	9/10/92	NS
699-S27-E9C	12/05/91	04/20/92	9/10/92	NS
699-S28-E12	12/05/91	04/21/92	9/9/92	NS
699-S29-E16A	12/04/91	04/13/92	8/31/92	NS
699-S29-E16B	12/04/91	04/13/92	8/31/92	NS
699-S29-E16C	12/04/91	04/13/92	8/31/92	NS
699-S30-E15A	12/04/91	05/04/92	9/14/92	NS

NS = Well not sampled during this round.
Source: DOE-RL 1994e.

Table 2-3. Aquifer Tests at Cluster Sites 699-S22-EX and 699-S27-EX in the 300-FF-5 Operable Unit.

Well Name	Test Type	Test Date	Flow Rate (gal/min)	Test Duration (min)
699-S22-E9T (pumping well)	Step-drawdown	3/18/92	20 39	96 94
	Constant discharge 1	3/20/92	27.5	540
	Constant discharge 2	3/25 - 3/27/92	20.9	2,440
	Constant discharge 3	3/30 - 4/1/92	24.5	2,880
	Slug test	3/13/92 4/14 - 4/16/92	N/A N/A	N/A N/A
	Slug interference	4/14 - 4/16/92	N/A	N/A
699-S22-E9A	Slug test	1/1/92	N/A	N/A
699-S22-E9C	Constant head	5/12/92	0.62 - 1.2	254
699-S27-E9T (pumping well)	Step-drawdown	3/7/92	35, 78.8, 103.9	92, 89, 89
	Constant discharge	3/10/92 - 3/12/92	134.7	2,880
	Slug test	2/28/92 3/23/92	N/A N/A	N/A N/A
699-S27-E9A	Step-drawdown	1/14/92	1.96, 4.3, 7.5, 9.5	60, 60, 62, 62
	Slug test	1/2/93	N/A	N/A

N/A - Not applicable
Source: Swanson 1992

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Table 2-4. Plant Species Identified in 300-FF-5 Operable Unit and Upstream. (3 sheets)

	Scientific name	Common name
Trees	*Crataegus douglasii*	hawthorn
	Gleditsia triacanthos	honey locust
	Malus pumila	apple
	Morus alba	white mulberry
	Populus trichocarpa	black cotonwood
	Prunus sp.	plum, cherry
	Salix amygdaloides	peach-leaf willow
	Salix exigua	coyote willow
	Salix sp.	willow
	Ulmus pumila	Siberian elm
Shrubs	*Artemisia tridentata*	big sage
	Chrysothamnus nauseosus	gray rabbit-brush
	Chrysothamnus viscidiflorus	green rabbit-brush
	Eriogonum niveum	snow buckwheat
	Purshia tridentata	antelope bitterbrush
	Rosa woodsii	pearhip rose
Grasses	*Agropyron dasytachyum*	thickspike wheatgrass
	Agropyron intermedium	intermediate wheatgrass
	Agropyron repens	quack grass
	Bromus carinatus	California brome
	Bromus tectorum	cheatgrass
	Deschampsia atropurpurea	mountain hairgrass
	Echinochloa crusgalli	large barnyard-grass
	Elymus flavescens	sand wildrye
	Elymus triticoides	beardless wildrye
	Festuca arundinacea	tall fescue
	Festuca bromoides	barren fescue
	Poa annua	annual bluegrass
	Poa bulbosa	bulbous bluegrass
	Poa sandbergii	Sandberg's bluegrass
	Poa sp.	bluegrass
	Phalaris arundinacea	reed canarygrass
	Sporobolus cryptandrus	sand dropseed
Reeds/rushes/sedges/horsetails		
	Carex sp.	sedge
	Cyperus sp.	flatsedge
	Eleocharis palustris	common spike-grass
	Equisetum arvense	common horsetail
	Equisetum sp.	horsetail
	Typha latifolia	common cat-tail
Forbs	*Achillea millefolium*	yarrow
	Allium robinsonii	Robinson's onion
	Allium schoenoprasum	chives
	Allium sp.	wild onion

Table 2-4. Plant Species Identified in 300-FF-5 Operable Unit and Upstream. (3 sheets)

Amsinckia lycopsoides	tarweed fiddleneck
Amsinckia tessellata	tessellate fiddleneck
Arabidopsis thaliana	common wall cress
Artemisia spp.	mugwort
Artemisia campestris	northern wormwood
Artemisia dracunculus	tarragon
Artemisia lindleyana	Columbia River mugwort
Asclepias speciosa	showy milkweed
Asparagus officinalis	asparagus
Cardaria draba	whitetop
Centaurea diffusa	tumble knapweed
Centaurea repens	Russian knapweed
Cirsium arvense	Canada thistle
Cirsium sp.	thistle
Cirsium vulgare	bull thistle
Clematis ligusticifolia	western virginsbower
Collinsia parviflora	small-flowered blue-eyed Mary
Comandra umbellata	Bastard toad-flax
Convolvulus arvensis	field bindweed
Conyza canadensis	horseweed
Cryptantha pterocarya	winged cryptantha
Cymopterus terebinthinus	terpentine cymopterus
Descurainia pinnata	western tansymustard
Dipsacus sylvestris	teasel
Draba verna	spring whitlow-grass
Epilobium paniculatum	autumn willow-herb
Epilobium sp.	willow-herb
Erigeron sp.	fleabane
Eriogonum douglasii	Douglas' buckwheat
Eriogonum niveum	snow buckwheat
Eriogonum sp.	buckwheat
Erodium cicutarium	stork's-bill
Erysimum asperum	rough wallflower
Holosteum umbellatum	jagged chickweed
Lactuca serriola	prickly lettuce
Lepidium perfoliatum	clasping pepperweed
Lomatium grayi	Gray's desert-parsley
Lupinus sp.	lupine
Marsilea vestita	clover fern
Melilotus alba	white sweet-clover
Mertensia sp.	bluebells
Microsteris gracilis	pink microsteris
Montia perfoliata	miner's lettuce
Montia sp.	montia
Oenothera pallida	pale evening-primrose

Table 2-4. Plant Species Identified in 300-FF-5 Operable Unit and Upstream. (3 sheets)

Oenothera strigosa	common evening-primrose
Opuntia polyacantha	starvation prickly-pear
Phacelia linearis	threadleaf phacelia
Phlox longifolia	long-leaf phlox
Plantago patagonica	indian wheat
Plantago sp.	plantain
Plectritis macrocera	white plectritis
Potentilla sp.	cinquefoil
Psoralea lanceolata	lance-leaf scurf-pea
Ranunculus sp.	buttercup
Ranunculus testiculatus	hornseed buttercup
Rorippa columbiae	Columbia yellowcress
Rorippa sp.	yellowcress
Rumex salicifolius	narrow-leaved dock
Rumex venosus	winged dock
Salsola kali	Russian thistle
Senecio sp.	groundsel
Sisymbrium altissimum	tumblemustard
Solanum dulcamara	bittersweet
Solidago missouriensis	Missouri goldenrod
Solidago sp.	goldenrod
Sphaeralcea munroana	Munro's globemallow
Stellaria sp.	starwort
Taraxacum officinale	dandelion
Tragopogon dubius	yellow salsify
Verbascum thapsus	common mullein
Veronica anagallis-aquatica	water speedwell
Vicia sp.	vetch
Xanthium strumarium	common cocklebur

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Table 2-5 Plants and Plant Communities of the 300-FF-5 Operable Unit and Vegetation Key to Figure 2-3.

Community[a]	Species Common Name[b]	Latin Name
Recovering Shrub-steppe	grey rabbitbrush	*Chrysothamnus nauseosus*
	cheatgrass	*Bromus tectroum*
	snow buckwheat	*Eriogonum niveum*
	diffuse knapweed	*Centaurea diffusa*
	yarrow	*Achillea millefolium*
	Russian thistle	*Salsola kali*
	Sandberg's bluegrass	*Poa sandbergii*
Disturbed	cheatgrass	*Bromus tectroum*
	Russian thistle	*Salsola kali*
	grey rabbitbrush	*Chrysothamnus nauseosus*
	tumble mustard	*Sisymbrium altissimum*
	Sandberg's bluegrass	*Poa sandbergii*
	whitetop	*Cardaria draba*
	lance-leaf scurf-pea	*Psoraleo lanceolata*
	bur ragweed	*Ambrosia acanthicarpa*
Riparian (River)	Sandberg's bluegrass	*Poa sandbergii*
	reed canary grass	*Phalaris arundinacea*
	perennial ryegrass	*Elymus cinerius*
	sandbar willow	*Salix exigua*
	Russian knapweed	*Centaurea repens*
	cheatgrass	*Bromus tectroum*
	wiregrass	*Eleocharis palustris*
	mulberry	*Morus alba*
	asparagus	*Asparagus officinalis*
Trench w/Aquatic Veg	smartweed	*Polygonum persicaria*
	bulrush	*Scirpus americanus*
	cattail	*Typha latifolia*
Shrub-Steppe	cheatgrass	*Bromus tectroum*
	Sandberg's bluegrass	*Poa sandbergii*
	grey rabbitbrush	*Chrysothamnus nauseosus*
	needle-and-thread grass	*Stipa comata*
	snow buckwheat	*Eriogonum niveum*
	tumble mustard	*Sisymbrium altissimum*
	Russian thistle	*Salsola kali*
	big sagebrush	*Artemisia tridentata*
	Indian ricegrass	*Oryzopsis hymenoides*
	bottlebrush squirreltail	*Sitanion hystrix*
	bitterbrush	*Purshia tridentata*

(a) See Figure 2-3 for locations.

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Table 2-6. Hydraulic Property Estimates for Wells in the Uppermost Aquifer of the 300-FF-5 Area.

Well Name	Transmissivity[c] m^2/day (ft^2/day)	Hydraulic Conductivity[c] m/day (ft/day)	Specific Yield	Formation
699-S27-E9T[a]	430 (4,800)	36 (120)	0.37	Ringold
699-S22-E9T[a]	600 (6,400)	50 (160)	0.014	Ringold
399-1-13[b]	10,000 (110,000)	3,000 (11,000)	-	Hanford
399-1-18A[b]	90,000 (1,000,000)	15,000 (50,000)	-	Hanford
399-1-14[b]	18,000 (190,000)	3,000[c] (10,000)[c]	-	Hanford
399-1-10[b]	18,000 (200,000)	3,000[c] (10,000)[c]	-	Hanford
399-1-16A[b]	900 (10,000)	150 (500)	-	Ringold

[a]Source: Swanson et al. 1992.
[b]Source: Schalla et al. 1988.
[c]Assuming an effective aquifer thickness of 6 meters (20 feet).
Note: - = information not available.

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Table 2-7. Saturated Hanford Formation Thicknesses in the 300 Area using Water Levels from Kasza et al. (1994).

Well	Groundwater elevation (ft AMSL)	Hanford/Ringold contact (ft AMSL)	Saturated Hanford Formation Thickness (ft)
699-S22-E9A,B,C	344	345	0
699-S27-E9A,B,C	349	360	0
699-S27-E14	342	345	0
699-S29-E12	347	340	7
699-S29-E16A,B,C	342	353	0
699-S30-E15A,B,C	341	337	4
399-1-1	342	326	16
399-1-2	340	323	17
399-1-3	342	334	8
399-1-4	342	334	8
399-1-10A	342	340	2
399-1-11	342	335	7
399-1-12	342	332	10
399-1-13B	342	336	6
399-1-15	342	333	9
399-1-17A,B,C	342	333	9
399-1-18A,B,C	343	338	5
399-2-1	342	327	15
399-2-3	342	314	28
399-3-1	342	335	7
399-3-9	342	330	12
399-3-10	342	328	14
399-3-12	342	321	21
399-4-1	342	329	13
399-4-7	342	295	47
399-4-9	342	315	27
399-4-11	342	330	12
399-5-1	342	333	9
399-6-1	342	336	6
399-8-1	342	345	0
399-8-2	342	342	0
399-8-3	342	332	10
399-8-5A,B,C	343	368	0

AMSL = above mean sea level.

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Table 2-8. Radionuclide Concentrations Measured in Columbia River Water, 1993.

Radionuclide	No. of Samples	Concentration[a], pCi/L	
		Maximum	Average
Priest Rapids Dam			
^{3}H	12	48 ± 3	40 ± 5%
^{90}Sr	12	0.11 ± 0.04	0.09 ± 22%
^{234}U	12	0.30 ± 0.06	0.25 ± 8%
^{235}U	12	0.03 ± 0.02	0.014 ± 36%
^{238}U	12	0.22 ± 0.05	0.18 ± 6%
U-Total	12	0.53 ± 0.06	0.45 ± 7%
Richland Pumphouse			
^{3}H	12	162 ± 4	96 ± 19%
^{90}Sr	12	0.14 ± 0.04	0.08 ± 250%
^{234}U	12	0.36 ± 0.05	0.28 ± 11%
^{235}U	12	0.02 ± 0.02	0.011 ± 36%
^{238}U	12	0.32 ± 0.05	0.22 ± 14%
U-Total	12	0.69 ± 0.07	0.51 ± 10%
300 Area			
^{3}H	4	182 ± 4	154 ± 19%
^{90}Sr	4	0.10 ± 0.04	0.10 ± 4%
^{234}U	4	0.56 ± 0.08	0.45 ± 29%
^{235}U	4	0.02 ± 0.02	0.02 ± 50%
^{238}U	4	0.48 ± 0.07	0.37 ± 24%
U-Total	4	1.10 ± 1.10	0.83 ± 28%

[a] Maximum values are ±2 sigma counting errors. Averages are ±2 times the standard error of the calculated mean.
Source: Dirkes et al. 1994.

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Table 2-9. Monitored Levels of Noise Propagated from Outdoor Activities at the Hanford Site.

Activity	Average Noise Level (Decibels)	Maximum Noise Level (Decibels)	Year Measured
Water wagon operation	104.5	111.9	1984
Well sampling Truck Compressor Generator	74.8 - 78.2 78 - 83 88 - 90 93-95		1987 1989
Well drilling, Well 32-2	98-102	102	1987
Well drilling, 32-3	105-11	120-125	1987
Well drilling, 33-29	89-91		1987
Pile driver (diesel 5 ft from source)	118 - 119		1987
Modified from Cushing 1994.			

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Table 2-10. Threatened (T) and Endangered (E) Species Identified on the Hanford Site.

Common Name	Scientific Name	Federal	State
Plants			
Columbia milk-vetch	*Astragalus columbianus*		T
Columbia yellowcress	*Rorippa columbiae*		E
Dwarf evening (desert) primrose	*Oenothera pygmaea*		T
Hoover's desert parsley	*Lomatium tuberosum*		T
Northern wormwood[a]	*Artemisia campestris borealis var. wormskioldii*		E
Birds			
Aleutian Canada goose[b]	*Branta canadensis leucopareia*	T	E
Peregrine falcon[b]	*Falco peregrinus*	E	E
Bald eagle	*Haliaeetus leucocephalus*	T	T
White pelican	*Pelecanus erythrorhychos*		E
Sandhill crane	*Grus canadensis*		E
Ferruginous hawk	*Buteo regalis*		T
Mammals			
Pygmy rabbit[a]	*Brachylagus idahoensis*		E

[a] Probably not currently occurring on the Hanford Site.
[b] Incidental occurrence.
Source: Cushing 1994

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Table 2-11. Candidate Species to the Threatened or Endangered List Identified on the Hanford Site. (2 sheets)

Common Name	Scientific name	Federal[a]	State
Molluscs			
Shortfaced lanx	*Fisherola (= Lanx) nuttalli*	X[(C3)]	X
Columbia pebble snail	*Fluminicola (= Lithoglyphus) columbiana*	X[(C2)]	X
Birds			
Common loon	*Gavia immer*		X
Swainson's hawk	*Buteo swainsoni*		X
Ferruginous hawk	*Buteo regalis*	X[(C2)]	
Western sage grouse[b]	*Centrocercus urophasianus phaios*	X[(C2)]	X
Sage sparrow	*Amphispiza belli*		X
Burrowing owl	*Athene cunicularia*		X
Loggerhead shrike	*Lanius ludovicianus*	X[(C2)]	X
Northern goshawk[b]	*Accipter gentilis*	X[(C2)]	X
Lewis' woodpecker[b]	*Melanerpes lewis*		X
Long-billed curlew	*Numenius americanus*	X[(C3)]	
Sage thrasher	*Oreoscoptes montanus*		X
Flammulated owl[b]	*Otus flammeolus*		X
Western bluebird[b]	*Sialia mexicana*		X
Golden eagle	*Aquila chrysaetos*		X
Black tern[b]	*Childonius niger*	X[(C2)]	
Trumpeter swan[b]	*Cygnus columbianus*	X[(C2)]	
Insects			
Columbia River tiger beetle[c]	*Cinindela colubica*		X
Reptiles			
Striped whipsnake	*Masticophis taeniatus*		X
Mammals			
Merriam's shrew	*Sorex merriami*		X
Pacific western big-eared bat[c]	*Plecotus townsendii townsendii*	X[(C2)]	X
Pygmy rabbit[c]	*Brachylagus idahoensis*	X[(C2)]	
Plants			
Columbia milk-vetch	*Astragalus columbianus*	X[(C1)]	
Columbia yellowcress	*Rorippa columbiae*	X[(C2)]	
Hoover's desert parsley	*Lomatium tuberosum*	X[(C2)]	
Northern wormwood[c]	*Artemisa campestris borealis var. wormskioldii*	X[(C1)]	
Desert Evening primrose	*Oenothera Caespitosa*		S
Shining flatsedge	*Cyperus rivularis*		S
Dense sedge	*Carex densa*		S
Gray cryptantha	*Cryptantha leucophaea*		S
Piper's daisy	*Erigeron piperianus*		S
Southern mudwort	*Limosella acaulis*		S

Table 2-11. Candidate Species to the Threatened or Endangered List Identified on the Hanford Site. (2 sheets)

Common Name	Scientific name	Federal[(a)]	State
Plants (cont.)			
False-pimpernel	*Lindernia anagallidea*		S
Tooth-sepal dodder	*Cuscuta denticulata*		M1
Thompson's sandwort	*Arenaria franklinii v. thompsonii*		M2
Bristly cryptantha	*Cryptantha interrupta*		M2
Robinson's onion	*Allium robinsonii*		M3
Columbia River mugwort	*Artemisia lindleyana*		M3
Stalked-pod milkvetch	*Astragalus sclerocarpus*		M3
Medic milkvetch	*Astragalus speirocarpus*		M3
Crouching milkvetch	*Astragalus succumbens*		M3
Rosy balsamroot	*Balsamorhiza rosea*		M3
Palouse thistle	*Cirsium brevifolium*		M3
Smooth cliffbrake	*Pellaea glabella*		M3
Fuzzy-beard tongue penstemon	*Penstemon eriantherus*		M3
Squill onion	*Allium scillioides*		M3
The following species may inhabit the Hanford Site, but have not been recently collected, and the known collections are questionable in terms of location and/or identification.			
Palouse milkvetch	*Astragalus arrectus*		S
Few-flowered blue-eyed Mary	*Collinsia sparsiflora*		S
Coyote tobacco	*Nicotiana attenuata*		S

[1] (a) Abbreviations:

C1 = Taxa for which the Service has enough substantial information on biological vulnerability to support proposals to list them as endangered or threatened species. Listing is anticipated but has temporarily been precluded by other listing activity.

C2 = Taxa for which current information indicates that proposing to list as endangered or threatened is possibly appropriate, but for which conclusive data on biological vulnerability are not available to support listing. The Service will not propose listing unless additional supporting information becomes available.

C3 = Taxa that were once considered for listing as endangered or threatened, (i.e., in categories 1 or 2) but are no longer current candidates for listing. Such taxa are further subdividied into three categories that indicate why they were removed from consideration.

S = sensitive, i.e., taxa vulnerable or declining, and could become endangered or threatened without active management or removal of threats;

M1 = Monitor group 1. Taxa for which there are insufficient data to support listing as threatened, endangered, or sensitive.

M2 = Monitor group 2, i.e., taxa with unresolved taxonomic questions.

M3 = Monitor group 3, i.e., taxa that are more abundant and/or less threatened than previously assumed.

[2] (b) Species reported, but seldom observed, on the Hanford Site.

(c) Probable, but not observed, on the Hanford Site.

Source: Cushing 1994.

Table 2-12. Summary of Contaminants of Potential Concern Carried Forward to the Risk Assessment for Groundwater, Sediment and Surface Water. (3 sheets)

MEDIUM/Parameter	Maximum Detected Concentration	Number of Detects	Number of Results	MCL[a]
GROUNDWATER				
ALL WELLS SCREENING SCENARIO				
Unconfined Aquifer				
Organics	(μg/L)			(μg/L)
Chloroform	18	40	198	100
1,2-Dichloroethene (Total)	150	6	175	-
Dichloroethene (trans)	130	2	23	100
Trichloroethene	14	78	198	5
Total coliform (c/100 ml)	280	18	129	a
Inorganics	(μg/L)			
Copper	11.6	15	166	1,300
Nickel	118	31	166	100
Nitrate	15,600	86	109	44,000
Radionuclides	(pCi/L)			(pCi/L)
Strontium-90	4.57	16	149	8
Technetium-99	65	23	67	900
Tritium	11,800	32	59	20,000
Uranium-234	120	85	149	-
Uranium-235	17	74	150	-
Uranium-238	93	88	150	-
Total Uranium	189	72	76	15
Confined Aquifer				
Inorganics	(μg/L)			
none				

Table 2-12. Summary of Contaminants of Potential Concern Carried Forward to the Risk Assessment for Groundwater, Sediment and Surface Water. (3 sheets)

MEDIUM/Parameter	Maximum Detected Concentration	Number of Detects	Number of Results	MCL[a]
Organics				
none				
Radionuclides	(pCi/L)			
none				
ONSITE WELL SCREENING SCENARIO				
Inorganics	(μg/L)			
none				
Organics	(μg/L)			(μg/L)
Chloroform	8	2	4	100
Trichloroethene	7	4	4	5
Radionuclides	(pCi/L)			(pCi/L)
Tritium	1890	1	1	20,000
Uranium-234	8.10	2	3	-
Uranium-235	0.51	1	3	-
Uranium-238	8.40	2	3	-
Total Uranium	17.5	2	2	15
TRITIUM PLUME SCREENING SCENARIO				
Organics	(μg/L)			
None				
Inorganics	(μg/L)			
None				
Radionuclides	(pCi/L)			(pCi/L)
Tritium	11,800	3	3	20,000
SEDIMENT				
Inorganics				
none				

Table 2-12. Summary of Contaminants of Potential Concern Carried Forward to the Risk Assessment for Groundwater, Sediment and Surface Water. (3 sheets)

MEDIUM/Parameter	Maximum Detected Concentration	Number of Detects	Number of Results	MCL[a]
Organics				
none				
Radioisotopes				
none				
SURFACE WATER				
Organics	(μg/L)			(μg/L)
Trichloroethene	0.002J	3	9	5
Radionuclides	(pCi/L)			(pCi/L)
Technetium-99	5.40J	1	9	900
Tritium	3,100	9	9	20,000
Uranium-234	18	9	9	-
Uranium-235	1.10J	5	9	-
Uranium-238	19	9	9	-
Inorganics	(μg/L)			
none				

Note:
The "J" qualifier indicates an estimated value.
Source: DOE-RL 1994d.
[a]See Appendix E.

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Table 2-13. Maximum Contaminant Concentrations in Groundwater Measured in 1992 and Predicted in 2018.

Parameter	Units	Half-life (yr)	K_d[a] (ml/g)	Maximum groundwater concentration	
				Measured in 1992	Predicted in 2018
ORGANICS					
1,2-Dichloroethene (total)[b]	µg/L	NA	0.59	150	150
1,2-Dichloroethene (trans)[b]	µg/L	NA	0.59[c]	130	130
Chloroform	µg/L	NA	0.44	18	0
Total Coliform[d]	cfu/100 ml	NA	NA	280	280
Trichloroethene[b]	µg/L	NA	0.65	14	14
METALS					
Copper	µg/L	NA	35	11.6	1.5
Nickel	µg/L	NA	400	118	50
ANIONS					
Nitrate[e]	mg/L	NA	NA	15.6	NA
RADIONUCLIDES					
Strontium-90	pCi/L	28	35	4.57	0.24
Technetium-99[e]	pCi/L	NA	NA	65	NA
Tritium[f]	pCi/L	NA	NA	11,800	11,800
Uranium-234	pCi/L	2.50×10^5	25[g]	120	5
Uranium-235	pCi/L	7.10×10^8	25[g]	17	1
Uranium-238	pCi/L	4.50×10^9	25[g]	93	4
Uranium Total[h]	µg/L	4.50×10^9	25	270	12

NA = Not Applicable
Source: DOE-RL 1994d.

[a] The distribution coefficients used are from Appendix I of the Phase I RI (DOE-RL 1994d). When a range of values exists for a particular contaminant, the largest distribution coefficient was chosen to maximize contaminant travel time to the Columbia River.

[b] There appears to be a steadily dissolving source for these dense nonaqueous phase liquids. It was assumed that the mass of the source is large enough to ensure steady dissolution and therefore steady concentrations beyond 2018.

[c] The distribution coefficient for dichloroethene was assumed identical to that of 1,2-dichloroethene.

[d] Discharge of coliform bacteria is expected to continue indefinitely. The maximum future concentration of total coliform in 300-FF-5 Operable Unit groundwater was therefore assumed equal to the maximum measured in 1992.

[e] Impacts of the nitrate and technetium-99 plumes on 300-FF-5 Operable Unit groundwater were modeled for the 1100-EM-1 Operable Unit phase I and II RI Reports (DOE-RL 1990a and 1992c). Refer to these RI Reports for future concentrations of nitrate and ^{99}Tc in 300-FF-5 Operable Unit groundwater.

[f] Rather than modeling the 200 Area tritium plume, future concentrations of tritium in 300-FF-5 operable unit groundwater were assumed identical to those currently measured.

[g] Maximum reasonable distribution coefficient for uranium in the 300-FF-5 Operable Unit. Using a K_d of 1.0, predicted uranium concentrations are calculated to be indistinguishable from background by the year 2018. Background values are from Table 4-2 of DOE-RL 1994d.

[h] The half-life and distribution coefficient for total uranium were assumed identical to that of uranium-238.

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Table 2-14. Maximum Future Mass Flux into the Columbia River and the Resulting Future River Concentration.

Parameter	Maximum Future Mass Flux		Predicted Maximum River Concentration[a]	Predicted Average River Concentration
	Value	Units		
ORGANICS				
1,2-Dichloroethene (total)	NZ	μg/d	NZ	NZ
1,2-Dichloroethene (trans)	NZ	μg/d	NZ	NZ
Chloroform	4.5×10^7	μg/d	2.2 μg/L	0.028 μg/L
Total Coliform[b]	NA	cfu/100 ml	30 cfu/100 ml	30 cfu/100 ml
Trichloroethene	3.6×10^7	μg/d	1.8 μg/L	0.022 μg/L
METALS				
Copper	3.2×10^7	μg/d	1.6 μg/L	0.020 μg/L
Nickel	1.4×10^8	μg/d	7.1 μg/L	0.088 μg/L
ANIONS				
Nitrate[c]	NA	NA	NA	NA
RADIONUCLIDES				
Strontium-90	6.3×10^5	pCi/d	0.03 pCi/L	3.9×10^{-4} pCi/L
Technetium-99[c]	NA	NA	NA	NA
Tritium[d]	NA	NA	5,800 pCi/L	130[e] pCi/L
Uranium-234	2.0×10^7	pCi/d	1.0 pCi/L	0.013 pCi/L
Uranium-235	1.3×10^6	pCi/d	0.06 pCi/L	0.0008 pCi/L
Uranium-238	1.6×10^7	pCi/d	0.81 pCi/L	0.010 pCi/L
Uranium Total	4.2×10^7	μg/d	2.1 μg/L	0.03 μg/L

NA = Not Applicable.
NZ = Near Zero. Frequency of detection is so small that calculation of the future maximum mass flux is not possible, but is expected to be near zero.

Source: DOE-RL 1994d.

[a] Calculated as the average proportionality factor from Table 5-3 of the Phase I RI multiplied by the predicted maximum mass flux.

[b] Discharge of total coliform bacteria is expected to continue indefinitely. The maximum future Columbia River concentration of total coliform was therefore assumed equal to the maximum measured in 1992.

[c] Impacts of the nitrate and ^{99}Tc plumes on the Columbia River were modeled for the 1100-EM-1 Operable Unit Phase I and II RI reports (DOE-RL 1990b and 1992a). The reader is referred to the aforementioned reports for future concentrations of nitrate and ^{99}Tc in the Columbia River.

[d] Rather than modeling the 200 Area tritium plume, future concentrations of tritium in the Columbia River were instead assumed identical to those currently measured.

[e] Represents the average concentration of tritium measured in water obtained from the 300 Area intake structure for 1991 (Bisping and Woodruff 1992).

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Table 2-15. Matrix of Locations, Times, and Exposure Scenarios Evaluated for the 300-FF-5 Operable Unit.

Scenario	300 Area	On Hanford Site[a]	Off Hanford Site[b]
Current			
Industrial	yes	no	yes
Residential	no	no	yes
Recreational	no	no	yes
Agricultural	no	no	yes
Future			
Industrial	yes	yes	yes
Residential	no	yes	yes
Recreational	no	yes	yes
Agricultural	no	yes	yes

Source: DOE-RL 1994d.
[a]Receptors located in non-300 Area portions of the Hanford Site.
[b]Receptors located off the Hanford Site.

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Table 2-16. Matrix of Current Exposure Scenarios and Exposure Points Evaluated for the 300-FF-5 Operable Unit.

Media[a]	Exposure Point	Current Scenario				
		Industrial on 300 Area	Off Hanford Site			
			Industrial	Residential	Recreational	Agricultural
Ground[b] Water	Well 399-4-12	yes	no	no	no	no
Surface[c] Water	Columbia River at 300 Area	yes	no	no	yes	no
Surface[c] Water	Columbia River at Richland	no	yes	yes	yes	yes

[a] Current exposure to sediment and biota are not assessed in this report.
[b] Exposure to groundwater from well 399-4-12 is evaluated only for dermal and inhalation pathways. Well water is not used for drinking water purposes.
[c] Exposure to surface water is evaluated for ingestion, dermal, and inhalation pathways. However, the inhalation pathway is not evaluated for recreational receptors.
Source: DOE-RL 1994d.

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Table 2-17. Matrix of Future Exposure Scenarios and Exposure Points Evaluated for the 300-FF-5 Operable Unit.

Media	Exposure Point	Future Scenario								
		Industrial on 300 Area	On Hanford Site				Off Hanford Site			
			Industrial	Residential	Recreational	Agricultural	Industrial	Residential	Recreational	Agricultural
Ground Water	Any Well[a]	yes	no	no	no	no	no	no	no	no
Surface Water	Columbia River at 300 Area[a]	yes	yes	yes	yes	yes	no	no	no	no
Surface Water	Columbia River at Richland[a,b]	no	no	no	no	no	yes	yes	yes	yes
Biota	Fish	no	no	yes	yes	yes	no	yes	yes	yes

Source: DOE-RL 1994d.
[a]Exposure to groundwater and surface water is evaluated for ingestion, dermal, and inhalation pathways. However, the inhalation pathway is not evaluated for recreational receptors.
[b]Qualitatively evaluated.

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Table 2-18. Summary Table of Lifetime Incremental Cancer Risks for Current Exposure Scenarios for the 300-FF-5 Operable Unit.

Media	Exposure Point	Current Scenario				
		Industrial on 300 Area	Off Hanford Site			
			Industrial	Residential	Recreational	Agricultural
Ground Water	Well 399-4-12	2E-05[a]	-	-	-	-
Surface Water	Columbia River at 300 Area	9E-08[b] (5E-06[c])	-	-	4E-07	-
Surface Water	Columbia River at Richland	-	1E-07	4E-07	8E-09	4E-07
Total ICR		2E-05	1E-07	4E-07	5E-07	4E-07

Source: DOE-RL 1994d.
[a]Includes contribution from chloroform attributable to water chlorination (2E-05).
[b]Data from 300 Area water intake (represents average river concentrations).
[c]Data from spring locations 9 and 11 (represents maximum river concentrations). Includes contribution from uranium-238 (3E-06) and uranium-234 (1E-06).
- = Not evaluated.
ICR = Lifetime Incremental Cancer Risk.

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Table 2-19. Summary of Contaminants of Concern for Current Exposure Scenarios.

Media	Contaminants of Concern[a]	ICR	Pathway
Industrial Scenario - 300 Area			
Groundwater	chloroform trichloroethene	2E-05 1E-06	inhalation of volatiles
Surface Water 300 Area Average	none	-	-
Surface Water 300 Area Maximum	uranium-238 uranium-234	3E-06 1E-06	ingestion ingestion
Industrial, Residential, Recreational, Agricultural - Off-Hanford Site			
Surface Water Richland	none	-	-

Source: DOE-RL 1994d.
[a] A contaminant of concern is a contaminant for which the ICR (via multiple pathways) is equal to or greater than 1E-06.
ICR = Lifetime Incremental Cancer Risk.

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Table 2-20. Summary Table of Lifetime Incremental Cancer Risks for Future Exposure Scenarios for the 300-FF-5 Operable Unit.

Media	Exposure Point	Future Scenario								
		Industrial on 300 Area	On Hanford Site				Off Hanford Site			
			Industrial	Residential	Recreational	Agricultural	Industrial	Residential	Recreational	Agricultural
Ground Water	Any Well	7E-06[a]	-	-	-	-	-	-	-	-
Surface Water[b]	Columbia River at 300 Area	1E-07 (8E-06[c])	1E-07 (8E-06[c])	3E-07 (2E-05[d])	3E-09 (2E-07[e])	3E-07 (2E-05[d])	-	-	-	-
Surface Water	Columbia River at Richland	-	-	-	-	-	<1E-06[f]	<1E-06[f]	<1E-06[f]	<1E-06[f]
Biota	Fish	-	-	2E-07	2E-07	2E-07	-	2E-07	2E-07	2E-07
Total ICR[b]		7E-06 (2E-05)	1E-07 (8E-06)	5E-07 (2E-05)	2E-07 (4E-07)	5E-07 (2E-05)	<1E-06	<1E-06	<1E-06	<1E-06

Source: DOE-RL 1994d.
[a]Includes contribution from tritium plume from 200 Area (3E-06), and trichloroethene (3E-06).
[b]Risk values associated with exposure to surface water from the 300 Area are based on predicted average river concentrations (300 Area water intake); risk values in parentheses are based on predicted maximum river concentrations (spring locations 9 and 11).
[c]Includes contribution from tritium plume from 200 Area (2E-06), and chloroform attributable to water chlorination (5E-06).
[d]Includes contribution from tritium plume from 200 Area (7E-06), and chloroform attributable to water chlorination (8E-06).
[e]Includes contribution from tritium plume from 200 Area (1E-07).
[f]Qualitatively evaluated.
- = Not evaluated.
ICR = Lifetime Incremental Cancer Risk.

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Table 2-21. Summary of Contaminants of Concern for Future Exposure Scenarios.

Media	Contaminants of Concern[a]	ICR	Pathway
Industrial Scenario - 300 Area			
Groundwater	trichloroethene tritium	3E-06 3E-06	inhalation ingestion
Surface Water 300 Area Average	none	-	-
Surface Water 300 Area Maximum	chloroform tritium	5E-06 2E-06	inhalation ingestion
Industrial Scenario - On Hanford Site			
Surface Water 300 Area Average	none	-	-
Surface Water 300 Area Maximum	chloroform tritium	5E-06 2E-06	inhalation ingestion
Residential and Agricultural Scenarios - On Hanford Site			
Surface Water 300 Area Average	none	-	-
Surface Water 300 Area Maximum	chloroform tritium	8E-06 7E-06	inhalation of volatiles ingestion
Biota	none	-	-
Recreational Scenario - On Hanford Site			
Surface Water 300 Area Average	none	-	-
Surface Water 300 Area Maximum	none	-	-
Biota	none	-	-
Industrial, Residential, Recreational, Agricultural - Off-Hanford Site			
Surface Water Richland	none	-	-
Biota	none	-	-

Source: DOE-RL 1994d.
[a] A contaminant of concern is a contaminant for which the ICR (via multiple pathways) is equal to or greater than 1E-06.
ICR = Lifetime Incremental Cancer Risk.

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Table 2-22. Computer Calculated Radiological Dose to Aquatic Organisms.

Organism	Dose (rad/d)
Fish	0.081
Crustacean	0.052
Plant Eating Duck	0.42
Fish Eating Duck	0.74
Heron	0.48
Source: DOE-RL 1994d.	

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Table 2-23. Toxicity Value Comparison for Aquatic Organisms.

Contaminant	Acute LOEL (μg/L)	Chronic LOEL (μg/L)	300-FF-5 Concentrations[3] (μg/L)	Above Criteria (LOEL)
Copper	11[1]	7.6[1]	11.6	yes
Nickel	920[1]	102[1]	118	yes
Nitrate	400,000	No values	15,600	no
Chloroform	28,900	1,240	18	no
1-2 Dichloroethene	116,000[2]	No value	150	no
Trichloroethene	45,000	21,900	14	no

Source: DOE-RL 1994d.
[1] Assuming calcium carbonate concentration of 60 mg/L.
[2] Values for dichloroethylene.
[3] Values represent maximum concentrations detected in the unconfined aquifer.
[4] From ambient Aquatic Life Water Quality Criteria (EPA 1986)
LOEL = Lowest observable adverse effect level.

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3.0 SUPPLEMENTAL REMEDIAL INVESTIGATION DATA COLLECTION ACTIVITIES

The 300-FF-5 Operable Unit RI Report (DOE-RL 1994d) recommended that supplemental investigative activities be performed. In this Section, the three categories of work performed during the Supplemental RI are presented:

- Surface water investigation (Section 3.1)
- Groundwater investigation (Section 3.2)
- Uranium fate and transport (Section 3.3).

Interpretations of the data collected and analyzed are provided in the subsequent chapters of this report.

Environmental investigative activities performed during the Supplemental RI were conducted either under a formal sampling and analysis plan approved by DOE-RL, EPA, and Ecology, or by plans approved by the Tri-Party Agreement signatories through the Unit Managers Meetings. In the latter case, presentation and approval of such plans was documented in the minutes of the Unit Managers Meetings.

3.1 SURFACE WATER INVESTIGATION

Additional sampling and analysis of near shore Columbia River water was performed as part of the Supplemental RI. The river sampling event occurred on June 23, 1994. The intent of the sampling event was to collect river water samples during near average river flow and to characterize near average river water contaminant levels. The sampling event was coordinated with the Grant County Public Utility District (PUD), which is responsible for controlling releases at the Priest Rapids Dam upstream of the Hanford Site. Sampling actually occurred during a slightly higher than average river stage (~ + 2 ft).

The activities occurred as outlined in Hulstrom (1994a). Samples were collected from the same three river sampling locations as were sampled during the RI effort: immediately upstream of spring #6, and immediately downstream of Springs 9 and 11 (Figure 2-1 and Table 3-1). Samples were collected at 3, 10, and 20 ft from the shoreline at two depths (along the river bottom and at mid-water depth) using methods identical to those specified previously in WHC (1993b). Chemical and radiological analyses included total uranium (unfiltered), filtered and unfiltered Inductively Coupled Plasma (ICP) metals for samples collected along the bottom of the river, and total uranium (unfiltered) for the sample collected at mid-depth.

Table 3-1 lists the river water sample Hanford Environmental Information System (HEIS) numbers, sample locations and analyses performed. The river water samples were analysed by IT Corporation. Analytical results are summarized in Appendix A.

3.2 GROUNDWATER INVESTIGATION

Three more groundwater sampling rounds (rounds 5, 6, and 7) were conducted after the completion of the Phase I RI investigation. Round 5 sampling occurred during February/March 1993 with some wells also sampled in May 1993. Following round 5, sampling was reduced from quarterly to semiannually; round 6 sampling took place in September 1993, and round 7 sampling occurred in June 1994. The sampling that occurred in May 1993 was conducted specifically in response to a spill of ethylene glycol. That sampling was part of the 300 Area RCRA groundwater sampling program. WHC (1993a, 1994a) provide additional information regarding details of the spill.

As in rounds 1 through 4, sampling was performed in coordination with the RCRA sampling program. As such, the CERCLA sampling was limited to those wells that were not already scheduled to be sampled for RCRA activities during the same sampling time period. As seen in Table 3-2, 35 wells were sampled during round 5; 22 were sampled during round 6; and 22 were sampled during round 7. Table 3-2 summarizes wells sampled during rounds 5, 6, and 7, dates sampled, HEIS numbers, and analyses performed. The locations of wells in the 300-FF-5 Operable Unit are shown in Figure 2-2. Chemical analysis results are presented in Appendix B.

The analytes included in the CERCLA sampling program for rounds 5, 6, and 7 consisted of Contract Laboratory Program (CLP) VOC and unfiltered uranium analyses. In addition, gross alpha and gross beta analyses were performed during round 5. Isotopic uranium analyses were conducted during round 6. Technetium-99 analyses were conducted at wells 399-5-1 and 699-S27-E14 during round 5. ICP metals (both filtered and unfiltered) were included in the list of constituents for round 7 CERCLA sampling. As discussed in Section 3.3.1, additional samples for filtered total uranium analyses were collected during round 6 from six wells located in the uranium plume.

Under the RCRA sampling, the constituent list for all wells except 399-1-17A included volatile organics, herbicides, semivolatiles, pesticides, ICP metals (filtered and unfiltered), arsenic, selenium, lead, and mercury (each filtered and unfiltered), and unfiltered radionuclides (tritium, radium, uranium, alpha and beta). For well 399-1-17A, the constituent list included anions, gamma scan, PCB, ^{90}Sr, total and isotopic uranium, and volatile organics. The specific constituents included are summarized in Table 3-2.

For rounds 5 and 6, Thermo Analytical (TMA) analyzed samples and Weston analyzed split samples. The same laboratories were used for the previous four rounds. During round 7, IT Corporation was used as the main laboratory and TMA as the split laboratory.

Sampling conducted under rounds 5, 6, and 7 occurred as a continuation of sampling conducted previously and was based on the first four rounds of data and comparison of those results to historical data, when available. Recommendations and plans for rounds 5, 6, and 7 sampling were presented to the regulatory agencies and approved in the Unit Managers Meetings. Round 7 was the final round of groundwater sampling to be conducted in support of the 300-FF-5 RI/FS. Additional sampling may continue beyond round 7 semiannually or seasonally for constituents of special interest.

3.3 URANIUM FATE AND TRANSPORT

The Phase I RI (DOE-RL 1994d) identified uncertainties in the current understanding of the fate and transport of uranium in the unconfined aquifer at the 300-FF-5 Operable Unit. A better understanding was necessary to provide more accurate predictions of future risk from groundwater, and to more accurately predict the time required for uranium concentrations in the aquifer to decrease through extraction systems or natural flushing. The Phase I RI report recommended additional investigative activities, as discussed in Section 2.6 of this report; this sub-section describes the work conducted as a result of these recommendations.

3.3.1 Filtered Uranium Analyses

Uranium analyses were performed on filtered and unfiltered split samples collected from six operable unit wells during sampling round 6: 399-1-5, 399-1-7, 399-2-2, 399-4-10, 399-4-12, and 399-4-7. Splits were collected and analyzed for all six. All of these wells are located within the uranium plume area. The well locations are shown in Figure 2-2. Filter sizes of 0.1, 0.45, and 1 micron were used to filter the samples. Table 3-3 presents a summary of the filtered/unfiltered split sample collection, including well number, filter size, and HEIS number. The results of the filtered/unfiltered uranium analyses are presented in Section 4.3.1. All chemical data for groundwater are tabulated in Appendix B.

3.3.2 Uranium Mobility and Solubility

In support of the Phase III FS for the 300-FF-1 Operable Unit, PNL conducted a series of laboratory investigations (Serne et al. 1994) to evaluate, among other items, the adsorption potential of several 300-FF-1 soil contaminants, including uranium. Because this work directly relates to the data needs of the 300-FF-5 RI, no additional 300-FF-5-specific work related to uranium sorption evaluations was performed under the 300-FF-5 Supplemental RI.

The work conducted by PNL was summarized in the Phase III FS for the 300-FF-1 Operable Unit (DOE-RL 1994f) and included two primary elements:

- Measuring the concentrations of selected chemical constituents (uranium, copper, and chromium) in leachate samples obtained from contaminated 300-FF-1 soils and soil-washed fines. The fines were generated during a pilot-scale soil physical separation test performed at the 316-2 north process pond in support of the Phase III 300-FF-1 FS (DOE-RL 1994f). The leach testing was performed using the Toxicity Characteristic Leaching Procedure (TCLP) and EPA method 1312 batch leachate test and ASTM draft Method 161 sequential batch leaching test. The leachate measurements supported evaluations of the acceptability of disposing of the materials at the proposed Environmental Restoration and Disposal Facility (ERDF).

- Performing a series of column leaching tests involving leachate from the most contaminated sediments and "clean" soil. The purpose was to further refine the evaluation made in the 300-FF-5 Phase I RI of potential groundwater quality impacts from 300-FF-1 soils.

Breakthrough curves generated in the column experiments were intended to indicate the sorption tendencies of the contaminants in the vadose zone soils and the potential for migration of the compounds to groundwater, including calculation of a value for the uranium distribution coefficient (K_d) from the breakthrough curves. Unfortunately, the sample obtained to represent "clean" soil contained significant quantities of uranium that dissolved and flushed through the columns with the leachate. The presence of this uranium prevented the intended interpretation of the uranium adsorption behavior.

Estimates of distribution coefficients are important for the accurate estimate of chemical retardation and ultimately flushing of the contaminant from the aquifer. The laboratory work performed by PNL was not successful in estimating a K_d for uranium. Therefore it was not possible to determine site specific soil distribution coefficients for uranium. In order to avoid duplication of effort the 300-FF-5 operable unit relied on the work being conducted under the 300-FF-1 Operable Unit to fulfill this data need. Schedule commitments for this document made it impossible to redo the experiments. A K_d of 2 translates into a retardation coefficient of approximately 10; i.e. uranium will move 1 ft for every 10 ft of water movement. The nearness of the disposal facilities in the 300 Area to the river and the relatively high-pore water velocities would indicate a reduced importance for the accurate determination of this parameter. Water should flush the uranium many more times than needed by the year 2018 to allow very low concentrations to be reached. Should more accurate predictions be needed and K_d proves to be a particularly sensitive parameter for these predictions, additional tests will be conducted. Additional information is included in Section 4.3.3

3.4 DATA VALIDATION

The Supplemental RI includes data collected from three rounds of groundwater sampling and a single Columbia River sampling event. Table 3-4 summarizes the results of data validation performed on the rounds 5, 6, and 7 groundwater data. As seen in the tables, validation has been performed on approximately 75% of the data collected to date; approximately 20% of rounds 1 through 4 data were validated. Full scale data validation was not conducted on the remaining Supplemental RI data. These remaining data were blank adjusted from laboratory and field blank sample results as discussed in Section 4.2.1. Data validation for the Supplemental RI is summarized in Hulstrom (1993a, 1993b, 1993e, 1994b, 1994c, and 1994d) for CERCLA data and in DOE-RL (1993d, 1994g) and WHC (1993d, 1994d, and 1994e) for RCRA data. Approximately 75% of all analyses were validated, while nearly 100% of the total and isotopic uranium analyses (for CERCLA sampling) were validated. Data validation was conducted in accordance with established procedures and guidelines developed for chemical and radiological analyses (WHC 1992a and 1992b) consistent with EPA procedures and guidelines (Bleyler 1988a and 1988b).

Table 3-1. River Sampling Summary Table

Sample location and distance from bank	Bottom of sample (ft)	Laboratory	Filtered	HEIS No.	M	Rad
SPRING 6,3 ft	1.58	IT	NO	B0C2R3		Y
SPRING 6,3 ft	3.17	IT	NO	B0C2R4	Y	Y
SPRING 6,3 ft	3.17	IT	YES	B0C2R5	Y	
SPRING 6,10 ft	2.33	IT	NO	B0C2R6		Y
SPRING 6,10 ft	4.75	IT	NO	B0C2R7	Y	Y
SPRING 6,10 ft	4.75	IT	YES	B0C2R8	Y	
SPRING 6,20 ft	3.17	IT	NO	B0C2R9		Y
SPRING 6,20 ft	6.33	IT	NO	B0C2S0	Y	Y
SPRING 6,20 ft	6.33	IT	YES	B0C2S1	Y	
SPRING 9,3 ft	1.25	IT	NO	B0C2S2		Y
SPRING 9,3 ft	2.25	IT	NO	B0C2S3	Y	Y
SPRING 9,3 ft	2.25	IT	YES	B0C2S5	Y	
SPRING 9,10 ft	1.92	IT	NO	B0C2S7		Y
SPRING 9,10 ft	3.75	IT	NO	B0C2S8	Y	Y
SPRING 9,10 ft	3.75	IT	YES	B0C2T0	Y	
SPRING 9,20 ft	2.33	IT	NO	B0C2T2		Y
SPRING 9,20 ft	4.67	IT	NO	B0C2T3	Y	Y
SPRING 9,20 ft	4.67	IT	YES	B0C2T4	Y	
SPRING 11,3 ft	1	IT	NO	B0C2T5		Y
SPRING 11,3 ft	2	IT	NO	B0C2T6	Y	Y
SPRING 11,3 ft	2	IT	YES	B0C2T8	Y	
SPRING 11,10 ft	2.5	IT	NO	B0C2V0		Y
SPRING 11,10 ft	5	IT	NO	B0C2V1	Y	Y
SPRING 11,10 ft	5	IT	YES	B0C2V2	Y	
SPRING 11,20 ft	2.67	IT	NO	B0C2V3		Y
SPRING 11,20 ft	5.5	IT	NO	B0C2V4	Y	Y
SPRING 11,20 ft	5.5	IT	YES	B0C2V5	Y	

Note:
All samples collected 23-June-94.
M = ICP Metals analysis
R = total uranium analysis

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Table 3-2. Well Sampling Summary for Rounds 5, 6 and 7. (Sheet 1 of 4)

	Round 5[11]				Round 6				Round 7			
Well	Date	HEIS No.[1]	Analysis[2]	Program	Date	HEIS No.[1]	Analysis[2]	Program	Date	HEIS No.[1]	Analysis[2]	Program
399-1-10A	10-Mar-93	B086Q1	VOA, RAD	CERCLA	14-Sep-93	B09641	SVOA,RAD,PEST,VOA[6],M,HERB,C	RCRA	23-Jun-94	BOBYJ9	SVOA,RAD,PEST,VOA,M,HERB,C	RCRA
	14-May-93	B07BM5	TOC	RCRA		B09642	Filtered M			BOBYK0	Filtered M	
	20-May-93	B07BQ7	TOC	RCRA								
	12-Feb-93	B085B9	A	RCRA								
	12-Feb-93	B085D9	SVOA,RAD,PEST,VOA[6],M,HERB,C	RCRA								
	12-Feb-93	B085D9	Filtered M	RCRA								
399-1-10B	16-Feb-93	B085D2	To-99,U,H-3,Chloride,Fluoride	SURV	NS				NS			
	16-Feb-93	B085D3	Filtered M[9]	SURV								
399-1-11	12-Feb-93	B085C0	A	RCRA	14-Sep-93	B09643	SVOA,RAD,PEST,VOA[6],M,HERB,C	RCRA	22-Jun-94	BOBYK1	SVOA,RAD,PEST,VOA,M,HERB,C	RCRA
	12-Feb-93	B085F0	SVOA,RAD,PEST,VOA[6],M,HERB,C	RCRA		B09644	Filtered M			BOBYK2	Filtered M	
	12-Feb-93	B085F1	Filtered M	RCRA								
399-1-12	20-May-93	B07BR0	TOC	RCRA	14-Sep-93	B09645	SVOA,RAD,PEST,VOA[6],M,HERB,C	RCRA	22-Jun-94	BOBYK3	SVOA,RAD,PEST,VOA,M,HERB,C	RCRA
	12-Feb-93	B085C1	A	RCRA		B09646	Filtered M			BOBYK4	Filtered M	
	12-Feb-93	B085F2	SVOA,RAD,PEST,VOA[6],M,HERB,C	RCRA								
	12-Feb-93	B085F3	Filtered M	RCRA								
399-1-13A	10-Mar-93	B086Q2	VOA, RAD	CERCLA	NS				NS			
399-1-14A	12-Feb-93	B085C2	A	RCRA	14-Sep-93	B09647	SVOA,RAD,PEST,VOA[6],M,HERB,C	RCRA	22-Jun-94	BOBYK5	SVOA,RAD,PEST,VOA,M,HERB,C	RCRA
	12-Feb-93	B085F4	SVOA,RAD,PEST,VOA[6],M,HERB,C	RCRA		B09648	Filtered M			BOBYK6	Filtered M	
	12-Feb-93	B085F5	Filtered M	RCRA								
399-1-14B	16-Feb-93	B085D4	To-99,U,H-3,Chloride,Fluoride	SURV	NS				NS			
	16-Feb-93	B085D5	Filtered M[9]	SURV								
399-1-15	10-Mar-93	B086Q3	VOA, RAD	CERCLA	NS				NS			
399-1-16A	14-May-93	B07BM8	TOC	RCRA	29-Sep-93	B09649	SVOA,RAD,PEST,VOA[6],M,HERB,C	RCRA	23-Jun-94	BOBYK7	SVOA,RAD,PEST,VOA,M,HERB,C	RCRA
	20-May-93	B07BQ8	TOC	RCRA		B09650	Filtered M			BOBYK8	Filtered M	
	16-Feb-93	B085C3	A	RCRA								
	16-Feb-93	B085F6	SVOA,RAD,PEST,VOA[6],M,HERB,C	RCRA								
	16-Feb-93	B085F7	Filtered M	RCRA								
399-1-16B	18-Feb-93	B085C4	A	RCRA	29-Sep-93	B09651	SVOA,RAD,PEST,VOA[6],M,HERB,C	RCRA	22-Jun-94	BOBYK9	SVOA,RAD,PEST,VOA,M,HERB,C	RCRA
	18-Feb-93	B085G0	SVOA,RAD,PEST,VOA[6],M,HERB,C	RCRA		B09652	Filtered M			BOBYL0	Filtered M	
	18-Feb-93	B085G1	Filtered M	RCRA								
399-1-16C	1-Mar-93	B086Q4	VOA, RAD	CERCLA	26-Sep-93	B095K0	VOA, RAD	CERCLA	24-Jun-94	BOBZK0	VOA,U,M	CERCLA
										BOBZK1	Filtered M	
399-1-17A	14-May-93	B08JD0	SVOA,RAD[6],PEST,VOA[6],M[8],HERB,C	RCRA	3-Sep-93	B09653	SVOA,RAD,PEST,VOA[6],M,HERB,C	RCRA	22-Jun-94	BOBYL1	SVOA,RAD,PEST,VOA,M,HERB,C	RCRA
		B08JD1	Filtered M			B09654	Filtered M			BOBYL2	TOX, TOC	
	20-May-93	B07BQ5	TOC	RCRA	9-Dec-93	B09MX4	A,RAD[3],VOA[7], TOC	RCRA		BOBYL3	TOX, TOC	
	8-Jan-93	B07TJ0	A, Rad[3],VOA,SVOA[4],PCB,GAMMA SCAN	RCRA		B09MX5	A,RAD[3],VOA[7], TOC			BOBYL4	TOX, TOC	
	14-Jan-93	B07TJ4	A, Rad[3],VOA,SVOA[4],PCB,GAMMA SCAN	RCRA		B09MX6	Conductivity, pH, TOC			BOBYL5	Filtered M	
	21-Jan-93	B07TJ1	A, Rad[3],VOA,SVOA[4],PCB,GAMMA SCAN	RCRA		B09MX7	Conductivity, pH, TOC					

Table 3-2. Well Sampling Summary for Rounds 5, 6 and 7. (Sheet 2 of 4)

	Round 5[11]				Round 6				Round 7			
Well	Date	HEIS No.[1]	Analysis[2]	Program	Date	HEIS No.[1]	Analysis[2]	Program	Date	HEIS No.[1]	Analysis[2]	Program
	27-Jan-93	B07TJ2	A, Rad[3],VOA,SVOA[4],PCB,GAMMA SCAN	RCRA		B09MX8	Conductivity, pH, TOC					
	12-Feb-93	B07TJ3	A, Rad[3],VOA,SVOA[4],PCB,GAMMA SCAN	RCRA		B09MX9	Conductivity, pH, TOC					
						B09MY0	Conductivity, pH, TOC					
						B09MY1	Conductivity, pH, TOC					
399-1-17B	18-Feb-93	B085G2	SVOA,RAD,PEST,VOA[5],M,HERB,C	RCRA	7-Sep-93	B09655	SVOA,RAD,PEST,VOA[5],M,HERB,C	RCRA	22-Jun-94	BOBYL6	SVOA,RAD,PEST,VOA,M,HERB,C	RCRA
	18-Feb-93	B085G4	Filtered M	RCRA		B09656	Filtered M			BOBYL7	Filtered M	
399-1-18A	12-Feb-93	B085C5	A	RCRA	7-Sep-93	B09657	SVOA,RAD,PEST,VOA[5],M,HERB,C	RCRA	22-Jun-94	BOBYL8	SVOA,RAD,PEST,VOA,M,HERB,C	RCRA
	12-Feb-93	B085G6	SVOA,RAD,PEST,VOA[5],M,HERB,C	RCRA		B09658	Filtered M			BOBYL9	Filtered M	
	12-Feb-93	B085G7	Filtered M	RCRA								
399-1-21A	9-Mar-93	B086Q5	VOA, RAD	CERCLA	24-Sep-93	B095K1	VOA,RAD	CERCLA	24-Jun-94	BOBZK2	VOA,U,M	CERCLA
	20-May-93	B07BR1	TOC	RCRA	14-Sep-93	B08ZV2	A,Bromide,H-3,Tc-99,Total U	SURV		BOBZK3	Filtered M	
						B08ZV3	Filtered M[6]	SURV				
399-1-5	10-Mar-93	B086P9	VOA, RAD	CERCLA	24-Sep-93	B095J2	Filtered Total U	CERCLA	24-Jun-94	BOBZJ2	VOA,U,M	CERCLA
	14-May-93	B07BM9	TOC	RCRA		B095J3	Filtered Total U			BOBZJ3	Filtered M	
	20-May-93	B07BQ6	TOC	RCRA		B095J4	Filtered Total U					
						B095J0	VOA,RAD					
399-1-7	9-Mar-93	B086Q0	VOA, RAD	CERCLA	16-Sep-93	B095J7	Filtered Total U	CERCLA	23-Jun-94	BOBZJ8	VOA,U,M	CERCLA
	14-May-93	B07BM7	VOA[5], SVOA[4], TOC	RCRA		B095J8	Filtered Total U			BOBZJ9	Filtered M	
	20-May-93	B07BQ4	TOC	RCRA		B095J9	Filtered Total U					
						B095J5	VOA,RAD					
399-2-1	16-Feb-93	B085C6	A	RCRA	16-Sep-93	B09663	SVOA,RAD,PEST,VOA[5],M,HERB,C	RCRA	23-Jun-94	BOBYM0	SVOA,RAD,PEST,VOA,M,HERB,C	RCRA
	16-Feb-93	B085G8	SVOA,RAD,PEST,VOA[5],M,HERB,C	RCRA		B09664	Filtered M			BOBYM1	Filtered M	
	16-Feb-93	B085G9	Filtered M	RCRA								
399-2-2	17-Mar-93	B08BF2	VOA, RAD	CERCLA	21-Sep-93	B095K4	Filtered Total U	CERCLA	23-Jun-94	BOBZK4	VOA,U,M	CERCLA
	20-May-93	B07BQ9	TOC	RCRA		B095K5	Filtered Total U			BOBZK5	Filtered M	
						B095K2	VOA,RAD					
399-3-10	16-Feb-93	B085C7	A	RCRA	03-Sep-93	B09659	SVOA,RAD,PEST,VOA[5],M,HERB,C	RCRA	23-Jun-94	BOBYM2	SVOA,RAD,PEST,VOA,M,HERB,C	RCRA
	16-Feb-93	B085H0	SVOA,RAD,PEST,VOA,M,HERB,C	RCRA		B09660	SVOA,RAD,PEST,VOA,M,HERB,C			BOBYM3	Filtered M	
	16-Feb-93	B085H1	Filtered M	RCRA		B09661	Filtered M					
						B09662	Filtered M					
399-3-11	3-Mar-93	B086Q8	VOA, RAD	CERCLA	22-Sep-93	B095K7	VOA,RAD	CERCLA	22-Jun-94	BOBZL0	VOA,U,M	CERCLA
										BOBZL1	Filtered M	
399-3-12	26-Feb-93	B086Q9	VOA, RAD	CERCLA	24-Sep-93	B095K9	VOA,RAD	CERCLA	22-Jun-94	BOBZL4	VOA,U,M	CERCLA
										BOBZL5	Filtered M	
399-3-2	8-Mar-93	B086Q7	VOA,RAD	CERCLA	13-Sep-93	B095K8	VOA,RAD	CERCLA	22-Jun-94	BOBZK8	VOA,U,M	CERCLA
										BOBZK9	Filtered M	
399-4-1	12-Mar-93	B086R0	VOA, RAD	CERCLA	NS				NS			

Table 3-2. Well Sampling Summary for Rounds 5, 6 and 7. (Sheet 3 of 4)

	Round 5[11]				Round 6				Round 7			
Well	Date	HEIS No.[1]	Analysis[2]	Program	Date	HEIS No.[1]	Analysis[2]	Program	Date	HEIS No.[1]	Analysis[2]	Program
399-4-10	3-Mar-93	B096R2	VOA,RAD	CERCLA	22-Sep-93	B095L6	Filtered Total U	CERCLA	23-Jun-94	B0BZM0	VOA,U,M	CERCLA
						B095L7	Filtered Total U			B0BZM1	Filtered M	
						B095L9	Filtered Total U					
						B095L4	VOA,RAD					
399-4-11	9-Mar-93	B096R3	VOA,RAD	CERCLA	NS				NS			
399-4-12	25-Feb-93	B096R4	VOA,RAD	CERCLA	17-Sep-93	B095M0	Filtered Total U	CERCLA	22-Jun-94	B0BZM4	VOA,U,M	CERCLA
						B095M1	Filtered Total U			B0BZM5	Filtered M	
						B095M2	Filtered Total U					
						B095L9	VOA,RAD					
399-4-7	26-Feb-93	B096R1	VOA,RAD	CERCLA	17-Sep-93	B095L1	Filtered Total U	CERCLA	23-Jun-94	B0BZL6	VOA,U,M	CERCLA
						B095L2	Filtered Total U			B0BZL7	Filtered M	
						B095L3	Filtered Total U					
						B095L0	VOA,RAD					
399-5-1	26-Feb-93	B096S7	VOA, Tc-99, alpha, beta	CERCLA	NS				NS			
399-6-1	26-Feb-93	B096R5	VOA,RAD	CERCLA	NS				NS			
399-8-1	8-Mar-93	B096R8	VOA,RAD	CERCLA	NS				NS			
399-8-3	17-Mar-93	B09BF1	VOA,RAD	CERCLA	NS				NS			
399-8-5A	25-Feb-93	B096R7	VOA,RAD	CERCLA	NS				NS			
699-S27-E14	26-Feb-93	B096S8	VOA, Tc-99, alpha, beta	CERCLA	NS				NS			
699-S28-E12	12-Mar-93	B099B0	VOA	CERCLA	NS				NS			

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Table 3-2. Well Sampling Summary for Rounds 5, 6 and 7. (Sheet 4 of 4)

	Round 5[11]				Round 6				Round 7			
Well	Date	HEIS No.[1]	Analysis[2]	Program	Date	HEIS No.[1]	Analysis[2]	Program	Date	HEIS No.[1]	Analysis[2]	Program

RAD - Radionuclides
Gross alpha (only RCRA and round 5 CERCLA)
Gross beta (only RCRA and round 5 CERCLA)
Radium (only RCRA)
Sr-90 (only 1-17A)
Total U
Isotopic U (only 1-17A and round 6 CERCLA)
Tritium (only RCRA)

C - Wet Chemistry
Alkalinity
Coliform Bacteria
Total Organic Carbon
Total Organic Halides

A - Anions
Chloride
Fluoride
Nitrate
Sulfate
Bromide (well 1-17A round 5 only)
Phosphate (well 1-17A round 5 only)
Nitrite (well 1-17A round 5 only)
Conductivity
pH

HERB - Herbicides
2,4,5-T
2,4,5-TP
2,4-Dichlorophenoxyacetic acid
2-secButyl-4,6-dinitrophenol

PEST - Pesticides
4,4'-DDD
4,4'-DDE
4,4'-DDT
Aldrin
Alpha-BHC
Beta-BHC
Chlordane
Delta-BHC
Dieldrin
Endosulfan I
Endosulfan II
Endosulfan sulfate
Endrin
Endrin aldehyde
Gamma-BHC (Lindane)
Heptachlor
Heptachlor epoxide
Methoxychlor
Toxaphene

SVOA - Semivolatiles
1,4-Dichlorobenzene
2,4,6-Trichlorophenol
2,4-Dichlorophenol
2,4-Dimethylphenol
2,4-Dinitrophenol
2,6-Dichlorophenol
2-Chlorophenol
2-Nitrophenol
4,6-Dinitro-o-cresol
4-Chloro-3-methylphenol
4-Nitrophenol
Pentachlorophenol
Phenol
Tetrachlorophenol
Tetrahydrofuran
Total cresols
Trichlorophenol

Gamma Scan
Antimony-125
Cesium-137
Cobalt-60
Ruthenium-106

M - Metals
Aluminum
Antimony
Arsenic (only RCRA)
Barium
Beryllium
Cadmium
Calcium
Chromium
Cobalt
Copper
Iron
Lead (only RCRA)
Magnesium
Manganese
Mercury (only RCRA)
Nickel
Potassium
Selenium(only RCRA)
Silver
Sodium
Tin
Vanadium
Zinc

PCB
Aroclor 1016
Aroclor 1221
Aroclor 1232
Aroclor 1242
Aroclor 1248
Aroclor 1254
Aroclor 1260

VOA - Volatiles
1,1,1-Trichloroethane
1,1,2,2-Tetrachloroethane
1,1,2-Trichloroethane
1,1-Dichloroethane
1,1-Dichloroethene
1,2-Dichloroethene
1,2-Dichloroethylene
1,2-Dichloropropane
1-Butanol
2-Butanone
2-Hexanone
4-Methyl-2-pentanone
Acetone
Benzene
Bromodichloromethane
Bromoform
Bromomethane
Carbon disulfide
Carbon tetrachloride
Chlorobenzene
Chloroethane
Chloroform
Chloromethane
cis-1,3-Dichloropropene
Dibromochloromethane
Ethyl cyanide
Ethylbenzene
Methylene chloride
Styrene
Tetrachloroethene
Toluene
trans-1,3-Dichloropropene
trans-1,2-Dichloroethylene
Trichloroethene
Vinyl chloride
Xylenes (total)

[1]QA samples not shown.
[2]All samples unfiltered unless otherwise indicated.
[3]RAD restricted to Sr-90, U, U-234, -235, -238.
[4]SVOA limited to 1,4-Dichlorobenzene and tetrahydrofuran.
[5]Full list of VOAs not analyzed.
[6]Metals restricted to magnesium, potassium, sodium, barium, and calcium.
[7]VOA restricted to 1,1,1-TCE, 1,2-DCE, chloroform and TCE.
[8]Sr-90 and isotopic U not analyzed.
[9]Metals restricted to barium, calcium, iron, magnesium, manganese, potassium, sodium.
[10]Tin was not analyzed.
[11]RCRA sampling in round 5 which occurred during May 93 was conducted in response to an ethylene glycol spill, as discussed in WHC (1993b, 1994e).

NS - Not Sampled
H-3 - Tritium
U - Total Uranium
Tc-99 - Technetium-99
TOX - Total Organic Halogen
TOC - Total Organic Carbon
SURV - Sitewide Surveillance Program

Table 3-3. Summary of Filtered vs Unfiltered U Sampling.

Well #	Round	Filtered?	Filter size in microns	Sample ID
399-1-5	6	NO		B095J0
399-1-5	6	YES	0.1	B095J2
399-1-5	6	YES	0.45	B095J3
399-1-5	6	YES	1	B095J4
399-1-7	6	NO		B095J5
399-1-7	6	YES	0.1	B095J7
399-1-7	6	YES	0.45	B095J8
399-1-7	6	YES	1	B095J9
399-2-2	6	NO		B095K2
399-2-2	6	YES	0.45	B095K4
399-2-2	6	YES	1	B095K5
399-4-10	6	NO		B095L4
399-4-10	6	YES	0.1	B095L6
399-4-10	6	YES	0.45	B095L7
399-4-10	6	YES	1	B095L8
399-4-12	6	NO		B095L9
399-4-12	6	YES	0.1	B095M0
399-4-12	6	YES	0.45	B095M1
399-4-12	6	YES	1	B095M2
399-4-7	6	NO		B095L0
399-4-7	6	YES	0.1	B095L1
399-4-7	6	YES	0.45	B095L2
399-4-7	6	YES	1	B095L3

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Table 3-4. Data Validation Summary[a].

Round	Program	Volatiles			Gross Alpha and Beta			Tc-99			Total U			Isotopic-U		
		Validated Analyses	Total Analyses	%	Validated Analyses	Total Analyses	%	Validated Analyses	Total Analyses	%	Validated Analyses	Total Analyses	%	Validated Analyses	Total Analyses	%
5	CERCLA[1]	396	1287	31	50	56	89	0	2	0	23	26	88	NA	NA	
	RCRA[3,5]	1653 validated analyses out of 1653 total (100%)														
6	CERCLA[2]	792	792	100	NA	NA		NA	NA		33	34	97	51	51	100
	RCRA[4,5]	701 validated analyses out of 1483 total (47%)														
7	River[6]	NA	NA		NA	NA		NA	NA		25	25	100	576[8]	576[8]	100
	CERCLA[6]	726	726	100	NA	NA		NA	NA		17	17	100	684[8]	684[8]	100
	RCRA[7]	1314 validated analyses out of 1397 total (94%)														

NA- Not Analysed
[a] - Data are presented in Appendix A and B, and Chapter 4.0.
1 - Hulstrom (1993a, 1993b, 1994d)
2 - Hulstrom (1994b, 1994c)
3 - DOE-RL (1993d) and WHC (1993b)
4 - WHC (1994a,b)
5 - Insufficient information provided in the RCRA data reports to differentiate amongst analyses.
6 - Hulstrom (1994e)
7 - DOE-RL (1994g)
8 - ICP metals analyses

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4.0 REFINEMENT OF THE BASELINE RISK ASSESSMENT

This chapter presents the additional data collected and analyses performed as part of the Supplemental RI for the 300-FF-5 Operable Unit. This information is used to update and refine the conceptual understanding of operable unit conditions and baseline risk assessment presented previously in the Phase I RI report (DOE-RL 1994d). This chapter presents physical characteristics (Section 4.1), nature and extent of contamination (Section 4.2), fate and transport (Section 4.3), and the baseline risk assessment (Section 4.4). These four sections correspond to Chapters 3.0 through 6.0 of the Phase I RI Report (DOE-RL 1994d).

4.1 PHYSICAL CHARACTERISTICS

This sub-section describes any additional RI work activities related to refinement of the physical understanding of operable unit conditions. The only such work performed involved a compilation and evaluation of available hydraulic data for further characterization of the hydraulic properties of the unconfined aquifer and is described in Section 4.1.1.

4.1.1 Hydraulic Properties

Groundwater in the 300-FF-5 Operable Unit flows generally west to east across the site and is controlled by changing lithologic conditions, artificial discharges, and changing river stage. An assessment of hydraulic conductivities is presented in this section with emphasis on the saturated Hanford formation found under the major disposal units located near the Columbia River. This is the area where pumping systems could be used to remove or contain groundwater contamination and where estimates of groundwater flow parameters are therefore most critical for the purposes of the FS. Although the uncertainty has not been eliminated, it has been reduced through examination of the data and application of best professional judgement.

Sources of hydraulic conductivity data for the unconfined Hanford aquifer and the reported values are summarized in Table 4-1. Data are summarized from the following sources:

- Schalla et al. (1988)
- Spane (1991)
- Spane (1994)
- Swanson et al. (1992)
- Gaylord and Poeter (1991)
- Bierschenk (1959)
- DOE-RL (1992a).

These sources represent the reported hydraulic conductivity estimates for the operable unit obtained from field data; i.e., pumping tests or other field-based methods of analysis. The hydraulic conductivity data presented in the 300 Area modeling effort (Appendix D of the Phase I RI report [DOE-RL 1994d]) was also considered.

Many of the hydraulic conductivity values presented in Table 4-1 have been calculated herein from the reported transmissivities. The estimated saturated thickness of the unconfined aquifer was used to convert the transmissivity values to hydraulic conductivity. The values used for saturated thickness are shown in the Table 4-1.

Based on information presented in Table 4-1, the following observations can be made.

- The range of hydraulic conductivities reported varies over a wide range from about 30 to about 15,240 m/day (100 to about 50,000 ft/day) in the operable unit. This range is partially explained by the differing capability of the Hanford and Ringold Formation to transmit water. The Ringold Formation is typically a less transmissive formation than the Hanford formation.

- The smaller values (<300 m/day [1,000 ft/day]) are restricted primarily to wells located in the western portions of the operable unit (wells 699-S22-E9T, and 699-S27-E9T). These lower values likely reflect the presence of fine-grained intervals within the upper Ringold which is eroded and overlain by saturated sediments of the Hanford formation in the eastern portions of the operable unit along the river (Figures 2-6 to 2-9). Lower conductivity values at these wells is consistent with a decrease or absence of saturated Hanford formation in the western part of the operable unit and an increase in the saturated thichness near the river in the Phase I RI of a higher transmissivity zone along the river. Therefore, the data reported in Swanson et al. (1992) are probably not representative of the hydraulic characteristics of the uranium plume area.

- Values at the high end of hydraulic conductivity, such as the extremely high conductivities reported in DOE-RL (1992a), represent outliers from a dataset of significantly lower values, and can probably be eliminated. If these extreme values are eliminated, the upper end of the reported range in hydraulic conductivity values is reduced from about 15,240 m/day (50,000 ft/day) to approximately 3,000 to 6,100 m/d (10,000 to 20,000 ft/day).

Based on an evaluation of the information presented in Table 4-1, the range of possible average hydraulic conductivities for the Hanford formation is about 300 to 10,000 m/day (1,000 to 32,800 ft/day); however, there is considered to be a low probability that the high end of these reported values is representative. For probabilistic (stochastic) analysis, a lognormal distribution is appropriate to represent a parameter where the most likely values are believed to be near the lower end of the range, but there are high values with low probabilities to be considered. Based on a review of the probabilistic distribution functions, further discussions with professional hydrogeologists, consideration of the local hydrogeology, and best professional judgement, a most likely value for hydraulic conductivity of 1,830 m/day (6,000 ft/day) was selected for use in the evaluations presented in the FS portion of this report. The difference between this value and the mean value of 3,050 m/day (9,995 ft/day) discussed in Appendix F results in a conservative estimation of parameters evaluated in the remedial alternative evaluations presented in Appendix G.

4.2 NATURE AND EXTENT OF CONTAMINATION

This sub-section describes the nature and extent of contamination in the operable unit based on the additional chemical and radiological data collected during Supplemental RI. The primary purpose of this sub-section is to re-evaluate the regulatory and risk-based screening performed in the Phase I RI (DOE-RL 1994d) in the context of the supplemental data and to determine if any changes occur that need to be addressed in an update to the baseline risk assessment. This re-evaluation consists of the following.

- For the various media- and pathway-specific screening scenarios that were examined in the Phase I RI, determine if there are any new chemical or radiological compounds that need to be added to the lists of CsOPC

- Determine if the maximum concentrations of CsOPC used as input to the baseline risk assessment still represent maximum values, or if new maximum values have been detected that need to be incorporated into the risk assessment calculations.

4.2.1 Data Processing

Chapter 4.0 of the Phase I RI (DOE-RL 1994d) consisted of a very detailed screening process for defining the chemical and radiological compounds at the 300-FF-5 Operable Unit that potentially pose risk to human health and the environment. The compounds identified were termed the CsOPC. The CsOPC were identified for each media (soil, groundwater, sediment, and surface water) that represented a potential contaminant exposure route, were chosen using a step-wise screening process that considered laboratory and field blank data, background concentrations, appropriate regulatory criteria, and media-specific risk-based benchmark screening concentrations. The screening performed for this report was based on the procedures and guidelines used in the Phase I RI. Refer to Chapter 4.0 of the Phase I RI (DOE-RL 1994d) for a complete discussion of this screening process; only a summary is provided here.

For this report, the data screening process essentially consisted of checking for any changes to the lists of CsOPC determined previously in the Phase I RI and the maximum concentrations that served as input to the baseline risk assessment. The data collected since Phase I consist of groundwater and surface water data. Screening was performed for these media. For groundwater, screening was performed separately for the unconfined and confined aquifers. In addition, because well 399-4-12 represents the only current groundwater exposure pathway, the additional data from this well was also screened, as in the Phase I RI.

The screening process was performed for the following four datasets: unconfined aquifer, confined aquifer, well 399-4-12, and surface water. The screening consisted of the following steps:

- Data validation
- Blank adjustments
- Background screening
- Screening against previous maxima
- Risk-based and regulatory screening.

Each step is briefly described in the sections that follow.

4.2.1.1 Data Validation. Data validation is a quality assurance related task that defines the limitations in use of the reviewed data based on accuracy, precision, holding times, instrument performance, blanks, and other parameters. Data validation performed as part of this report is presented in Hulstrom (1993a, 1993b, 1993e, 1994b, 1994c, and 1994d) for CERCLA data and in DOE-RL (1993d, 1994g) and WHC (1993a, 1994a, and 1994b) for RCRA data, and is summarized in Section 3.4.

4.2.1.2 Blank Adjustments. Blank adjustments remove detect bias, which results from laboratory, field, or equipment contamination. Sample detects that fall below calculated blank adjustment factors are adjusted to non-detects. Blank adjustment factors are determined from detects observed in blank samples. Blank adjustments were performed in a manner identical to the adjustments made in the Phase I RI, which consisted of performing laboratory blank adjustments on the portions of the data that were not validated, and then adjusting all the data with field blanks. Blank adjustments using field blanks were performed by case (a case is defined as all samples delivered to a particular lab during each round). Refer to Section 4.2.2 (DOE-RL 1994d) of the Phase I RI for a detailed discussion of the blank adjustment process. All detected compounds remaining after the blank adjustments were carried forward to the next step in the screening process, background screening, described below. The Supplemental RI validated and blank adjusted data, and all quality control (QC) data are presented in Appendices A and B for surface water and groundwater analyses, respectively, along with explanations for the data qualifiers used.

4.2.1.3 Background Screening. Following the blank adjustments, the maximum value for each constituent detected was compared to the operable unit background value to determine which compounds were elevated above naturally occurring chemical concentrations. Background values used in this screening were the same background concentrations determined in the Phase I RI. Background concentrations were calculated in the Phase I RI using a one-sided, upper tolerance limit (UTL) for the 95th percentile (alpha=0.05) for the distribution of each parameter. For selected media, the Hanford Site background values were also used. Background UTLs were calculated only for the Target Analyte List (TAL) metals, inorganic anions, and the naturally occurring radionuclides that are normally detectable (total uranium, ^{228}Th, ^{226}Ra, and ^{40}K. Background values for all other constituents (organics and other radionuclides) were all assumed to be zero. Refer to Section 4.2.3 of the Phase I RI for a detailed discussion on the determination of operable unit background values for groundwater and surface water.

In the background screening, filtered data were used for metals. Justification for this is provided in Section 4.2.3 of the Phase I RI. Unfiltered samples were used for all other groundwater analytes, and for all surface water analytes, as in the Phase I RI.

4.2.1.4 Previous Maximum Screening. Because the purpose of the screening was to identify any changes in screening results from the Phase I RI, the next step was to compare the maximum detected values for all compounds above background (from the supplemental data) with the Phase I maximum values. Any compound lower than the maximum value from Phase I was eliminated from the screening. Compounds above background and those having new maxima higher than the Phase I maxima were retained for the final step, the regulatory and risk-based screening.

4.2.1.5 Risk-Based and Regulatory Screening. The final step in the screening involves comparing the maximum values for all retained compounds to regulatory and risk-based screening

concentrations. This screening step narrowed the list of contaminants exceeding background to those with the greatest likelihood of dominating the overall risk at the operable unit.

If a retained compound was less than both the minimum regulatory screening level and the minimum risk-based screening concentration, the compound was eliminated from the screening. If, however, the compound exceeded either of the two screening values, it was retained. In this case, either a new CsOPC has been identified or a new maximum concentration has been detected for an existing CsOPC. In either case, the baseline risk assessment may need to be updated to account for the change. Section 4.4 addresses any required changes to the baseline risk assessment resulting from of additional RI data.

The risk-based screening concentrations are calculated to represent a specific HQ of 0.1 or a lifetime incremental cancer risk (LICR) of 1E-07 using defined exposure assumptions, as specified in the HSRAM (DOE-RL 1993). Exceedance of a risk-based concentration does not necessarily establish the existence of a significant risk, but rather indicates the need to retain the contaminant for further evaluation in the risk assessment.

Screening against chemical-specific ARARs (i.e., drinking water MCLs) is performed as a supplement to the risk-based screening. For the purposes of the screening, the MCLs are reduced by a factor of 10 to account for possible additive effects from multiple contaminants and sources. Chemical-specific ARARs used in the screening are summarized in Appendix E.

The regulatory and risk-based screening values used herein, and the screening approach, are identical to those presented in the Phase I RI. Refer to Chapter 4.0 and Appendix H of the Phase I RI for a detailed presentation of the risk-based and regulatory screening approach and calculations.

4.2.2 Surface Water

This section addresses the nature and extent of contamination in the Columbia River based on the Supplemental RI sampling event and the approach to data screening outlined in Section 4.2.1. The results of the screening for the Columbia River data are presented in Table 4-2. All river water data are presented in Appendix A. Any required updates or changes to the baseline risk assessment that result from these data are presented in Section 4.4.

The purpose of screening the river data differs somewhat from the purpose for screening groundwater data, so the screening procedure used was slightly modified from that described in Section 4.2.1. For groundwater, the screening is intended to show whether any changes should be made to the existing list of CsOPC determined during the Phase I RI. Groundwater sampling conducted in rounds 5, 6, and 7 represented a continuation of the Phase I RI monitoring program. The maximum detects in rounds 5, 6, and 7 groundwater data were screened against the Phase I RI maximum values. For the river, however, the purpose of the Supplemental RI sampling event was evaluating risks under a different exposure scenario in the river than was assessed under the Phase I RI. The Phase I RI event took place under extreme low flow conditions in the river. This Supplemental RI event was intended to reflect more of an average flow condition. Therefore, the maximum detects observed in the Supplemental RI sampling event were not screened against Phase I RI maxima. The river data were assessed as a separate dataset, whereas the goundwater data were assessed as part of the Phase I dataset.

Table 4-2 summarizes the results of the data screening for the river sampling event. Background screening and the risk-based and regulatory screening are all summarized. An asterisk indicates exceedance of the screening value by the constituent-specific maximum.

As seen in Table 4-2, the following constituents exceeded background and the regulatory or risk-based screening values:

- Aluminum
- Iron
- Manganese
- Vanadium
- Uranium.

The compounds are discussed individually below. Definitions for the data qualifiers are provided in Appendix A.

Aluminum. Aluminum was detected at a maximum concentration of 1,120 μg/L at sample location SP-6. The next highest value for aluminum was 68 "B" μg/L. The maximum value detected exceeds background (20-130 μg/L) and the minimum regulatory screening value of 5 μg/L. The minimum risk-based value is 1,600 μg/L. The regulatory screening value is based on a secondary MCL (non-health based).

Iron. Iron was detected at a maximum concentration of 1,860 μg/L at sample location SP6. The background value for iron is presented as a range from 40 to 520 μg/L. The maximum value detected exceeds the minimum regulatory screening value of 30 μg/L. There is no risk-based value for iron because the compound is generally not considered a human health hazard. The regulatory screening value is based on a secondary MCL (non-health based).

Manganese. Manganese was detected at a maximum concentration of 77.8 μg/L at sample location SP-6. The background value for manganese is 0-20 μg/L. The next highest value for manganese was 9.5 μg/L. The maximum value detected exceeds background, the minimum risk-based screening value of 8 μg/L, and the minimum regulatory screening value of 5 μg/L. The regulatory screening value is based on a secondary MCL (non-health based).

Vanadium. Vanadium was detected at a maximum concentration of 12.5 "B" μg/L at sample location SP-9. There was no background value reported for vanadium. The maximum value detected exceeds the minimum risk-based screening value of 11.2 μg/L. There is no regulatory screening value for vanadium.

Uranium. Uranium was detected at a maximum concentration of 0.501 μg/L at sample location SP-9. The background value for uranium is 0.438 μg/L. The maximum value detected exceeds the minimum risk-based screening value of 0.163 μg/L but not the minimum regulatory screening value of 2 μg/L.

4.2.3 Groundwater

This section addresses the nature and extent of contamination in groundwater based on the Supplemental RI data. As described in Section 4.2.3.1, the approach to data screening outlined in

Section 4.2.1 was applied to the Supplemental RI groundwater data to check for any changes in the Phase I RI list of CsOPC. Section 4.2.3.2 incorporates frequency of detection and other considerations into the screening process to further refine the lists of CsOPC determined in Section 4.2.3.1. Trends in uranium and DCE/TCE concentrations in the unconfined aquifer are presented in Section 4.2.3.3. Plume maps for uranium from all rounds of the RI are presented in Section 4.2.3.4. Any changes to the list of CsOPC are incorporated into an updated baseline risk assessment in Section 4.4. All Supplemental RI groundwater data are summarized in Appendix B.

4.2.3.1 Results of Data Screening. The round 5, 6, and 7 groundwater data were screened under the following three scenarios: unconfined aquifer, confined aquifer, and well 399-4-12. These are the same basic scenarios evaluated in the Phase I RI, with the exception that wells associated with the tritium plume have not been screened for tritium since tritium has not been reevaluated in this report data for other CsOPC were used. The results of the screening for these three scenarios are shown in Tables 4-3, 4-4 and 4-5, respectively; they identify changes to the lists of CsOPC since the Phase I RI.

4.2.3.1.1 Unconfined Aquifer. Table 4-3 summarizes the results of the data screening for the unconfined aquifer. Background screening, screening against previous maxima, and the risk-based and regulatory screening are all summarized. Shading indicates exceedance of the screening value by the constituent-specific maximum.

As indicated the table, the following constituents exceeded background, the previous maximum, and the regulatory or risk-based screening values:

- Chloride
- Nickel
- Nitrate
- Antimony
- Chloroform
- 1,2-DCE, trans-1,2-DCE, and cis-1,2-DCE
- 4,4'-DDD
- Methylene chloride
- Radium
- ^{99}Tc
- ^{106}Ru
- ^{60}Co
- Gamma-BHC (lindane).

These compounds are either new CsOPC or are existing CsOPC that exhibited new maximum values. The compounds are discussed individually below. Definitions for the data qualifiers are provided in Appendix B.

Chloride. Chloride does not have toxicity values with which to calculate risk-based screening values. The compound was retained, however, because the maximum concentration (140,000 "D" μg/L) exceeds background (51,740 μg/L), the previous maximum (26,700 μg/L), and the regulatory screening value (25,000 μg/L), although the regulatory value used in the screening is 1/10 of a secondary MCL. The "D" qualifier indicates that the sample was diluted during analysis and the value given is the adjusted value. Chloride was not a CsOPC in the Phase I RI.

Nickel. Nickel was detected at a maximum concentration of 140 μg/L at well 399-1-16A during round 5. This value exceeds the previous maximum (118 μg/L) and both the risk-based (32 μg/L) and regulatory (10 μg/L) screening values. This well has consistently demonstrated the maximum concentrations for nickel during sampling rounds 1 through 4. Nickel was a CsOPC in the Phase I RI. The increase in nickel concentration suggests that the compound may take longer to reach acceptable levels in groundwater than estimated in the Phase I RI.

Nitrate. Nitrate was detected at a maximum value of 23,000 μg/L at well 399-1-18A during round 5. This value exceeds the previous maximum (15,600 μg/L) and both the risk-based (2,560 μg/L) and regulatory (4,400 μg/L) screening values. Nitrate was a CsOPC in Phase I; however, the detected values occurred in wells located in the southwest portion of the 300-FF-5 Operable Unit: 399-4-11, 399-5-1, and 699-S28-E12. Nitrate detected in Phase I was reported to be related to a plume of nitrate and ^{99}Tc emanating from near the 1100-EM-1 Operable Unit. Well 399-1-18A, however, is located to the north and east of the 1100-EM-1 plume area. Previous concentrations at the well were 4,500 and 4,900 "J" μg/L during rounds 1 and 2, respectively.

Antimony. Antimony was detected at a maximum concentration of 37.7 μg/L at well 399-3-12 during round 7. The detect exceeded the background value (< 16 μg/L), the risk-based screening value (0.64 μg/L), and the minimum ARAR (0.6 μg/L). The compound was not detected in any samples collected during sampling rounds 1 through 4.

Chloroform. Chloroform was detected at a maximum concentration of 22 μg/L at well 399-1-17A during round 6. This exceeds the previous maximum (18 μg/L), the minimum risk-based screening value (0.028 μg/L), and the minimum regulatory screening value (7 μg/L). This is consistent with previous data where values at well 399-1-17A were 15, 12 "U", and 16 μg/L for rounds 1, 2, and 3, respectively. The previous maximum occurred at well 399-3-3; however, the Phase I RI reported that the chloroform plume in the operable unit was centered in the vicinity of well 399-1-17A. Chloroform is believed to be the result of discharge of chlorinated water to the process trenches.

1,2-DCE, trans-DCE and cis-DCE. 1,2-DCE and trans-DCE were detected at maximum concentrations of 180 and 150 μg/L, respectively, at well 399-1-16B. The previous maxima were 150 and 130 μg/L, respectively, at the same well. The minimum regulatory screening values for the two compounds are 7 and 10 μg/L, respectively. cis-DCE was detected at a maximum concentration of 130 μg/L at well 399-1-16B during round 7. The compound had not been detected during sampling rounds 1 through 4. The minimum regulatory screening value for cis-DCE is 7 μg/L. All DCE detects from rounds 5, 6, and 7 occurred at wells 399-1-16A, 399-1-16B, and 399-1-17B. This is consistent with Phase I data where all 1,2-DCE detects occurred at the 399-1-16 and 399-1-17 well clusters. Trends in DCE contamination are discussed in Section 4.2.3.3.

Methylene chloride. Methylene chloride was detected at a maximum value of 8 "J" μg/L at well 399-4-6 during round 6. This result is greater than the regulatory screening value of 1.09 μg/L and the risk-based screening value of 0.5 μg/L. Methylene chloride was not detected during the Phase I sampling. The "J" qualifier indicates that the compound was an estimated value.

Radium. Radium was detected at a maximum concentration of 0.179 pCi/L at well 399-1-17B during round 7. The previous maxima was 0.08 pCi/L. This detect also exceeded the risk-based screening value of 0.0381 pCi/L. Radium was not a CsOPC during the Phase I RI.

Technetium-99. Technetium-99 was detected at a maximum concentration of 74 pCi/L at well 399-5-1. The previous maximum was 65 pCi/L at the same well. The minimum risk-based screening value is 3.51 pCi/L and the minimum regulatory screening value is 90 pCi/L. The Phase I RI indicated that ^{99}Tc observed in the unconfined aquifer was related to a plume of ^{99}Tc and nitrate emanating from the 1100-EM-1 Operable Unit area. The observed occurrence of ^{99}Tc at well 399-5-1 during the Supplemental RI sampling rounds is consistent with this previously observed ^{99}Tc contamination.

Ruthenium-106. Ruthenium-106 was detected at a maximum value of 55.6 pCi/L at well 399-1-17A during round 7. The previous maximum value was 34.4 pCi/L. The minimum risk-based screening value is 0.481 pCi/L, and the minimum regulatory screening value is 3 pCi/L. Ruthenium-106 was eliminated as a CsOPC from the Phase I RI sampling because of low frequency of detection.

Cobalt-60. Cobalt-60 was detected at a maximum value of 8.5 pCi/L at well 399-1-17A during round 7. The previous maximum value was 3.49 pCi/L. The minimum risk-based screening value is 0.304 pCi/L, and the minimum regulatory screening value is 10 pCi/L. Cobalt-60 was eliminated as a CsOPC from the Phase I RI sampling because of low frequency of detection.

Gamma-BHC (Lindane). Gamma-BHC was detected at a maximum value of 0.002 μg/L at well 399-1-11 during round 7. The detect exceeded the minimum regulatory screening value of 0.00002 μg/L. The compound had not been detected previously during sampling rounds 1 through 4.

Round 5, 6, and 7 data do not indicate an increase in tritium levels in the unconfined aquifer since the Phase I sampling. The maximum value for tritium was 11,300 pCi/L at well 399-1-18A during round 7. The Phase I maximum for tritium was 11,770 pCi/L at well 699-S19-E14 during round 1. Previous tritium concentrations at well 399-1-18A were 11,300 and 11,200 pCi/L, each from round 3. The MCL for tritium is 20,000 pCi/L.

4.2.3.1.2 Confined Aquifer. Table 4-4 summarizes the results of the data screening for the confined aquifer. Only one confined aquifer well (399-1-16C) was sampled during rounds 5, 6, and 7 because most of the contaminants detected during Phase I in the confined aquifer were detected only at this well.

As seen in Table 4-4, total uranium, which was not detected during Phase I in the confined aquifer, was observed during the additional sampling at well 399-1-16C. The total uranium concentration observed at the well (5.8 μg/L) for the 5th sampling round exceeds the background (0.08 μg/L), risk-based (0.163 μg/L) and regulatory screening values (2.0 μg/L). There were no CsOPC for the confined aquifer during Phase I. All detected constituents were eliminated because of low concentrations, low frequency of detection, or suspected leakage of the 399-1-16C well seal. Other total uranium results at well 399-1-16C were 0.06 "U" μg/L during round 4, 0.68 μg/L during round 6 and 0.163 "J" μg/L during round 7. The "U" qualifier indicates the compound was analyzed for but not detected. The "J" qualifier indicates an estimated value.

4.2.3.1.3 Well 399-4-12. Table 4-5 summarizes the results of the rounds 5, 6, and 7 data screening for well 399-4-12. Uranium-235, which was already a CsOPC for the well, was detected at a higher concentration than during Phase I. The new maximum (0.5 pCi/L) is only slightly above the previous maximum to (0.55 pCi/L). Also, antimony was detected at a maximum value of 33.7 "B"

μg/L at the well during round 7. (The "B" qualifier indicates that the result is greater than the Instrument Detection Limit but less than the Contract Required Detection Limit.) The compound had not been detected previously at the well. This value exceeded the minimum risk-based screening value of 0.64 μg/L and the minimum regulatory screening value of 0.6 μg/L.

4.2.3.2 Refinements to Data Screening Results. This sub-section incorporates other considerations, including frequency of detection, into the data screening process to further refine the lists of CsOPC discussed previously.

4.2.3.2.1 River Water Screening. Compounds that were retained in the river water screening include aluminum, iron, manganese, vanadium, and uranium. Because of the small number of samples collected as part of the river water sampling event (nine results per analyte), it is not considered appropriate to further screen the results on the basis of frequency of detection.

Other considerations, however, are appropriate for further refining the list of CsOPC for the river sampling event. Aluminum and iron did not exceed any risk-based standards. The compounds were retained because they exceeded secondary MCLs. These MCLs are not health-based standards, but are rather intended to be protective of non-health based, primarily aesthetic qualities of drinking water. The secondary MCLs are not enforceable under federal regulation; however, secondary MCLs may potentially be considered ARAR under MTCA if applicable. The EPA Region X guidance (EPA 1991) suggests that essential nutrients, such as aluminum and iron, can generally be excluded from human health risk assessments. Because the compounds do not appear to pose an unacceptable human health risk, they are eliminated from further consideration. In addition, the maximum values for aluminum and iron were observed at the SP-6 sample location, which is upriver of the operable unit plume and does not represent operable unit impacts to the river. No other detected values for aluminum and iron exceeded background.

Manganese also exceeded an MCL that is non-health based. The compound was also retained because it exceeded a risk-based screening value (8 μg/L). The risk-based screening value, however, corresponds to an HQ of 0.1, which is a very conservative value used only for screening. Exceedance of a screening concentration corresponding to an HQ of 0.1 does not necessarily indicate a health risk. Because the maximum detect exceeds a non-health based MCL and does not exceed a risk-based screening value corresponding to a HQ of 1, the compound was eliminated from further consideration. In addition, the maximum value was observed at sample location SP6, which is upstream of the operable unit. No other detected values for manganese exceeded background.

Vanadium was retained because the maximum value (12.5 μg/L) exceeded the minimum risk-based screening value (11.2 μg/L). The maximum value for vanadium occurred at sample location SP-9. No regulatory value exists for vanadium. Because the maximum detect just slightly exceeded a conservative risk-based value corresponding to an HQ of 0.1 and did not exceed a value corresponding to an HQ of 1, the compound was eliminated.

Uranium was retained because the maximum concentration (0.501 μg/L) exceeded the minimum risk-based value of 0.163 μg/L. However, the compound exceeded the background (0.438 μg/L) by only a very slight margin, and the maximum value does not exceed the MCL (20 μg/L). The compound was therefore eliminated.

There were no CsOPC retained for the river sampling event.

4.2.3.2.2 Unconfined Aquifer. In Section 4.2.3.1, a number of changes to Phase I RI list of CsOPC were reported for the unconfined aquifer, resulting either from the occurrence of new compounds that exceeded the screening values or from new maximum concentrations for existing CsOPC. A number of the compounds retained, however, have been detected only one or two times throughout the seven rounds of sampling; therefore, they were eliminated from the risk assessment. These compounds are antimony, 4,4'-DDD, methylene chloride, ^{106}Ru, ^{60}Co, and Gamma-BHC (lindane). Antimony was detected in only 2 of 209 samples collected during the 7 rounds of RI sampling. 4,4'-DDD was detected once in 159 samples. Methylene chloride was detected in only 1 of 277 samples. Ruthenium-106 was detected in only 3 of 73 samples. Cobalt-60 was detected three times out of 156 total results. Gamma-BHC (lindane) was only detected once in 159 samples.

Radium was also eliminated because the maximum concentration (0.179 pCi/L) is much smaller than any ARAR (MCL of 5 pCi/L or DOE Order 5400.5 value of 4 pCi/L). The compound was retained because it exceeded the very conservative risk-based screening value (10^{-7} ICR) and regulatory screening value (one-tenth the MCL).

Chloride was eliminated because the maximum concentration detected (140,000 μg/L) does not exceed the MCL, which is also not a health-based standard.

Chloroform was eliminated because the compound is present in groundwater as a result of chlorination, as discussed in Section 2.5.1, and does not exceed the MCL of 100 μg/L. Also, chloroform in groundwater is expected to be remedied by the planned connection of the 300 Area sanitary sewer to the city of Richland sewer system in late 1994.

Nitrate was eliminated because the maximum value (23,000 μg/L) does not exceed the MCL (44,000 μg/L). However, the maximum values for nitrate observed in the rounds 5, 6, and 7 data were found in wells distant from the nitrate maxima observed in the Phase I RI, which were attributed to the 1100-EM-1 operable unit. It is possible that the nitrate detected during this Supplemental RI associated with the tritium plume emanating from the 200 Areas.

Although coliform bacteria was detected at a concentration of only 1 cfu/100 mL during the rounds 5, 6, and 7 sampling, it was identified as a CsOPC in the Phase I RI. Because of issuance of the Phase I RI the schedule for the planned connection of the 300 Area sanitary sewer to the city of Richland sanitary sewer system has been finalized for completion by the end of June, 1995; natural degradation will account for coliform bacteria remaining in the groundwater. Because the connection will eliminate the source of coliform bacteria to the groundwater and the groundwater is not utilized as a drinking source, coliform bacteria was eliminated from the list of CsOPC.

4.2.3.2.3 Confined Aquifer. One change occurred to the list of CsOPC for the confined aquifer based on the Supplemental RI screening performed: uranium was added to the CsOPC list. All compounds were eliminated from the list of CsOPC for the confined aquifer during the Phase I RI because of low frequency of detection or suspected problems with leakage of the 399-1-16 well seal.

The maximum value observed for uranium (5.8 μg/L), although it does exceed the risk-based and regulatory screening values of 0.163 and 2 μg/L, is well below the MCL of 20 μg/L. In addition, all other detects at the well have either been non-detect values or very near the detection limit. The values for the two most recent rounds (6 and 7) were 0.68 and 0.163 "J" μg/L, respectively. For these reasons, the compound was eliminated from the list of CsOPC, and there are no CsOPC for the confined aquifer, as in the Phase I RI. The confined aquifer was therefore

eliminated as a pathway of concern for the risk assessment.

4.2.3.2.4 Well 399-4-12. Changes to the well 399-4-12 screening included a new maximum value for ^{235}U of 0.55 pCi/L (as compared to the Phase I RI value of 0.51 pCi/L), and the addition of a new compound (antimony). Antimony was not detected in rounds 1, 2, and 3. Rounds 4, 5, and 6 did not include antimony analysis. The compound was detected in only one of four samples analyzed. There were an insufficient number of samples, however, to eliminate the compound because of low frequency of detection. The detected value exceeds the MCL of 6 μg/L.

4.2.3.3 Final Screening Results. Based on the Supplemental RI data and the screening described previously, the following changes result to the lists of CsOPC determined in the Phase I RI.

4.2.3.3.1 Unconfined Aquifer. Nickel was detected at a new maximum value of 140 μg/L compared to the previous maximum of 118 μg/L. DCE was detected at new maxima of 180, 150, and 130 μg/L for 1,2-DCE (total), trans-DCE, and cis-DCE, respectively. Technetium-99 was detected at a new maxima of 74 pCi/L compared to the previous maxima of 65 pCi/L. Technetium-99 emanates from the 1100-EM-1 Operable Unit, however, and is addressed through the 1100-EM-1 RI/FS process.

4.2.3.3.2 Confined Aquifer. No changes occurred to the results of the Phase I RI screening, which indicated no CsOPC for the confined aquifer.

4.2.3.3.3 Well 399-4-12. Uranium-235 was detected at a new maximum value (0.55 pCi/L), which is only very slightly greater than the previous value (0.51 pCi/L). Also, a new compound (antimony) was added to the list of CsOPC for well 399-4-12.

4.2.3.3.4 River Sampling Event. No CsOPC resulted from the screening of the river data.

4.2.3.4 Data Trends. This section summarizes trends in uranium and DCE/TCE concentrations based on the seven rounds of RI groundwater sampling.

4.2.3.4.1 Uranium. Trend plots for uranium concentrations at selected 300-FF-5 Operable Unit groundwater well locations are shown in Appendix C.

Total uranium concentrations are plotted in the trend plots using the actual total uranium data, as well as the isotopic uranium data (^{234}U, ^{235}U, and ^{238}U). Isotopic Uranium results, which are reported from the laboratory in units of pCi/L, were converted to μg/L in accordance with their specific isotopic activity and then summed to create equivalent total uranium concentrations for plotting. The conversion factors for converting isotopic uranium values from pCi/L to μg/L are shown in Table 4-4 of the Phase I RI (DOE-RL 1994d). Trend plots have been prepared for all wells where uranium was detected at a concentration in excess of the proposed MCL (20 μg/L). All data plotted represent unfiltered uranium samples.

In addition, the uranium levels at well 399-1-17A have decreased with time. As shown in Figure 4-1 from Dresel et al. (1994), the concentration dropped to levels less than the MCL after completion of an ERA at the 316-5 process trenches (DOE-RL 1992b). Contaminated material was removed from the inflow area of the trenches which is just upgradient of the location of the well. Variations in concentration before the ERA (Figure 4-1) appear to be cyclic in nature and may be related to river stage, precipitation, or discharge fluctuations. Recent discharges to the trenches have

been less than in the past, approximately 850 L/min (220 gal/min), down from a maximum of approximately 7,600 L/min (2,000 gal/min) (DOE-RL 1994c). The lower uranium concentration in well 399-1-17A may be a function of the ERA and/or the reduced flow. Discharges to the trenches ceased on December 29, 1994.

Several observations can be made upon examining of the trend plots, including the following:

- Uranium levels are declining in several wells located in the northern portion of the plume area (the upgradient perimeter of the existing uranium plume) including wells 399-1-5, 399-1-6, 399-1-10A, 399-1-11, and 399-1-12. Trend plots provided in Appendix C show a definite downward trend at each of these wells. The result has been uranium concentration reductions from 275 to 90 μg/L at well 399-1-5; 180 to 70 μg/L at well 399-1-10A; 110 to 30 μg/L at well 399-1-11; 140 to 50 μg/L at well 399-1-12; 180 to 80 μg/L at well 399-1-16A; and 80 to 20 μg/L at well 399-1-21A.

- Comparison of the uranium trend data to water levels taken at the time of sampling indicates some correlation between the elevation of the water table and the observed uranium concentrations. In general, increases in uranium correlated to higher water levels, and decreases corresponded to water level declines. However, the reductions observed over the seven rounds have occurred despite relatively high water levels during the later rounds, and the magnitude of the uranium increases that have been observed with water level increases are declining with time. Therefore, relatively minor uranium fluctuations may be expected to occur as a result of water level fluctuations, but the overall trend is expected to continue downward.

- At other wells in the operable unit, trends are not apparent, uranium levels are relatively constant, or levels may be increasing. There is no discernible spatial pattern to the trends at these wells, however.

- In general, there is good agreement and correlation between the total uranium results and the summed isotopic uranium values.

These data are discussed further in Section 4.3.2 with regard to the potential presence of a solid phase uranium precipitate within the matrix of the unconfined aquifer.

4.2.3.4.2 DCE/TCE. As discussed in Section 2.6.2, uncertainty exists with respect exists to the time required for TCE and DCE to reach acceptable levels in the unconfined aquifer. The Phase I RI recommended continued monitoring of the plume and trend analysis as a means of assessing future concentrations. Trend plots using data from the HEIS database have been prepared for the two compounds. Trend plots for TCE and 1,2-DCE are shown in Figures 4-2 and 4-3, respectively.

The fate and transport of the organic contaminants, TCE and DCE, are heavily dependent upon the nature of the source, soil-water partitioning, and degradation mechanisms. Of particular concern is the potential for dense non-aqueous phase liquid (DNAPL) TCE in the unconfined aquifer. Several studies have shown that even minor quantities of DNAPL in an aquifer can lead to the development of laterally and vertically extensive aqueous phase organic contaminant groundwater plumes (Cohen and Mercer, 1993).

The likelihood that a TCE source is present in the 300-FF-5 Operable Unit unconfined aquifer can be qualitatively evaluated by applying an assessment methodology developed by the EPA (EPA 1993). This assessment methodology relies upon an analysis of various factors including the historical use and disposal of DNAPL compounds at the site, and the magnitude of groundwater aqueous phase organic concentrations. These factors are then used to delineate a qualitative rank of low, medium, or high. These ranks are indicative of the likelihood that DNAPL is present in the aquifer system below the site. If site history information is unavailable or incomplete, the assessment methodology can still be applied using the available groundwater aqueous (dissolved) phase concentration data for DNAPL-related compounds.

Application of the EPA assessment methodology is somewhat limited in the 300 Area since no detailed information has been recovered concerning the quantities and disposal of TCE. Recognition of the use of TCE during the fuel fabrication process has been noted (DOE-RL 1990c and Young 1991). As a result, assessment of the TCE in the 300-FF-5 Operable Unit rests entirely on the analysis of groundwater concentrations of TCE. The DCE is not considered a potential DNAPL component since there is no recorded use of DCE in 300 Area operations. In addition, DCE is a common transformation product of TCE degradation (Montgomery and Welkom, 1989). Application of the EPA assessment methodology to groundwater organic concentration data is illustrated in Table 4-6. The assessment methodology for groundwater concentrations relies on a comparison of the observed maximum percentage solubilities for DNAPL-related compounds to their respective equilibrium solubility limits.

For systems containing only one DNAPL-related component, groundwater aqueous (dissolved) phase concentrations corresponding to less than 0.1% of the equilibrium solubility limit are not indicative of the presence of DNAPL in the aquifer (Table 4-6). For TCE, the solubility limit at 20°C is 1,100 mg/L; 0.1% of this value is 1.1 mg/L. Since the highest observed groundwater TCE aqueous phase concentration of 0.014 mg/L is much less than 1.1 mg/L, the liklihood of a TCE DNAPL source in the unconfined aquifer is low based on the criteria established by EPA methodology. In addition, the declining aqueous phase TCE concentrations in groundwater do not support the presence of a TCE source in the unconfined aquifer. If a TCE source were present, groundwater aqueous phase concentrations should remain fairly constant, rather than decline.

The source of DCE contamination in the 300-FF-5 Operable Unit groundwater is probably the degradation product of TCE. Trichloroethylene can be degraded by both chemical and biological processes. Hydrolysis is the primary chemical degradation mechanism, while anaerobic (microbial-mediated) reductive dehalogenation is the primary biological degradation mechanism. Given the presence of the DCE, it is likely that biodegradation is the primary mechanism of TCE degradation in the 300-FF-5 Operable Unit (Smith and Dragun 1984). Biodegradation may also produce vinyl chloride, but this compound has not been found in the operable unit groundwater.

Transport and migration of both TCE and DCE is affected by sorption onto organic material contained in the aquifer. Sorption is expressed as the soil partitioning coefficient, K_{oc}. The soil

partitioning coefficient can be used to roughly estimate the retardation of contaminant migration relative to the pore fluid movement. Retardation factors are calculated using the following equation:

$$R_d = 1 + \frac{\rho (K_{oc} \cdot f_{oc})}{\theta}$$

where

R_d = retardation factor (unitless)

ρ = average aquifer soil bulk density (g/cm^3)

K_{oc} = sorption coefficient (cm^3/g)

f_{oc} = organic carbon fraction in aquifer

θ = effective porosity

The log K_{oc} values for TCE, *trans*-1,2-DCE, and *cis*-1,2-DCE are 2.1, 1.81, and 1.77, respectively (Smith and Dragun 1984). It is expected that retardation of TCE and DCE will be minimal due to the low organic content of Hanford soils, which is generally less than 0.1% (DOE-RL 1993a, *200 West Groundwater Aggregate Area Management Study Report*).

TCE. Figure 4-2 shows TCE concentrations at selected wells in the 300-FF-5 Operable Unit. The wells shown include most of the wells where detectable TCE levels have been observed throughout the operable unit. Historical data are included for well 399-1-16B, which has generally displayed the highest TCE concentrations. The MCL for TCE is 5 μg/L.

Based on information provided in Figure 4-2, the following observations can be made.

- Since 1987, TCE levels at 399-1-16B have declined from about 20 μg/L to about 5 μg/L currently. The round 7 result (5.4 μg/L) is just above the MCL.
- At most of the other wells shown, TCE concentrations have been somewhat constant at levels just above or below the MCL.
- The MCL was exceeded only at wells 399-1-16B and 399-2-2 during the last 2 sampling rounds. These wells are located fairly close together (Figure 2-2).
- The levels at all the wells are now near to the MCL. There is uncertainty, however, as to when acceptable levels will be reached. Continued monitoring will indicate if the current trends continue.

1,2 - DCE. Figure 4-3 shows the 1,2-DCE concentrations at wells 399-1-16B and 399-1-17B. These are the primary wells where DCE has been detected in the 300-FF-5 Operable Unit. The analytical method used by the RCRA monitoring program in 1993 did not distinguish cis-1,2-DCE from trans-1,2-DCE, so the results were reported as total 1,2-DCE. It should also be noted that data collected until 1990 by the RCRA programs and the PNL Groundwater Surveillance Project apparently also did not distinguish cis-1,2-DCE from trans-1,2-DCE; however the data were reported as trans-1,2-DCE. The more detailed characterization in 1992 demonstrated that nearly all of the

DCE is cis-1,2-DCE. (Dresel et al. 1994) Figure 4-3 presents the maximum value of the DCE concentration that was reported. Based on information provided in Figure 4-3 the following observations can be made.

- There is an apparent upward trend for DCE at well 399-1-16B. 1,2-DCE concentrations increased from about 60 to 180 μg/L from 1986 to 1994. Since DCE may be a product of TCE degradation, the apparent fluctuations in DCE may be related to the reductions in TCE concentration that have been observed.

- DCE exceeds the MCL at only a single well in the operable unit (well 399-1-16B). Levels at well 399-1-17B (less than about 10 μg/L) are well below the MCL. The MCL for DCE is 70 μg/L for cis-1,2-DCE and 100 μg/L for trans-1,2-DCE.

- Although not shown in the Figure 4-3, DCE was detected at well 399-1-16A during round 6. The well is a designated "A" well and monitors the upper portion of the unconfined aquifer. This is the first occurrence of DCE in an "A" well or at a well other than 399-1-16B or 399-1-17B (which both monitor the lower portion of the unconfined aquifer). DCE was detected at the well at a concentration of 31 μg/L during round 6. All other previous results were non-detect values at the well. DCE was not detected at the well, however, during round 7.

Based on seven rounds of RI sampling and historical data, TCE levels appear to be declining and may soon be below the MCL throughout the operable unit, while DCE levels are fluctuating. This may result from the breakdown of TCE to DCE. TCE levels are near the MCL at a number of wells. During round 7, the TCE MCL was exceeded at 399-1-16B and 399-2-2, which are located in the same general area of the operable unit. The MCL for DCE is exceeded only at a single well (399-1-16B). DCE levels can be expected to exceed the MCL for an undetermined period of time.

4.2.3.5 Uranium Plume Maps. Uranium plume maps are presented in Appendix D for all rounds of RI sampling.

As with the trend plots, total uranium concentrations are presented in the plume maps using the actual total uranium data, as well as the isotopic uranium data that was converted from pCi/L to μg/L and then summed. Total uranium analyses were performed in rounds 2 through 7 (Figures D-1 to D-6); isotopic uranium analyses were performed in rounds 1, 2, 3, and 6 (Figures D-7 to D-10).

Where both RCRA and CERCLA sampling was conducted at a well during the same round, the CERCLA uranium results are used to construct the plume maps. If more than one RCRA result is available, the maximum uranium value was used.

In addition to the plume maps created for individual rounds, conceptual plume maps have also been created using interpreted total uranium values at all "A" wells in the operable unit. Interpreted values were selected to create plume maps based on as many wells as possible, thereby filling in data gaps that occurred during rounds 1 through 7 (Figures D-1 to D-10) when, in some cases, limited numbers of wells were sampled during each round. Because limited numbers of wells were sampled in some rounds, the plume areas and shapes shown in Figures 4-4 and 4-5 and in Appendix D are to some extent a function of the number and position of wells sampled. The conceptual plume maps were created specifically to lessen this effect, thereby rendering a more complete and accurate depiction of the plume shape and location. Maps have been created for the periods September 1993

and June 1996 and are shown in Figures 4-4 and 4-5, respectively. September 1993 corresponds approximately to a round 6 condition. June 1996 corresponds to an estimated plume configuration at the time of ROD implementation (a design condition). Due to the lack of well control, the area of high concentration is estimated.

The values used to create the plume maps are interpreted and based on the total uranium and isotopic uranium trends displayed at each well over the seven rounds of sampling. For the future values, uranium concentrations were selected by extrapolating, when a trend was apparent, to the June 1996 time period. If uranium concentrations were relatively constant at a well or if no obvious trend was apparent, the September 1993 value was chosen for the June 1996 time period.

The plume maps (Figures 4-4 and 4-5; Figures D-1 to D-10) show that uranium is present in an area that includes most of the southern three-quarters of the 300-FF-1 Operable Unit and that extends south approximately midway between well 399-4-12 and well 699-S29-E16A. Maximum values (currently about 100 to 150 μg/L) occur in the vicinity of the process trenches and north process pond near wells 399-1-16A, 399-2-2, and 399-1-7. This uranium contamination presumably results from the previous liquid waste disposal activities at the process trenches and ponds. A secondary maxima (levels of about 40 to 70 μg/L) occurs in the vicinity of wells 399-4-9, 399-4-10, and 399-4-7. The source of the uranium in this area of the site is unclear, but may be a remnant of an earlier plume from the process trench/north and south process pond area that has been directed to the south as the Columbia River levels fluctuate. This plume may also be related to a 300-FF-2 source such as the 316-3 (307 trenches) and/or the 307 retention basins.

4.3 URANIUM FATE AND TRANSPORT

4.3.1 Filtered vs Unfiltered Uranium Analyses

The results of the filtered total uranium analyses conducted during round 6 are shown in Figures 4-6 and 4-7. Filtered analyses were conducted for wells 399-1-5, 399-1-7, 399-2-2, 399-4-10, 399-4-12, and 399-4-7. Filter sizes of 0.1, 0.45, and 1 μm were used. Unfiltered split samples were also collected at the same time as the filtered samples.

Figure 4-6 plots the uranium analysis results vs filter size for each well. As indicated, the uranium concentration does not vary significantly with filtering or filter size. Sample results increase somewhat as filter size increases for wells 399-1-5 and 399-4-10; however, results decrease or are relatively constant for all other wells. The conclusion drawn from the data is that no definite relationship is demonstrated between filter size and measured uranium concentration.

Figure 4-7 further supports this conclusion. The filtered data (from the sample filtered with a 1 μm filter) are plotted vs the corresponding unfiltered data. A linear regression analysis of the data results in a straight line with a high correlation coefficient (96%), slope near a value of 1 (1.12), and y-intercept close to the origin (-11.3). This suggests that the filtered and associated unfiltered data are very nearly identical for each sample.

Uranium results from filtered samples are essentially identical to those from unfiltered samples. This results either from low uranium sorption to fines present in the groundwater samples, or from low levels of fines in the groundwater samples. These results indicate that uranium analytical

results of unfiltered samples are representative of groundwater conditions and eliminate the uncertainty expressed in the Phase I RI that risks posed by uranium in groundwater were possibly being overestimated because of the use of unfiltered samples.

4.3.2 Evaluation of Sorption - Controlled Release Mechanism

The possible presence of a solid phase uranium precipitate, or floc, in the unconfined aquifer has led to uncertainty regarding time estimates for cleanup of groundwater. A uranium precipitate within the unconfined aquifer (Hanford formation) could cause urnaium migration in groundwater to be controlled by a solubility-controlled release mechanism instead of a sorption-controlled release mechanism. This would extend the time required for uranium concentrations to reach acceptable levels in the aquifer. As such, the Phase I RI indicated a need to determine whether such a source of uranium exists in the aquifer of the 300-FF-5 Operable Unit. The uranium trend plots presented in Section 4.2.3.4 were examined and are discussed in this sub-section. The trend plots for uranium at selected 300-FF-5 Operable Unit wells are presented in Appendix C.

As indicated in Section 4.2.3.4, significant reductions in uranium concentrations were observed at several wells along the upgradient perimeter of the uranium plume area (399-1-5, 399-1-6, 399-1-10A, 399-1-11, 399-1-12, 399-1-16A, and 399-1-21A). These wells are located in close proximity to a possible location of a solid phase uranium source (i.e., in and around the 316-5 process trenches). Wells 399-1-5 and 399-1-11 are located immediately east of the two trenches. If a uranium source in groundwater exists in this area of the operable unit, the uranium concentrations at these wells would be expected to remain relatively constant because the source would continue to provide uranium to the groundwater. However, the levels at these wells have declined from concentrations of approximately 100-300 μg/L to levels below 100 μg/L during the seven rounds of RI monitoring. The reductions are probably related to the removal and isolation of contaminated sediments at the process trenches during the ERA, which eliminated a primary source of uranium within the vadose zone to the groundwater (DOE/RL 1992b) and to the fact that the uranium plume is associated with the highly transmissive Hanford formation and is rapidly flushed from the unconfined aquifer. These rapid declines in concentration provide evidence that a significant source is not present; however, round 7 data show slight increases in uranium concentrations in some wells, which may indicate the presence of uranium in the soils immediately above the average water table level in the area. Fluctuating concentrations in these wells appear related to variations in river stage and tend to support this hypothesis.

4.3.3 Uranium K_d Determinations

PNL recently evaluated the adsorption tendencies of uranium on uncontaminated Hanford Site soils (Serne et al. 1994). More discussion is provided in Section 3.3.2. The work involved a series of column leaching experiments using leachate from contaminated north process pond sediments and columns of "clean" soil. Theoretically, the breakthrough curves obtained from these tests would have allowed calculation of a uranium K_d value. Unfortunately, the "clean" soil selected for the tests contained significant quantities of uranium that dissolved and flushed through the columns during the tests. The presence of the uranium confounded the interpretation of the uranium adsorption tendencies and prevented calculation of a uranium K_d.

Despite the lack of data from the PNL study, it is possible to refine the estimates of uranium K_d used in the Phase I RI report (DOE-RL 1994d) from information available in the literature. This section discusses this literature review.

The Phase I RI (DOE-RL 1994d) reported that published uranium K_ds are moderate and usually range from about 1 to 10 ml/g. Operable unit-specific data were available at the time of the Phase I RI; however, that suggested that values for K_d could be as high as 25 mL/g. Based on this information, a range of K_d values from 1 to 25 mL/g was used in numerical and analytical predictions of future uranium concentrations in the unconfined aquifer. The use of this range of sorption coefficient values resulted in considerable uncertainty about the future uranium concentrations in groundwater at the operable unit.

Further review of the technical literature and consideration of uranium data trends presented in Section 4.2.3.4.1 has led to the conclusion that values of uranium K_d as high as 25 mL/g are not realistic and that the uranium K_d is probably in the range of 1 to 2 mL/g, based on the following:

- The significant reductions in uranium concentrations occurring in selected operable unit wells suggest that uranium is not highly sorbed to sediments of the unconfined aquifer. These reductions are not consistent with K_d values as high as 25 mL/g and suggest that the actual K_d is significantly lower.

- Serne and Wood (1990) report that uranium sorption values will be low under most circumstances at Hanford because uranium tends to form neutral or anionic species at neutral or basic pH values (conditions typical of the 300 Area groundwater) and is a poorly adsorbing cation at acidic pH values. Values for the uranium sorption coefficient typical of ambient Hanford groundwater conditions were estimated to range from 0 to <10 with 0 mL/g as a best estimate.

- Serne et al. (1993) reported adsorption test results on two typical Hanford sediments using a simulated process waste fluid and an uncontaminated Hanford Site groundwater. The sediments tested included a coarse sample (coarse gravel/sand [approximately 18% finer than 2 mm]) and a fine-grained material (Touchet Bed sand [approximately 99% finer than 2 mm]). Adsorption test results indicated that for the coarse sample, uranium sorption from groundwater is weak with reported K_ds of about 0 to 1 ml/g (after correcting for removal of the gravel-sized fractions before testing). This appears to occur because at pH values typical of groundwater ($pH > 8$), uranyl carbonate complexes predominate that sorb poorly because of their anionic charge. In the tests involving process waste fluids, uranium adsorption was considerably higher, and it was speculated that cationic forms of uranium are more prevalent in the process waste streams, and higher adsorption would be expected. Sorption onto the fine-grained sample was considerably higher than onto the coarse sample.

- To estimate a uranium K_d value, the Phase I RI (DOE-RL 1994d) included an analysis of the movement of the center of mass of the ^{238}U plume. Re-analysis of the calculation using the current estimates of hydraulic gradient and conductivity also support a low value of uranium K_d. The center of mass of the ^{238}U plume traveled approximately 90 m (295 ft) in the 135 days separating sampling rounds 1 and 2. The plume therefore moved with a velocity (V_u) of approximately 0.7 m/day (2.3 ft/day). Assuming an average hydraulic gradient of 0.0005 (dh/dl) average hydraulic

conductivity of 1,830 m/day (6,000 ft/day) (K), and an effective porosity of 0.3 (θ) the average groundwater pore velocity (V_w)in the vicinity of the plume is approximately 3 m/day (10 ft/day) based on Darcy' Law:

$$V_w = k/\theta * dh/dl.$$

The retardation (R) of the rate of movement of the uranium in groundwater to the rate of movement of the groundwater is related to the distribution coefficient according to the following relationship:

$$R = V_w/V_u = 1 + (\rho(K-\theta)/\theta)K_d$$

where:

ρ = bulk density (g/cm^3).

A bulk density of 2.0 g/cm^3 is assumed for Hanford gravel which yields a K_d equal to 0.8 or approximately 1 mL/g.

Based on these data and the conditions typical of the 300 Area (pH ~8 and general lack of fine-grained soils), the range of potential K_d values for the unconfined aquifer is conservatively estimated to be 0.5 to 5 mL/g. A K_d of 0 is not considered very likely given the current size of the uranium plume and concentrations exhibited. A best estimate value is 1 to 2 mL/g.

4.3.4 Evaluation of Time Required for Uranium Concentrations in the Operable Unit to fall below the MCL (20 μg/L) through Natural Attenuation

Estimates were made in the Phase I RI (summarized in Section 2.6 of this report) of future uranium concentrations in the unconfined aquifer. The estimates were made for the year 2018 because this is the first year in which the current institutional controls over Hanford groundwater use could be relaxed by DOE. The calculations were made using numerical as well as analytical methods. The results indicated uncertain predictions of uranium concentrations in the groundwater at or beyond the year 2018. This uncertainty primarily resulted from three factors: (1) uncertainty as to whether uranium transport in the unconfined aquifer is dominated by sorptive-release mechanisms (K_d), or by solubility-release mechanisms, (2) uncertainty with regard to the magnitude of the uranium sorption coefficient (K_d), and (3) uncertainty with regard to the average linear velocity of groundwater.

Published uranium K_d values used in the Phase I RI were about 1 and 10 mL/g; however, observations of uranium concentrations in aquifer soils and adjacent groundwater indicated they could be as high as 25 mL/g. Assuming a K_d of 1 mL/g, uranium contaminants will be flushed out of the unconfined aquifer by the year 2018. Assuming a K_d of 25 mL/g, concentrations of total uranium remaining in the aquifer by the year 2018 ranged from about 10 to 20 pCi/L (about 13 to 27 μg/L). If secondary sources of uranium exist in the aquifer (uranium precipitates or floc), they were predicted to add about 10 years to the results of the K_d modeled results. The MCL for uranium is 20 μg/L.

Upon completion of the Phase I RI, expected future concentrations of uranium in the unconfined aquifer and the amount of time required for uranium levels to fall below the 20 μg/L

MCL were undetermined. Although uranium was not a contaminant of concern in groundwater (it did not pose a risk greater than 1.00 E-06 under any of the current or future human health risk assessment scenarios), uranium concentrations do exceed ARARs. The eventual remedial measure selected for the operable unit will need to achieve the ARARs for uranium.

One such remedial approach being considered in the FS is Institutional Controls. Institutional controls is a preferred alternative if uranium is flushed from the aquifer fairly quickly. It is a less desirable alternative if urnaium remains in the aquifer above the MCL for some time.

To support FS evaluations of remedial alternatives, the following sections refine the estimates currently available for the rate of decline of uranium in groundwater. Estimates presented in sections that follow are based on the refined estimates of hydraulic conductivity (1,830 m/day [6,000 ft/day]) and K_d (1 to 2 mL/g) presented previously and use the analytical modeling of future uranium concentrations in groundwater that was performed in the Phase I RI.

The calculation is predicated on controlling impacts from 300-FF-1 and 300-FF-2 sources to negligible levels in 300-FF-5 groundwater. If these operable units act as sources of significant uranium contamination, the time estimates presented will be longer.

4.3.4.1 Analytical Modeling. Various analytical solutions to the partial differential equation describing groundwater flow and solute transport in saturated porous media are available. One such analytical solution was developed in a spreadsheet format to support the Phase I RI. The model used in the Phase I RI is applied here, based on the refinement of the site conceptual model developed in this report. A brief description of the model is included below. A complete discussion of this model and its application to the 300-FF-5 Operable Unit RI is presented in the Phase I RI report (DOE-RL 1994d).

The analytical solution solved in the spreadsheet model incorporates most of the physics important to flow and solute transport in saturated porous media. The model can be used to predict downstream concentrations of a decaying and retarded solute undergoing three-dimensional dispersion in a unidimensional flow field. Input to the model includes:

- Hydraulic gradient
- Hydraulic conductivity
- Effective porosity
- Longitudinal, transverse, and vertical dispersivity
- Contaminant half-life
- Contaminant distribution coefficient
- Contaminant source concentration
- Contaminant initial concentration conditions
- Contaminant source physical dimensions.

Output from the model consists of contaminant concentrations along the plume centerline at the phreatic surface for varying distances from the source.

Results presented in this section were derived using the analytical model created for the Phase I RI. Refinement of the site conceptual model since the Phase I RI led to several changes to the model input. These changes are summarized below.

Source Concentration. The original source concentration for total uranium was taken as the maximum groundwater concentration measured during 1992 independent of sampling round or location. This value was 270 μg/L measured at well 399-1-5 (round 2). However, as discussed in Section 4.2.3.4, uranium levels have been declining in selected operable unit wells. Using the groundwater data collected during the Supplemental RI, a more current estimate of the maximum uranium concentration in the operable unit is about 140 μg/L. This value occurred at well 399-1-16A during round 6 (late 1993).

Hydraulic Gradient. The original hydraulic gradient of 7.0×10^{-4} was changed to 5.0×10^{-4}. The former was consistent with conditions taken at a snapshot in time, while the latter represents an approximate yearly average value. Refer to Appendix F for details regarding the determination of this value.

Hydraulic Conductivity. The original hydraulic conductivity of 4,500 m/day (14,760 ft/day) was reduced to 1,830 m/day (6,000 ft/day) to be consistent with the discussion of Section 4.1.1, which consists of a compilation and evaluation of all available hydraulic conductivity data for the operable unit.

Distribution Coefficient. Data supporting a uranium distribution coefficient of 1 to 25 mL/g were available at the time of the Phase I RI (DOE-RL 1994d). The upper end of this range was previously chosen to maximize the concentration of uranium near the Columbia River at the year 2018. This range was used in the analytical modeling conducted for the Phase I RI. As discussed in Section 4.3.3, however, laboratory tests reported in Serne et al. (1993) and consideration of uranium trends in groundwater indicate a distribution coefficient significantly lower, about 1 to 2 mL/g. Results presented below were derived using a distribution coefficient of from 1 to 2 mL/g.

Initial Concentrations. Initial contaminant concentrations corresponding to 1992 conditions were previously modeled assuming a constant source concentration at the location of highest concentration. Because this constant source is now believed to not occur (Section 4.3.2), the model was modified so that initial contaminant concentrations resembled those presented in Figure 4-4 (late 1993). The time estimates presented here are from late 1993.

Using the model with the changes discussed above yields a uranium depletion rate of approximately 30 μg/L/yr. At that rate, in approximately 4 years (from late 1993) uranium levels in groundwater would fall below the MCL of 20 μg/L. If the distribution coefficient used were doubled from 1 mL/g to 2 mL/g, the depletion rate of uranium would also double and the time required for uranium levels to reach 20 μg/L would be 8 years instead of 4. This approximate one-to-one inverse relationship between depletion rate and distribution coefficient is valid for the entire range of possible distribution coefficients.

This analysis assumes that uranium solute travels 500 m (1,640 ft) from well 399-1-17A southeast to the Columbia River. The uranium depletion rate presented above would only change slightly if the actual travel distance were to differ from that assumed. For example, an increase in travel distance of 100 m (330 ft) would result in a depletion rate of approximately 26 μg/L/yr. Conversely, if the travel distance were to decrease by 100 m (330 ft) the depletion rate would increase to approximately 36 μg/L/yr. Hence the net result of 100 m (330 ft) change in travel distance is to either increase the time required for uranium levels to reach 20 μg/L to approximately

5 years or decrease the time required to approximately 3 years. Figure 4-8 shows the predicted maximum concentrations in groundwater vs time assuming a K_d of 1 mL/g and a travel distance of 500 m (1,640 ft).

The best estimate of time required for the maximum uranium levels to decline to the MCL (20 μg/L) is approximately 3 to 10 years from late 1993. This estimate is consistent with the results of the WHC modeling performed as part of the Phase I RI (DOE-RL 1994d), which showed that with a K_d of 1 mL/g, the maximum concentration of total uranium remaining in the aquifer at the year 2000 (approximately 17 μg/L) was below the MCL.

4.4 BASELINE RISK ASSESSMENT

4.4.1 Human Risk Assessment

The purpose of this section is to assess whether the conclusions of the baseline risk assessment presented in the Phase I RI remain valid considering the data collected as part of this Supplemental RI. Data collected in the Supplemental RI consisted of three more additional rounds of groundwater sampling and a second Columbia River sampling event. The analytical results (Section 4.2) obtained from these sampling efforts were screened against background concentrations, previous maxima (for groundwater data only), and regulatory and risk-based screening concentrations to determine if any changes resulted in the Phase I RI list of CsOPC discussed in Section 2.3. The results of this screening and its impact on the baseline risk assessment are discussed below.

4.4.1.1 Groundwater.

Unconfined Aquifer. For the unconfined aquifer screening scenario (Section 4.2.3.1.1), changes to the lists of CsOPC consisted of new maximum values for nickel, DCE, and ^{99}Tc. No new additional CsOPC resulted from the screening, except for cis-1,2,-DCE, which is an isomer of an existing CsOPC. The maximum value for nickel increased from 118 μg/L to 140 μg/L. DCE was detected at new maxima of 180, 150, and 130 μg/L (compared to 150, 130, and not detected) for 1,2-DCE (total), trans-DCE and cis-DCE, respectively. Technetium-99 increased from 65 to 74 pCi/L.

None of these contaminants were risk drivers for the baseline risk assessment, so the small increases are not significant from a risk estimation standpoint. Technetium-99 is associated with the 1100-EM-1 Operable Unit and is addressed as part of the 1100-EM-1 RI/FS process. None of these changes result in any significant change to the risk assessment presented in the Phase I RI. The increases for nickel, however, do suggest that longer time periods may be required for nickel to be flushed from the aquifer than were estimated in the Phase I RI.

Confined Aquifer. No changes occurred to the results of the Phase I RI screening for the confined aquifer (Section 4.2.3.1.2). The Phase I RI identified no CsOPC for the confined aquifer, the confined aquifer is not an exposure pathway of concern for the operable unit, as reported in the Phase I RI Report.

Well 399-4-12. For well 399-4-12, which represents the only current exposure pathway for groundwater in the operable unit, ^{235}U was detected at a new maximum value (0.55 pCi/L), which is only slightly greater than the previous value (0.51 pCi/L). Also, a new compound (antimony) was added to the list of CsOPC for well 399-4-12.

Exposure to ^{235}U in water from this well was not considered a risk driver. Because the increase in ^{235}U was very small, it has a negligible impact on the risk calculation. The primary risk drivers were TCE and chloroform, which did not increase. Although antimony exceeds the MCL at the well, groundwater from this well is not for potable use. The exposure pathway evaluated in the baseline risk assessment for groundwater use from 399-4-12 was contact and dermal adsorption, but not ingestion. Therefore, as long as the well is not used as a source of drinking water, antimony does not pose a risk. These modifications to the CsOPC for the well do not result in any significant changes to the baseline risk assessment.

4.4.1.2 Columbia River. No CsOPC resulted from the data screening conducted for the Supplemental RI river sampling event; therefore, under the conditions in which the samples were collected, the river poses no unacceptable human health risk. Secondary MCLs were exceeded by some river constituents; however, these are not health-based standards.

The conclusion of the baseline risk assessment regarding river water exposures remain unchanged: groundwater discharges to the river result in no unacceptable human health impacts under average flow conditions.

4.4.1.3 Conclusions. Based on the Supplemental RI data the results of the baseline risk assessment as presented in the Phase I RI remain unchanged: there is no current risk posed by the operable unit that exceeds a 1×10^{-6} point of departure ICR. This assumes exposure to average river water concentrations and excludes chloroform in groundwater because it can be attributed to water chlorination. MCLs are exceeded in water currently extracted by the 399-4-12 well; however, the well is not a drinking water source. For the exposures associated with the uses of the well, there is no unacceptable risk. The only future risk scenario that exceeds 1×10^{-6} is the industrial exposure scenario for groundwater in the 300 Area. By excluding tritium, which is derived from 200 Area sources, the risk falls to 3×10^{-6} under the conservative assumption that TCE concentrations will remain unchanged in the future. If the levels of TCE fall before the year 2018, the risk will be less. All other future scenarios (residential, recreational, and agricultural) evaluated using surface water had risks below 1×10^{-6}.

300-FF-5 contaminants that exceed ARARs in the operable unit and that will be addressed further in the FS include uranium, TCE, DCE, and nickel. Total coliform may also exceed ARARs; however, the planned connection to the city of Richland sewer system will eliminate discharges to the groundwater and therefore it need not be addressed in the FS. Technetium-99 also exceeds ARARs; however, the compound is being addressed under the 1100-EM-1 operable unit RI/FS process. Estimates of future uranium concentrations indicate that uranium values are expected to fall below the uranium MCL of 20 μg/L in 3 to 10 years through natural attenuation. Future levels of TCE, DCE, and nickel in the groundwater are uncertain, however, and these compounds may still exceed potential ARARs in the year 2018. Trend data for TCE suggest that TCE levels may soon fall below the MCL.

4.4.2 Ecological Risk Assessment

The results of the ecological risk assessment presented in the Phase I RI (DOE-RL 1994d) indicated that there was a potentially unacceptable ecological health risk posed by the operable unit from manganese, nickel, and copper in groundwater. The risk from manganese was associated with bird ingestion of reed canarygrass or Great Basin pocket mice. For nickel and copper, the risk was associated with potential groundwater discharges to the Columbia River that exceeded the chronic LOEL, a surface water quality criteria that is an ARAR for the operable unit.

There was considerable uncertainty in these risk characterizations, however, and the values were considered to represent bounding estimates not representative of the actual risks. For aquatic organisms, for example, maximum concentrations detected in groundwater were used as the source terms to represent Columbia River concentrations, when in fact, the groundwater will experience almost instantaneous dilution by the river. For riparian receptors, maximum contaminant concentrations measured in mice and reed canarygrass were used also, and it was assumed that the mice were the complete diet of the hawk and shrike, and reed canarygrass the complete diet for the geese, which is an overestimate of potential foodchain exposure. Therefore, the risk assessment overestimated the real risk because of the conservative exposure scenarios employed.

Although conservative exposure scenarios were used and uncertainties exist, the 300-FF-5 Operable Unit does not pose an unacceptable ecological health risk, based on the following review of the data used.

- **Manganese.** Manganese was detected in the groundwater at concentrations above background in a few samples collected during Phase I, and was therefore included in the ecological risk assessment. The compound was also initially retained as a CsOPC for the human health risk assessment. As discussed in Section 4.3.2.1.1 of the Phase I RI, however, fewer than 5% of the groundwater samples analyzed for manganese exceeded the 95% upper tolerance limit background value. The few detected values exceeding background prevented distiguishing the detected levels from the naturally occurring background concentrations. The compound was not observed above background in the operable unit groundwater during rounds 5, 6, and 7; therefore, the compound was eliminated as a CsOPC for the human health risk assessment and should be eliminated from the ecological health risk assessment as well.

- **Copper.** Copper was observed above background in the groundwater during Phase I and during the recent sampling. The compound was deemed to pose a potentially unacceptable ecological health risk during the Phase I RI because it was detected in the groundwater at concentrations exceeding the Chronic LOEL for surface water. All of these detects above the Chronic LOEL occurred during rounds 1 and 2, however. There were four exceedances in round 1, and one exceedance in round 2. There have been no occurrences of copper in groundwater above the Chronic LOEL since round 2. The compound should not be considered a contaminant of concern for the ecological risk assessment.

- **Nickel.** Nickel was observed above background in groundwater during Phase I, and during the supplemental sampling rounds as well. The compound was deemed to pose a potentially unacceptable ecological health risk during the Phase I RI because it was detected in the groundwater at concentrations exceeding the chronic LOEL for surface

water. Comparison of the maximum concentrations of nickel detected in the river, however, to the operable-unit specific background values determined in the Phase I RI (Table 4-11; DOE-RL 1994d) indicates that the compound is not elevated in the river from 300-FF-5 sources. Further evaluation of the data indicates that the location of the most frequent detections appear to be at the 399-1-16 well cluster site. Detections at other wells are sporadic and are not consistent through time. Based on the contaminant transport analysis performed in the Phase I RI (Section 5.2, DOE-RL 1994d) the predicted maximum concentration in groundwater in the year 2018 was 50 μg/L. Using a similar analysis which utilizes a distribution coefficient, K_d, for nickel of 15 mL/g it was determined that the predicted maximum river concentration would only be 7.1 μg/L. This is in part due to the longer time that it will take for nickel to travel the distance from the 399-1-16 well site to the river. Fewer than 2% of the groundwater samples analyzed and reported as detected values throughout the operable unit exceeded the chronic LOEL for surface water. Based on these analyses there is no measurable impact on the Columbia River or the operable unit ecosystems, and the compound should be eliminated as a contaminant of concern for the ecological risk assessment.

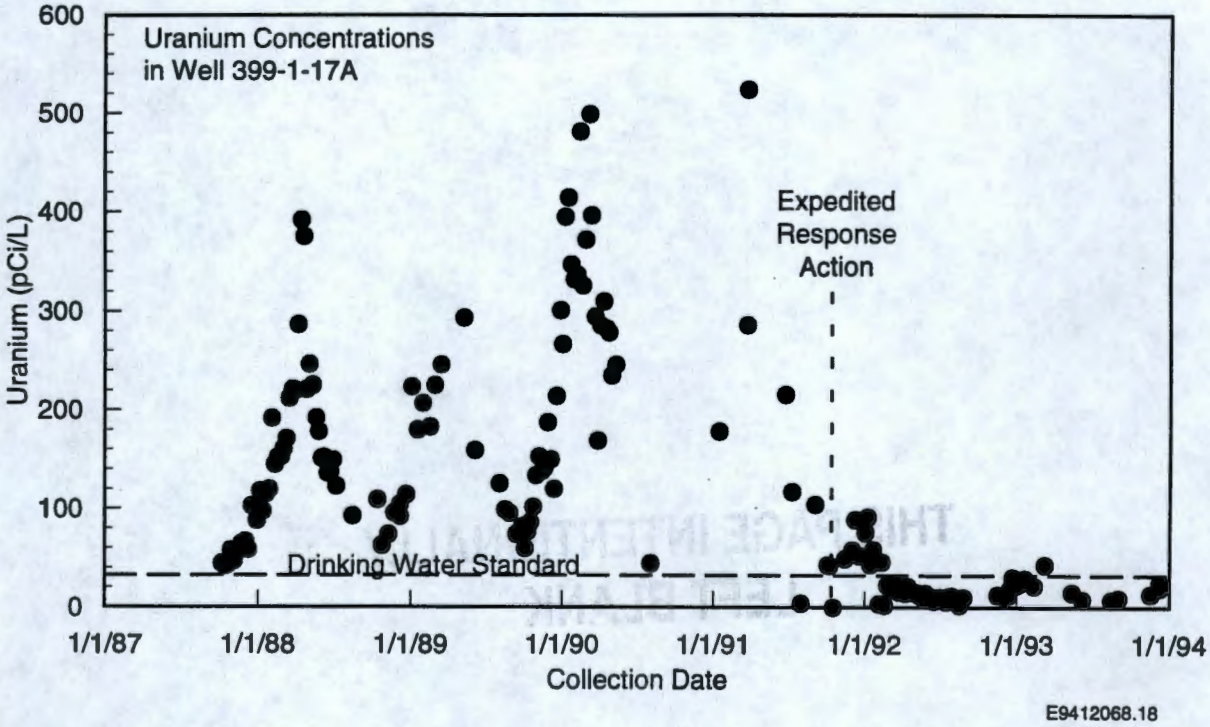

Figure 4-1. Uranium Concentration Trend for Well 399-1-17A.
(Source: Dresel et al. 1994)

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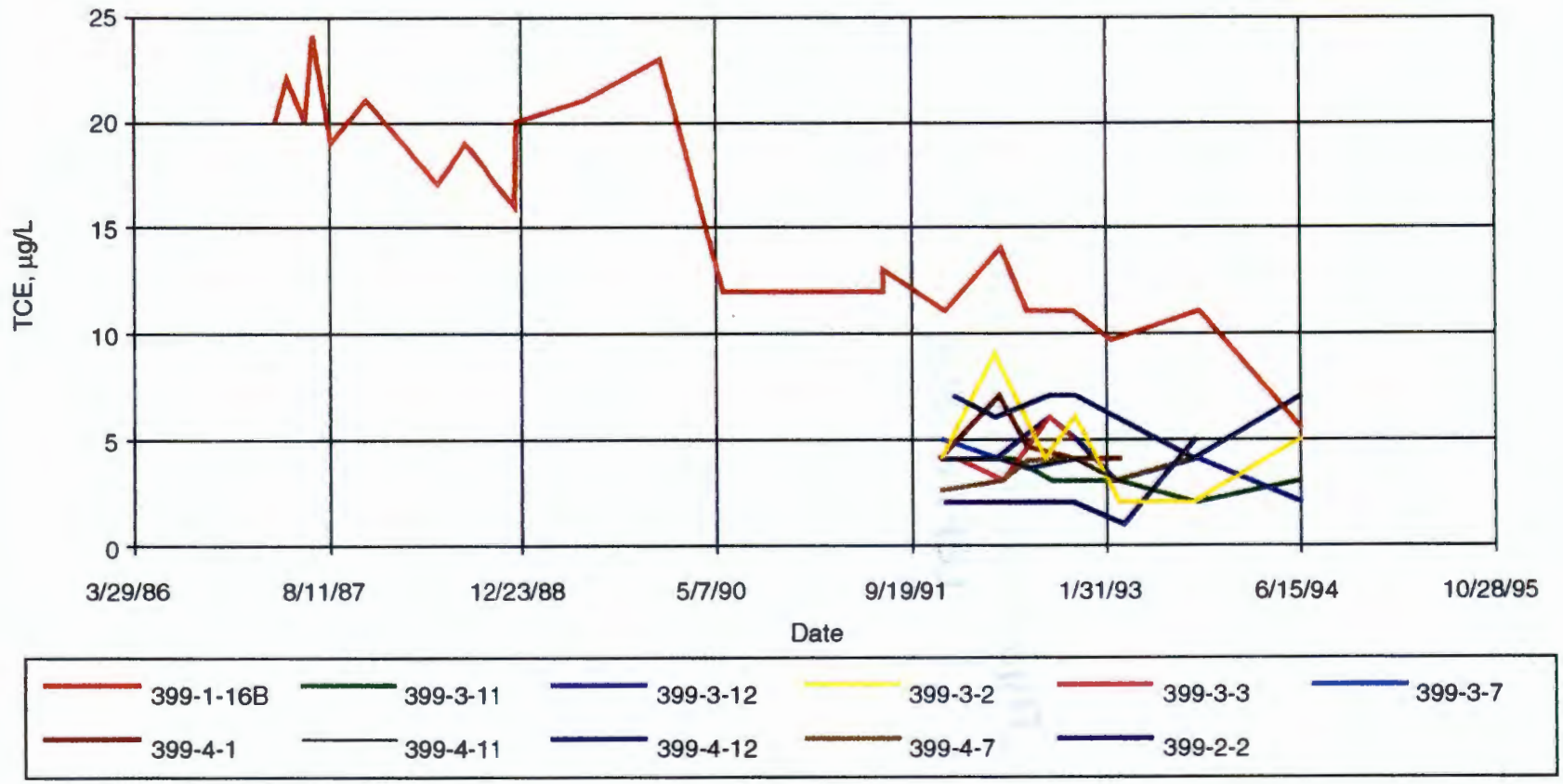

Note: The TCE MCL is 5 µg/L.

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Figure 4-2. TCE Trends at Selected 300-FF-5 Operable Unit Monitoring Wells.

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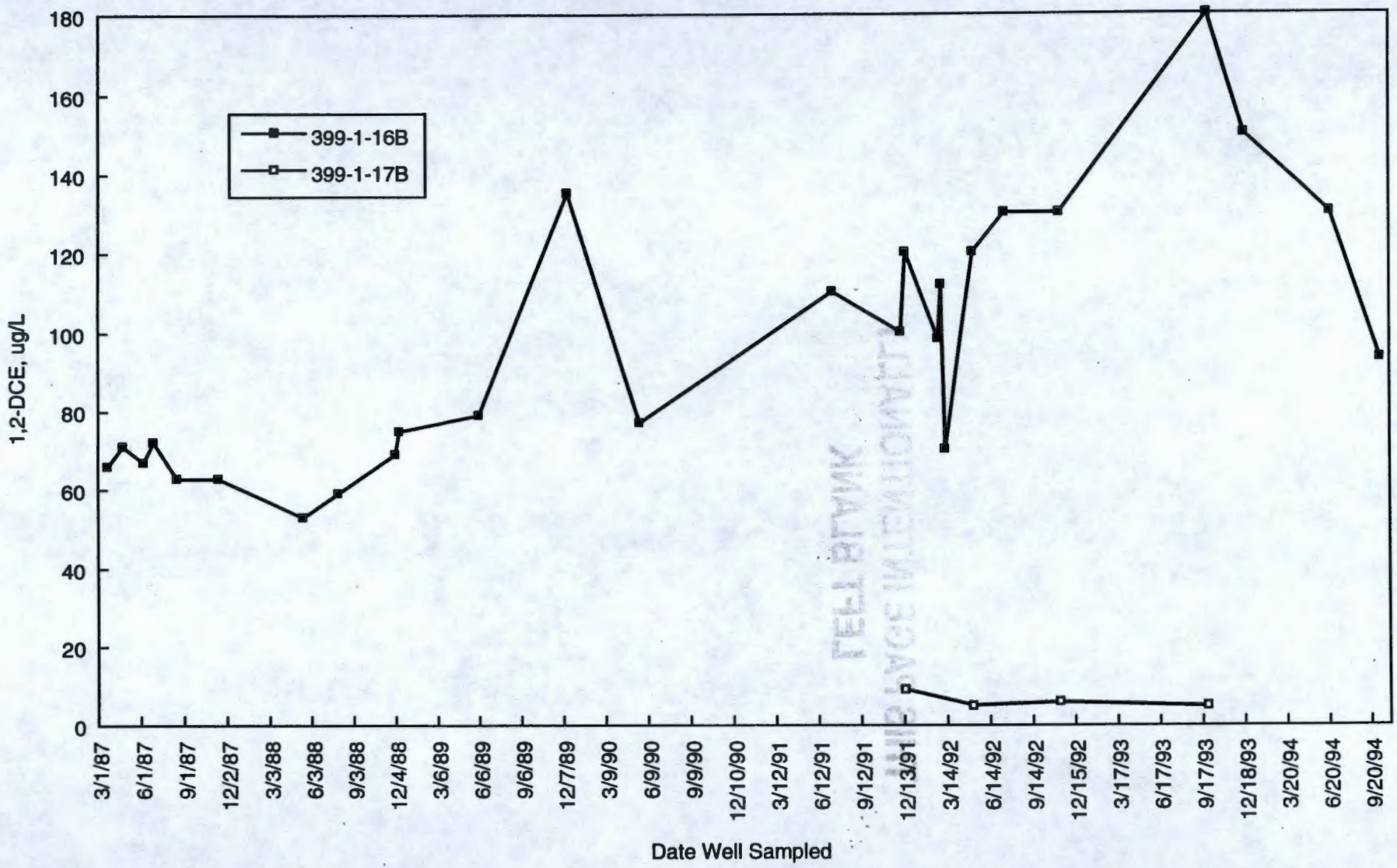

Note: The MCL for 1,2-DCE and cis-1,2-DCE is 70 ug/L and for trans-1,2-DCE is 100 ug/L

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Figure 4-3. TCE Concentrations at Selected Wells in the 300-FF-5 Operable Unit.

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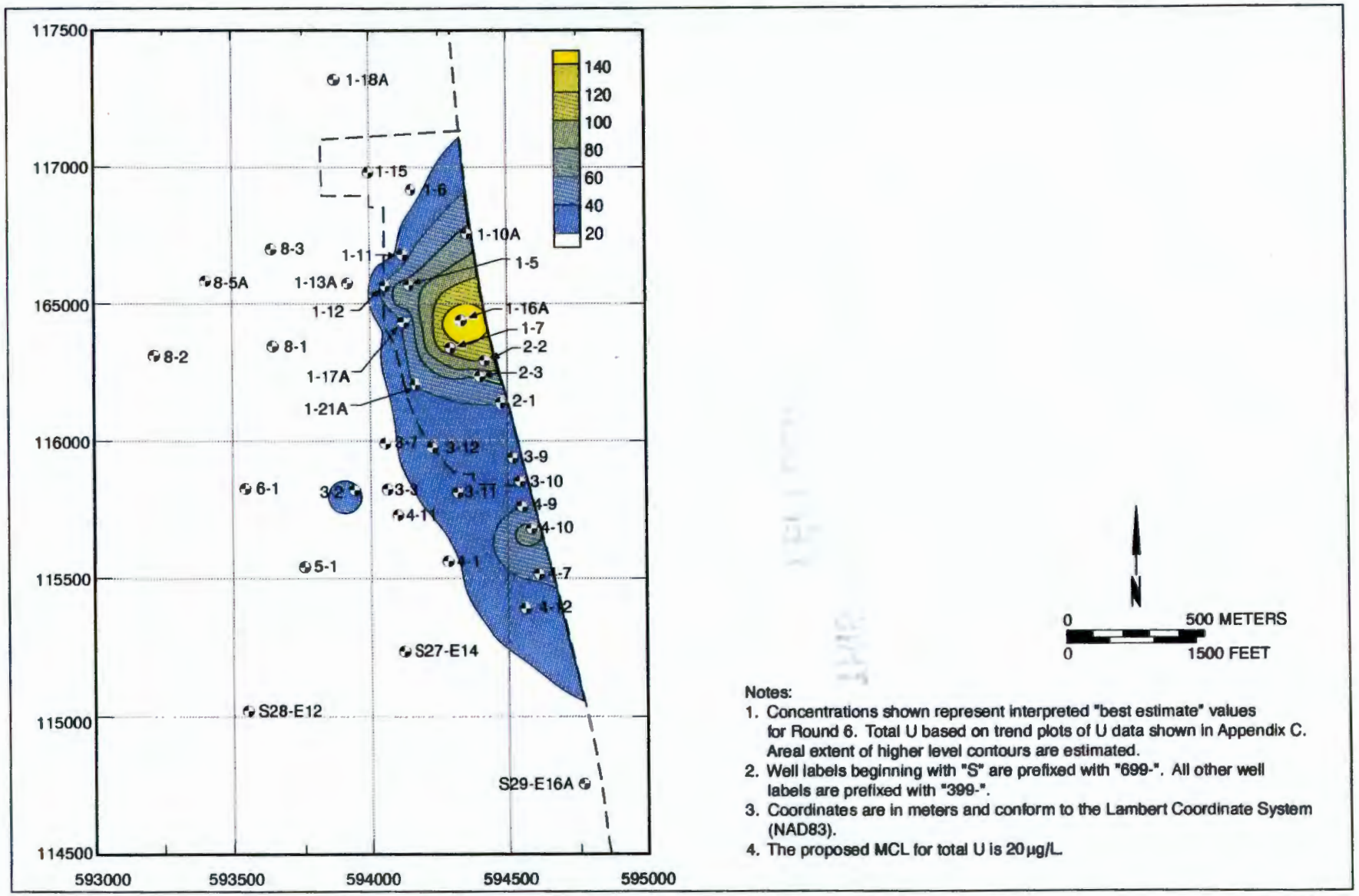

Notes:
1. Concentrations shown represent interpreted "best estimate" values for Round 6. Total U based on trend plots of U data shown in Appendix C. Areal extent of higher level contours are estimated.
2. Well labels beginning with "S" are prefixed with "699-". All other well labels are prefixed with "399-".
3. Coordinates are in meters and conform to the Lambert Coordinate System (NAD83).
4. The proposed MCL for total U is 20 µg/L.

E9412068.4

Figure 4-4. Total U Contours for September 1993 (Conceptual).

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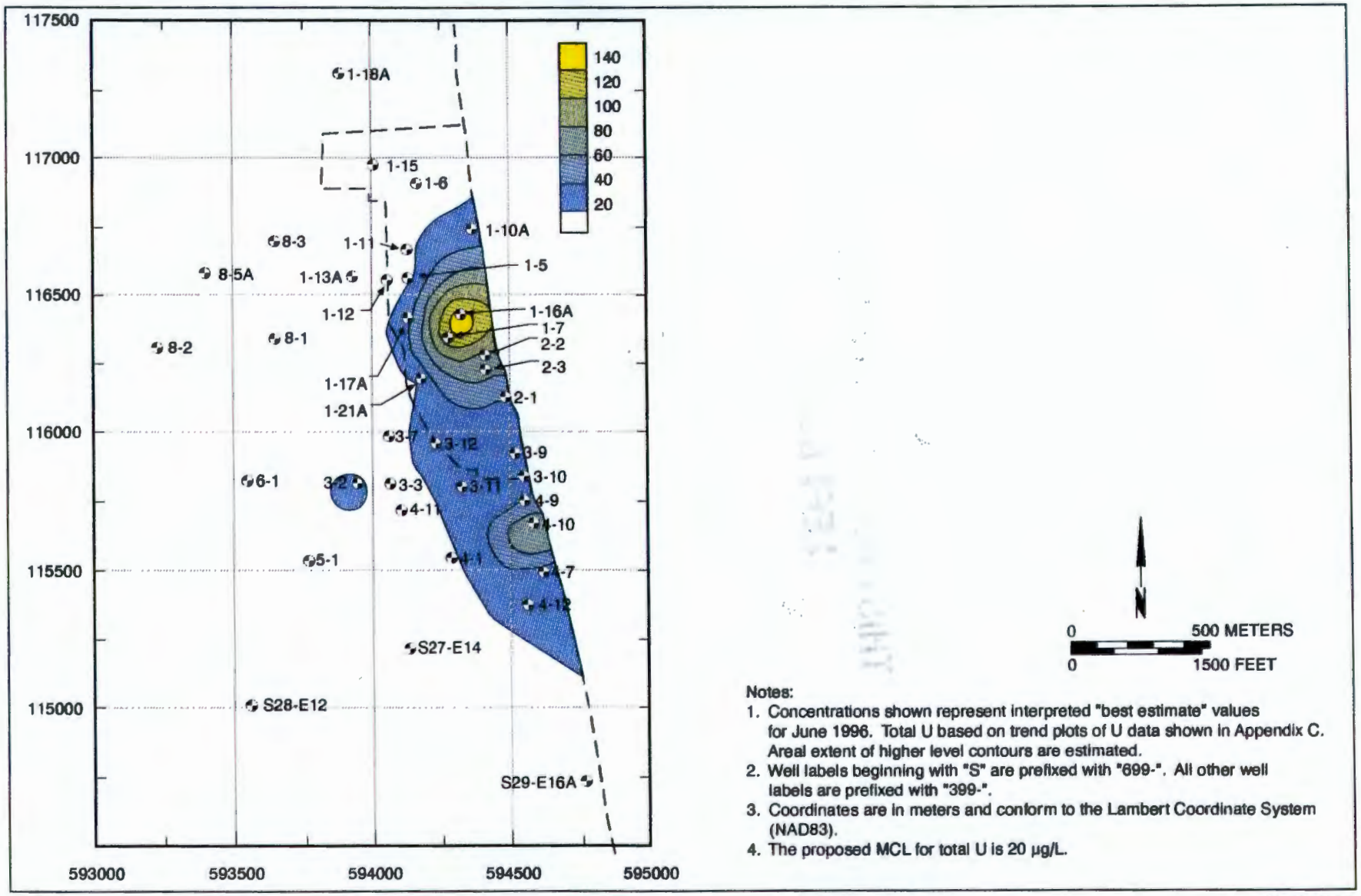

Notes:
1. Concentrations shown represent interpreted "best estimate" values for June 1996. Total U based on trend plots of U data shown in Appendix C. Areal extent of higher level contours are estimated.
2. Well labels beginning with "S" are prefixed with "699-". All other well labels are prefixed with "399-".
3. Coordinates are in meters and conform to the Lambert Coordinate System (NAD83).
4. The proposed MCL for total U is 20 µg/L.

E9412068.5

Figure 4-5. Total U Contours for June 1996 (Conceptual).

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Table 4-1. Summary of Hydraulic Conductivity Data for the Unconfined Aquifer. (3 sheets)

Source Reference	Wells Utilized in Analysis	Formation (or Interpreted Hydrofacies)	Reported Transmissivity, ft^2/d	Reported or Calculated Hydraulic Conductivity, ft/d	Comments
Spane (1991) and Schalla et al. (1988)					Spane (1991) consists of an evaluation of the "acceptability" of the data reported by Schalla et al. (1988)
	399-1-14	Hanford	190,000	**10,000**	Reported "Slight Level of Uncertainty"
Swanson et al. (1992)					multiple-well tests, wells located along western perimeter of operable unit. Various analytical approaches.
	699-S27-E9T	Upper Ringold	4100	**120**	
	699-S22-E9T	Upper Ringold	2900	**160**	
Spane (1994)	699-S22-E9T	Upper Ringold	2600-2700	NR	re-analysis of data presented in Swanson et al. (1992). Re-analysis produced very comparable results.
DOE-RL (1992a)					used Ferris Method to calcuate aquifer diffusivity (transmissivity/specific yield). K values calculated here assume b=80 ft, and Sy=0.2.
	399-1-2, 399-1-7	Hanford (U. Ringold)	1.24E06-4.44E06	3100-11,100	K calculated herein assuming b=80 ft and Sy=0.2
	399-3-12, 399-3-9	Hanford (U. Ringold)	1.15E05-1.46E07	300-36,000	K calculated herein assuming b=80 ft and Sy=0.2
	399-4-1, 399-4-9	Hanford (U. Ringold)	3.37E-5-2.32E07	850-58,000	K calculated herein assuming b=80 ft and Sy=0.2
	Composite of all the wells			3300-17,000	K calculated herein assuming b=80 ft and Sy=0.2

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Table 4-1. Summary of Hydraulic Conductivity Data for the Unconfined Aquifer. (3 sheets)

Source Reference	Wells Utilized in Analysis	Formation (or Interpreted Hydrofacies)	Reported Transmissivity, ft^2/d	Reported or Calculated Hydraulic Conductivity, ft/d	Comments
Gaylord and Poeter (1991)					re-analysis of previous pumping test data from Schalla et al. (1988). K values determined for open interval of well, the facies only, and for the entire saturated thickness.
	399-1-18A	Gravel facies	NR	80,000	open interval
			NR	40,000	Facies
			NR	20,000	Entire saturated thickness
	399-1-13	Sandy Gravel facies	NR	8,000	open interval K
			NR	10,000	Facies
			NR	2,000	Entire saturated thickness
	399-1-16A	Sand facies	NR	1,000	open interval
			NR	200	Facies
Gaylord and Poeter (1991) (Cont.)			NR	200	Entire saturated thickness
Bierschenk (1959)					used Ferris Method (analysis of cyclic fluctuations in wells and Columbia River) to calculate estimated K values in several 100 Area wells. K values shown here were calculated assuming b=80 ft.
	699-60-60	Hanford	300,000	3700	K calculated herein assuming b=80 ft
	699-61-66	Hanford	300,000	3700	K calculated herein assuming b=80 ft
	699-65-72	Hanford	300,000	3700	K calculated herein assuming b=80 ft
	699-63-90	Hanford	300,000	3700	K calculated herein assuming b=80 ft

Table 4-1. Summary of Hydraulic Conductivity Data for the Unconfined Aquifer. (3 sheets)

Source Reference	Wells Utilized in Analysis	Formation (or Interpreted Hydrofacies)	Reported Transmissivity, ft^2/d	Reported or Calculated Hydraulic Conductivity, ft/d	Comments
	699-66-103	Hanford	300,000	3700	K calculated herein assuming b=80 ft
	699-57-29	Hanford	80,000	1,000	K calculated herein assuming b=80 ft
	699-62-32	Hanford	100,000	1200	K calculated herein assuming b=80 ft
	399-3-2	Hanford (U. Ringold)	430,000	5400	Pumping test. K calculated here assuming b=80 ft.
	399-3-6	Hanford (U. Ringold)	850,000	11,000	Pumping test. K calculated here assuming b=80 ft.
	399-3-7	Hanford (U. Ringold)	1,500,000	19,000	Pumping test. K calculated here assuming b=80 ft.

Notes:
Only values reported for wells which monitor the upper portions of the unconfined aquifer.
NR - Not Reported.
Reported K values are indicated in bold. Values calculated herein are shown in plain text.
b = aquifer saturated thickness
k = hydraulic conductivity
Sy = specific yield

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Table 4-2. Columbia River Data Screening.

Constituents Detected	Sample Location[a]	Units	Maximum Concentration Detected	Qualifier	Background Concentration[e]	Minimum RBC[b,d]	Minimum ARAR Screening Level[c]
RADIONUCLIDES							
Uranium	SP9	µg/L	0.501*		.438	.163	2
INORGANICS							
Aluminum	SP6	µg/L	1120*		20-130	1600	5
Barium	SP6	µg/L	47.4	B	0-200		
Cadmium	SP9	µg/L	2	B	<1-2		
Calcium	SP6	µg/L	21,000		16,000-21,000		
Copper	SP9	µg/L	7.2	B	0-180		
Iron	SP6	µg/L	1860*		40-520		30
Magnesium	SP6	µg/L	4940	B	3400-5400		
Manganese	SP6	µg/L	77.8*		0-20	8	5
Sodium	SP11	µg/L	2620	B	1600-3000		
Vanadium	SP9	µg/L	12.5*	B	NR	11.2	-
Zinc	SP6	µg/L	75		10-90		

[a]Sample locations shown in Figure 2-1.
[b]Minimum surface water screening value, assuming ICR=1E-07 and HQ=0.1.
[c]Minimum chemical-specific ARAR value, applicable to surface water, shown in Appendix E. Have assumed screening level of 0.1 of MCL.
[d]Values presented only for those compounds which exceeded background.
[e]From Table 4-10, 300-FF-5 Phase I RI (DOE-RL 1994d).
Note: An asterisk indicates exceedance of other values by the maximum concentration detected. Screening based on unfiltered data for all constituents.
Qualifiers defined in Appendix B.
QA data not used.
NR - Not reported.
RBC - Risk based concentration

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Table 4-3. Rounds 5, 6 and 7 Groundwater Data Screening (Unconfined Aquifer). (3 sheets)

Constituents Detected (Rounds 5, 6, & 7)	Well where Maximum Value Occurred	Round	Units	Maximum Concentration Detected	Qualifier	Background Concentration[e]	Previous Maximum[a]	Minimum RBC[b,d]	Minimum ARAR Screening Level[c]
INORGANICS									
Aluminum	399-1-17A	5	µg/L	66	L	358	1780		
Antimony	399-3-12	7	µg/L	37.7*	B	<16	ND	.64	.6
Arsenic	399-1-18A	6	µg/L	6.2		12.9	13.9		
Barium	399-1-17B 399-2-1	5	µg/L	70		210.4	133		
Bromide	399-1-21A	6	µg/L	100*	L	-	ND	None	-
Calcium	399-1-5	7	µg/L	55,500		70,336	74,400		
Chloride	399-1-17A	6	µg/L	140,000*	D	51,740	26,700	None	25,000
Chromium	399-3-2	7	µg/L	4.5*	B	2.4	10.2	8	10
Cobalt	399-1-17A	6	µg/L	5.8*	L	<3	3.2	96	-
Copper	399-2-1	6	µg/L	4.5*	L	2.6	11.6		
Fluoride	399-1-10B 399-1-14B 399-1-16B	5	µg/L	1,200		1,114	1,300		
Iron	399-1-17B	7	µg/L	450*		420.7	560		
Lead	399-1-17A	7	µg/L	4.1	L	<5.2	5.6		
Magnesium	399-1-18A	5,6,7	µg/L	13,000*		12,912	14,200		
Manganese	399-1-10B 399-1-17A	5 7	µg/L	170		199	224		
Nickel	399-1-16A	5	µg/L	140*		5.3	118	32	10
Nitrate	399-1-18A	5	µg/L	23,000*		13,420	15,600	2,560	4,400
Potassium	399-1-18A	5	µg/L	6,800		6,443	6,880		
Selenium	399-1-12	7	µg/L	3	L	<20	14.1		
Silver	399-3-10	6	µg/L	3.8	L	<5	10		
Sodium	399-1-14B	5	µg/L	53,000*		44,738	64,300		
Sulfate	399-1-10A 399-1-11 399-1-18A	5	µg/L	51,000		75,910	54,000		

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Table 4-3. Rounds 5, 6 and 7 Groundwater Data Screening (Unconfined Aquifer). (3 sheets)

Constituents Detected (Rounds 5, 6, & 7)	Well where Maximum Value Occurred	Round	Units	Maximum Concentration Detected	Qualifier	Background Concentration[e]	Previous Maximum[a]	Minimum RBC[b,d]	Minimum ARAR Screening Level[c]
Tin	399-1-16A	7	µg/L	53*	L	-	ND	960	9600
Vanadium	399-1-18A	7	µg/L	12	L	14.9	16.6		
Zinc	399-2-1	6	µg/L	22*		21	85.6		
ORGANICS									
Chloroform	399-1-17A	6	µg/L	22*		-	18	0.028	7
1,2-Dichloroethylene (cis)	399-1-16B	7	µg/L	130*	D	-	ND	16	7
1,2-Dichloroethylene (total)	399-1-16B	6	µg/L	180*		-	150	16	7
Dichloroethene (trans)	399-1-16B	5	µg/L	150*		-	130	32	10
2,4,5-T	399-1-11	6	µg/L	0.38*	L	-	ND	16	160
2,4,5-TP	399-1-11	6	µg/L	0.36*	L	-	ND	12.8	5
2,4-Dichlorophenoxyacetic acid	399-1-11	6	µg/L	0.91*	L	-	ND	16	7
2-Butanone	399-1-21A	5	µg/L	11*		-	ND	80	480
4,4'-DDD	399-1-17A	5	µg/L	0.002*	L	-	ND	0.0341	.001
Coliform Bacteria	399-1-17A	5	cfu/100 mL	1		-	280		
Delta-BHC	399-1-16A	7	µg/L	.008*	L	-	ND	-	-
Gamma-BHC (Lindane)	399-1-11	7	µg/L	.002*	L	-	ND	.0063	.00002
Endosulfan sulfate	399-1-18A	6	µg/L	0.045*	BL	-	ND	0.08	-
Ethyl Benzene	399-1-16B	7	µg/L	.084*	L	-	ND	160	70
Methylene chloride	399-4-7	6	µg/L	8*	J	-	ND	1.09	0.5
Trichloroethene	399-1-16B	6	µg/L	11		-	14		
Tetrachloroethene	399-1-14A	7	µg/L	0.74		-	4	0.157	0.5

Table 4-3. Rounds 5, 6 and 7 Groundwater Data Screening (Unconfined Aquifer). (3 sheets)

Constituents Detected (Rounds 5, 6, & 7)	Well where Maximum Value Occurred	Round	Units	Maximum Concentration Detected	Qualifier	Background Concentration[e]	Previous Maximum[a]	Minimum RBC[b,d]	Minimum ARAR Screening Level[c]
RADIONUCLIDES									
Gross Alpha	399-1-16A	5	pCi/L	126*		4.3	130		
Gross Beta	399-5-1	5	pCi/L	33*		9.3	110		
Cobalt-60	399-1-17A	7	pCi/L	8.5*		-	3.49	.304	10
Radium	399-1-17B	7	pCi/L	0.179*		-	0.08	0.0381[f]	0.5
Ruthenium-106	399-1-17A	7	pCi/L	55.6*		-	34.4	.481	3
Strontium-90	399-1-17A	6	pCi/L	1.28*		-	4.57		
Technetium-99	399-5-1	5	pCi/L	74*	B	-	65	3.51	90
Tritium	399-1-18A	7	pCi/L	11,300*		-	11,770		
Uranium	399-2-2	7	µg/L	150*		12.9	270		
Uranium-233/234	399-1-7	6	pCi/L	45*		-	120		
Uranium-234	399-1-17A	5	pCi/L	25*		-	120		
Uranium-235	399-1-7	6	pCi/L	7.7*		-	17		
Uranium-238	399-1-7	6	pCi/L	33*		-	93		

[a]Maximum detected value from rounds 1-4.
[b]Minimum risk-based concentration for groundwater ingestion or inhalation of volatiles, assuming ICR=1E-07 and HQ=0.1.
[c]Minimum of chemical-specific ARARs shown in Appendix E. Have assumed screening level of 0.1 of MCL.
[d]Values presented only for whose compounds which exceeded background and/or the previous maxima.
[e]From Table 4-3, 300-FF-5 Phase I RI (DOE-RL 1994d).
[f]Ra-226 used as a surrogate for Total Radium.
Note: An asterisk indicates exceedance of other values by the maximum concentration detected. Screening based on filtered data for metals, unfiltered data for all other constituents.
Qualifiers defined in Appendix B.
QA data not used.
ND - Not detected in rounds 1-4.
NR - Not reported.
RBC - Risk based concentration

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Table 4-4. Rounds 5, 6 and 7 Groundwater Data Screening (Confined Aquifer).

Constituents Detected	Round	Units	Maximum Concentration Detected	Qualifier	Background Concentration[e]	Previous Maximum[a]	Minimum RBC[b,d]	Minimum ARAR Screening Level[c]
ORGANICS								
1,2-Dichloroethylene	5	µg/L	4*	J	-	55		
2-Butanone	7	µg/L	11*		-	ND	80	480
INORGANICS								
Barium	7	µg/L	68.9	B	279	115		
Calcium	7	µg/L	11,900		32,393	30,300		
Magnesium	7	µg/L	4,770	B	12,466	7,360		
Manganese	7	µg/L	35.3		115.1	102		
Potasium	7	µg/L	9750*		6926	10,200		
Sodium	7	µg/L	67,100		77,012	65,100		
RADIONUCLIDES								
Gross Alpha	5	pCi/L	3.1*	J	3	40.8		
Gross Beta	5	pCi/L	8.4		12.7	31.3		
Uranium	5	µg/L	5.8*		0.08	ND	0.163	2.00
Uranium-238	6	pCi/L	0.14*		-	19.61		

[a]Maximum detected value from rounds 1-4.
[b]Minimum risk-based concentration for groundwater ingestion or inhalation of volatiles, assuming ICR=1E-07 and HQ=0.1.
[c]Minimum of chemical-specific ARAR values shown in Appendix E. Have assumed screening level of 0.1 of MCL.
[d]Values presented only for whose compounds which exceeded background/or and the previous maxima.
[e]From Table 4-3, 300-FF-5 Phase I RI (DOE/RL 1994d).
Note: An asterisk indicates exceedance of other values by the maximum concentration detected. Screening based on filtered data for metals and unfiltered data for all other constituents.
Qualifiers defined in Appendix B.
QA data not used.
ND - Not detected in rounds 1-4.
RBC - risk based concentration

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Table 4-5. Rounds 5, 6 and 7 Groundwater Data Screening (Well 399-4-12).

Constituents Detected	Round	Units	Maximum Concentration Detected	Qualifier	Background Concentration[e]	Previous Maximum[a]	Minimum RBC[b,d]	Minimum ARAR Screening Level[c]
INORGANICS								
Antimony	7	µg/L	33.7*	B	<16	ND	.64	.6
Barium	7	µg/L	40.2	B	210.4	45.5		
Calcium	7	µg/L	46,300		70,336	44,500		
Magnesium	7	µg/L	9,200		12,912	8,610		
Potassium	7	µg/L	3,920		6,443	5,010		
Sodium	7	µg/L	17,200		44,738	18,000		
ORGANICS								
Chloroform	5	µg/L	8*	J	-	8		
Trichloroethene	5	µg/L	6*	J	-	7		
RADIONUCLIDES								
Gross Alpha	5	pCi/L	13*	J	4.3	15.2		
Gross Beta	5	pCi/L	9.7*		9.3	17		
Uranium	5 & 6	µg/L	25*		12.9	25		
Uranium-233/234	6	pCi/L	7.5*		-	8.1		
Uranium-235	6	pCi/L	0.55*		-	0.51	0.285	2.9
Uranium-238	6	pCi/L	7.7*		-	8.4		

[a]Maximum detected value from rounds 1-4.
[b]Minimum risk-based concentration for groundwater ingestion or inhalation of volatiles, assuming ICR=1E-07 and HQ=0.1.
[c]Minimum of chemical-specific ARAR values shown in Appendix E. Have assumed screening level of 0.1 of MCL.
[d]Values presented only for those compounds which exceeded background and/or the previous maxima.
[e]From Table 4-3, 300-FF-5 Phase I RI (DOE-RL 1994d).
Note: An asterisk indicates exceedance of other values by the maximum concentration detected. Screening based on filtered data for metals, and unfiltered data for all other constituents.
Qualifiers defined in Appendix B.
QA data not used.
RBC - risk based concentration

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Table 4-6. Contaminant Ranking of Sites Based on Maximum Percentage Solubilities of DNAPL Related Compounds (EPA, 1993).

Ranking by magnitude of groundwater contamination	Maximum percentage solubilities for DNAPL-related compounds in groundwater	Likelihood of subsurface DNAPL
1	No DNAPL compounds, or One DNAPL compound at < 0.1%, or Two at 0.03%, or Three at < 0.01%	Low
2	One DNAPL compound at 0.1% to 1%, or Two at 0.03% to 0.1%, or Three at 0.01% to 0.03%	Low
3	One DNAPL compound at 1% to 3%, or Two at 0.3% to 1%, or Three at 0.1% to 0.3%	Medium
4	One DNAPL compound at 3% to 10%, or Two at 1% to 3% solubility, or Three at 0.3% to 1% solubility	High
5	One DNAPL compound at 10% to 50%, or Two at 3% to 15% solubility, or Three at 1% to 5% solubility	High
6	One DNAPL compound at > 50%, or Two at > 25%, or Three at > 15%	Very High

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5.0 FEASIBILITY STUDY OBJECTIVES AND SCREENING OF REMEDIATION TECHNOLOGIES AND ALTERNATIVES

This section defines site-specific objectives for remediation of the 300-FF-5 Operable Unit, identifies and reports the results of screening remediation technologies and process options, categorizes technologies into remediation alternatives, and reports the results of screening the alternatives. The retained alternatives are further evaluated in Chapter 6.0.

In accordance with EPA guidance (EPA 1988b), an FS is generally conducted in the following steps:

1. Establish remedial action objectives (cleanup goals) for contaminants and media of interest. Base objectives on the findings of the baseline risk assessment and ARARs.

2. Identify the applicable general response actions (e.g., containment, removal, and treatment).

3. Estimate the areas and volumes of contaminated media that exceed remedial action objectives.

4. Identify and screen potentially applicable technologies for each contaminated medium to obtain a set of technologies feasible for use in achieving remedial action objectives.

5. Assemble retained technologies into remediation alternatives that cover the full range of possible response actions. Screen alternatives based on effectiveness, implementability, the ability to avoid or minimize impact to natural resources, and cost to eliminate those that are impractical or not feasible.

6. Further develop and perform a detailed evaluation of the alternatives to support selection of a remedy for the operable unit.

The FS for the 300-FF-5 Operable Unit has been completed in two parts. This section summarizes the following information from the Phase I/II FS (DOE-RL 1994e):

- ARARs and remedial action objectives
- Areas and volumes of contaminated media
- Identification and screening of remediation technologies
- Identification and screening of remediation alternatives.

Refer to the Phase I/II FS for the basis for the material summarized in this chapter. The discussion of ARARs and remedial action objectives has been updated in this report to reflect recent discussion with the regulatory agencies. The development and detailed evaluation of alternatives is presented in Section 6.0.

5.1 DEVELOPMENT OF REMEDIAL ACTION OBJECTIVES

RAOs are developed to establish site-specific remediation goals (cleanup levels). RAOs combine consideration of ARARs with risk-based cleanup levels for the specific contaminants, contaminated media, and potential exposure pathways of the operable unit. For the 300-FF-5 Operable Unit, the primary contaminated medium is groundwater.

The purpose of the 300-FF-5 FS is to develop and evaluate alternatives for remediation of contamination in the 300-FF-5 Operable Unit that has resulted from 300 Area operations. Remediation goals for this operable unit do not include remediation of contaminants migrating into the operable unit from sources outside the 300 Area.

5.1.1 Potential Applicable or Relevant and Appropriate Requirements

This section summarizes potential ARARs for the 300-FF-5 Operable Unit. Section 121 of CERCLA requires that any applicable or relevant and appropriate standard, requirement, criteria, or limitation under federal or state environmental laws and regulations be met for any contaminants that will remain onsite after completion of remedial action. A requirement for Superfund compliance at a hazardous substance cleanup site may be either "applicable" or "relevant and appropriate," but not both. EPA guidance also includes to-be-considered (TBC) standards, which are advisories and non-promulgated guidance issued by federal or state governments that are non-statutory requirements. TBCs may be considered in setting cleanup standards, or may note regulations that, while not currently ARAR, may become ARAR prior to remedial action. Final determination of ARARs will be made by negotiation among DOE, EPA, and Ecology under the Tri-Party Agreement (Ecology et al. 1994).

ARARs are often identified as chemical-specific, location-specific, or action-specific. A number of regulations include requirements in more than one of these three categories.

- Chemical-specific requirements are numerical values for specific chemicals. These numbers can be used to establish the acceptable amount or concentration of a chemical that can be found in, or discharged to, the ambient environment. MCLs established under the Safe Drinking Water Act are one example of chemical-specific ARARs.

- Location-specific requirements are regulations or standards that would apply to site remediation activities based on the location of the action. These regulations are generally intended to protect special or sensitive locations or environments.

- Action-specific requirements place either technology-based or activity-based requirements on remediation activities. For example, RCRA requirements for management of hazardous wastes are action-specific requirements.

Appendix E presents tables of the potential ARARs considered for the 300-FF-5 Operable Unit, based on the identification of ARARs performed in the Phase I/II FS (DOE-RL 1994e). Because MTCA regulations could have particular significance for alternative selection, they are discussed below.

MTCA Regulations

MTCA regulations establish three basic methods of determining cleanup levels for groundwater: Method A (routine, using tables); Method B (standard); and Method C (conditional, primarily for industrial sites). Total excess cancer risk cannot exceed 1×10^{-6} for Method B, and 1×10^{-5} for Method C. Hazard indices for both Method B and Method C cannot exceed 1.0. Method C industrial cleanup levels are most appropriate for use at the 300-FF-5 Operable Unit based on current and projected future land use. For this reason, evaluation of acceptable risk in this FS was taken to be incremental cancer risk less than 1×10^{-5} and a hazard index less than 1.0.

Risk estimation equations for setting Method C cleanup levels are specified in WAC 173-340-720(4). Because these equations were not designed for radionuclides, Ecology and the Washington State Department of Health are re-evaluating the methods for determining cleanup levels for radioactive contaminants under the MTCA. The Washington State Department of Health has published a notice of proposed rulemaking for the development of dose based cleanup standards for cleanup of radiologically contaminated sites under MTCA. Until Ecology promulgates cleanup levels specific to radionuclides, the MTCA Method C cleanup standards apply to only nonradioactive contaminants.

The point of compliance is defined as the point or points where cleanup levels are to be met. Under MTCA regulations, the point of compliance for groundwater is throughout the site. Conditional points of compliance may be set at sites where cleanup levels are based on the protection of surface waters. At these sites, the conditional point of compliance must be set as close as technically possible to the points where groundwater flows into the surface water (before mixing) [WAC 173-340-720(1)(c)(iii)].

The MTCA time frame for groundwater restoration is specified in WAC-173-340-360(6), which states in part:

(6) Restoration time frame.

(a) The cleanup action selected shall provide for a reasonable restoration time frame. The factors to be considered when establishing a reasonable restoration time frame shall include:

(i) Potential risks posed by the site to human health and the environment;

(ii) Practicability of achieving a shorter restoration time frame;

(iii) Current use of the site, surrounding areas, and associated resources that are, or may be, affected by releases from the site;

(iv) Potential future use of the site, surrounding areas, and associated resources that are, or may be, affected by releases from the site;

(v) Availability of alternative water supplies;

(vi) Likely effectiveness and reliability of institutional controls;

(vii) Ability to control and monitor migration of hazardous substances from the site;

(viii) Toxicity of the hazardous substances at the site; and

(ix) Natural processes which reduce concentrations of hazardous substances and have been documented to occur at the site or under similar site conditions.

Waiver of ARAR Compliance

The EPA may waive ARARs and select a remedial action that does not attain the same level of cleanup as identified by ARARs. Section 121 of the SARA identifies the following six circumstances in which EPA may waive ARARs for onsite remedial actions.

- The remedial action selected is only a part of a total remedial action, and the final remedy will attain the ARAR upon its completion.
- Compliance with the ARAR will result in a greater risk to human health and the environment than other alternatives that do not comply with the ARAR.
- Compliance with the ARAR is technically impracticable from an engineering perspective.
- An alternative remedial action will attain an equivalent standard of performance through the use of another method or approach.
- The ARAR is a state requirement that the state has not consistently applied in similar circumstances.
- In the case of Section 104 (Superfund-financed remedial actions) compliance with the ARAR will not provide a balance between protecting human health and the environment and the availability of Superfund money for response at other facilities.

Alternative Concentration Limits

The NCP [40 CFR 300.430(e)(2)(F)] states that alternative concentration limits (ACLs) may be established under CERCLA section 121(d)(2)(B)(ii). If the RI/FS identifies the point of human exposure beyond the boundary of the facility, an ACL may be established if:

- There are known and projected points of entry of such groundwater into surface water.
- On the basis of measurements or projections, there is or will be no statistically significant increase of such constituents from such groundwater in such surface water at the point of entry or at any point where there is reason to believe accumulation of constituents may occur downstream.

- The remedial action includes enforceable measures that will preclude human exposure to the contaminated groundwater at any point between the facility boundary and all known and projected points of entry of such groundwater into surface water then the assumed point of human exposure may be at such known and projected points of entry.

5.1.2 Remedial Action Objectives

The following considerations are important in developing RAOs for the 300-FF-5 Operable Unit for the protection of human health. No ecological contaminants of concern were identified, therefore ecological risk was not included in the development of RAOs.

- Groundwater in the 300 Area contains 300-FF-5 contaminants of concern above MCLs: uranium, nickel, TCE, and DCE. Of these, uranium is the most widespread. TCE and DCE are found above their MCLs only in the vicinity of well 399-1-16B. Nickel is found above its MCL only in groundwater from well 399-1-16A.

- The only current risk above acceptable levels for the operable unit is the cancer risk estimated for industrial use of groundwater from Well 399-4-12 (2×10^{-5}). This estimated risk, however, primarily results from inhalation of chloroform at concentrations considered acceptable for municipal water supply systems. Chloroform in 300 Area groundwater is expected to be remedied when the 300 Area sanitary sewer is connected to the city of Richland sewer system, which is planned for completion by the end of 1994. If chloroform is not included in the risk assessment, the estimated risk is reduced to 1×10^{-6} due to the presence of TCE. Chloroform was eliminated as a CsOPC as discussed in Section 2.5.1.

- The only future exposure pathway for which the risk estimate exceeds 10^{-6} is industrial use of groundwater beneath the 300 Area (estimated as 7×10^{-6}). This level is below 10^{-5}, which is considered acceptable for industrial site use. Tritium and TCE are the major risk drivers for this pathway. Tritium originates from another operable unit, and therefore does not represent incremental risk from the 300-FF-5 Operable Unit. By excluding tritium, which is below MCLs within the operable unit, the risk drops to an ICR of 3×10^{-6} and is attributable to TCE.

- Uranium concentrations are expected to fall below MCLs in an estimated 3 to 10 years (see Section 4.3.4). This estimate assumes sources within the 300-FF-1 and 300-FF-2 Operable Unit have negligible contributions, or are remediated to protect groundwater.

- Unlike uranium concentrations, nickel, TCE, and DCE concentration trends do not show a clear decrease with time. Therefore, although it is expected that these contaminants are being flushed from the aquifer (and/or biodegraded in the case of TCE and DCE) the time required to meet MCLs for these contaminants cannot be estimated. However, the highest current concentrations in monitoring wells are only slightly above their MCLs. Nickel, TCE, and DCE concentrations were all below MCLs in near-shore river water, even under worst-case conditions (low river stage).

- Concentrations of all 300-FF-5 contaminants were at background levels in the Columbia River away from the river's edge, including at the 300 Area and city of Richland water intakes.

Three remedial action objectives have been developed based on these considerations:

- **Limit current human exposure to contaminated groundwater in the 300-FF-5 Operable Unit.** Human exposure to contaminated groundwater, and the associated risk, can be minimized by restricting use of 300 Area groundwater. Therefore, one remedial action objective is to restrict use of and access to contaminated groundwater to the extent necessary to protect human health. Once acceptable concentrations are achieved in the groundwater, groundwater restriction will no longer be necessary. Current site controls already restrict access to and use of contaminated groundwater.

- **Achieve acceptable contaminant concentrations in groundwater by the year 2018.** One goal of the Tri-Party Agreement is to complete remediation of the Hanford Site by 2018. To meet this goal for the 300 Area (specifically the 300-FF-5 Operable Unit) residual contaminant levels should be acceptable for unrestricted use of groundwater for industrial land use. It is highly unlikely that site controls would be removed before this time.

- **Comply with ARARs to the maximum extent practical.** CERCLA requires considering ARARs in remedy selection. One potential ARAR, Washington State MTCA regulations, specifically addresses discharge of contaminants from groundwater into surface water. If MTCA is determined to be an ARAR, under the industrial future land-use scenario, the selected alternative should either comply with the substantive requirements under MTCA or meet the requirements for an ARAR waiver.

Remedial action objectives for the 300-FF-5 Operable Unit do not include remediation of contamination from sources originating outside the 300 Area. Any contamination not resulting from 300 Area operations is addressed by other operable units.

5.1.3 Preliminary Remediation Goals

Preliminary remediation goals are numeric expressions of RAOs. A remediation goal is the maximum acceptable concentration of a contaminant of concern to which the human or ecological receptors would be exposed via a specified exposure route (e.g., direct contact) under a specified exposure scenario (e.g., industrial land use). Remediation goals are generally established for contaminants of concern as the lower of a numeric chemical-specific ARAR or a risk-based cleanup concentration. Tables 5-1 and 5-2 present acceptable groundwater concentrations of contaminants for radionuclides and nonradionuclides, respectively. The preliminary remediation goals are selected from these two tables and presented in Table 5-3. Remediation goals are not developed for contaminants associated with two upgradient plumes (e.g., a tritium plume and a ^{99}Tc and nitrate plume) because these contaminants are not a result of 300 Area operations and will be addressed as part of other operable units. In addition, preliminary remediation goals are not necessary for contaminants with maximum concentrations already below acceptable levels (e.g., ^{90}Sr). The ^{99}Tc and

nitrate plume is addressed in the 1100 Area ROD (Ecology et al. 1993) with a preferred alternative of natural attenuation and monitoring. The large areal extent of the tritium plume, its multiple sources located outside the 300-FF-5 Operable Unit, and the lack of any commercially available treatment technology poses a difficult remediation problem that is being addressed under the Sitewide Groundwater Remediation Strategy (DOE-RL 1994c).

5.2 AREAS AND VOLUMES OF CONTAMINATED MEDIA

Groundwater is the primary medium that contains contaminant concentrations above potential ARARs. Near-shore surface water (i.e., the Columbia River) also exhibits contaminant concentrations above potential ARARs at low river stage. Under other river stages and elsewhere in the river (e.g., the water intakes for the 300 Area and city of Richland), concentrations of 300-FF-5 contaminants are at background levels. Contaminant levels in riparian sediments were below risk-based and regulatory screening levels. The sediment exposure pathway was therefore eliminated from the risk assessment (DOE-RL 1994d). Estimated areas and volumes of contaminated media are presented in Table 5-4. The areas and volumes of contaminated groundwater were based on concentration contours for total uranium, as shown in Figure 5-1. Uranium is a suitable indicator parameter for radionuclide contaminants (i.e., remediation based on uranium cleanup goals will achieve cleanup goals for the other contaminants).

The volume of impacted aquifer soils for radionuclides is based on the upper 6 m (20 ft) of the aquifer because these contaminants have only been detected in the upper portions of the unconfined aquifer. The volume of impacted soils associated with trichloroethene contamination represents only the lower 5 m (16 ft) of the aquifer because has been found primarily in the lower portions of the unconfined aquifer.

As discussed in Section 4.3.4, natural flushing is expected to reduce uranium concentrations in 300 Area groundwater below preliminary remediation goals in between 3 and 10 years. This estimate assumes negligible continuing contributions of contaminants from 300-FF-1 and 300-FF-2 sources to the groundwater, either because current contributions are negligible or because source control remedial actions have been implemented. This estimate has a number of uncertainties, but the probability is high that groundwater will return to a useable quality before the year 2018, the earliest date in which DOE might release control of the Hanford Site. Nickel, TCE, and DCE may remain above MCLs longer than uranium; however, these contaminants are above MCLs only in the vicinity of well cluster 399-1-16.

Because of the time required for natural flushing to occur, remediation goals may be achieved by relatively passive methods (i.e., institutional controls) or by active remediation (i.e., containment or recovery and treatment). Active remediation may be implemented for all groundwater not meeting remediation goals or the portion of the plume with the highest concentrations. Natural flushing may be relied upon for remediation of any remaining contamination. To address these various degrees of active remediation, two categories of active remedial alternatives were developed: "extensive" alternatives and "selective" alternatives.

"Extensive" remediation refers to the greatest extent of active remediation that would be performed. Extensive remediation alternatives would be designed to actively remediate all

groundwater with contaminant concentrations above remediation goals. Areas, volumes, and flowrates for extensive remediation were based on the MCL for total uranium of 20 μg/L (see Figure 5-1 for the 20 μg/L contour).

"Selective" remediation refers to a significantly lesser extent of active remediation than "extensive" remediation, allowing natural flushing of remaining contaminated areas. For the purposes of the FS, it was assumed that the selective remediation area would be defined by the 80 μg/L contour for total uranium (see Figure 5-1). This "selective" remediation area also encompasses the nickel, TCE, and DCE plumes that are above MCLs. Selective remediation alternatives are included in this FS to allow consideration of relatively cost-effective remediation, should groundwater containment or treatment be required. The action level for selective remediation would be selected to provide containment and treatment of most of the mass of contaminants within practical limits. The 80 μg/L level used in this FS is intended to illustrate the concept of selective remediation; the actual cleanup level would be subject to negotiation under the Tri-Party Agreement (Ecology et al. 1994).

5.3 IDENTIFICATION AND SCREENING OF REMEDIATION TECHNOLOGIES

Identification and screening of remediation technologies and process options was reported in Section 4 of the Phase I/II FS (DOE-RL 1994e). A comprehensive list of technologies and process options that are potentially applicable to this operable unit was developed to cover the applicable general response actions. The list of technologies was then screened to obtain a refined list of technologies to assemble into remediation alternatives for the operable unit. The technology screening is summarized in Table 5-5.

Remediation technologies were identified for the following general response actions:

- No action
- Institutional controls
- Containment
- Removal
- Disposal
- Ex-situ treatment
- In-situ treatment.

Except for "no action," each action represents a category of technologies. The applicable technologies vary depending on the media (e.g., soil or groundwater) and contaminants of concern (e.g., organic compounds or metals).

The remediation technologies and process options were screened using the following criteria:

- **Effectiveness** - The potential effectiveness of the technology to (1) address site-specific conditions, including applicability to the media and contaminants of concern for this operable unit, (2) meet remedial action objectives, (3) minimize human health and environmental impacts during implementation, and (4) provide proven and reliable remediation under site conditions.

- **Implementability** - The technical and administrative feasibility of implementing a technology. Technical considerations cover site-specific factors that could prevent

successful use of a technology, such as physical interferences or constraints, practical limitations of a technology, and soil properties. Administrative considerations include the ability to obtain permits and the availability of qualified contractors, equipment, and disposal services.

- **Cost** - The capital, operation, and maintenance costs associated with the technology. At the screening stage, cost is used to reject a technology only if another technology is retained within the same general response action that is at least as effective in achieving remedial action objectives. Because of this limited role, the cost evaluation is based primarily on engineering judgment of relative costs.

Screening of technologies and process options was performed in a single step. The key criterion in selecting the screening level (technology class, individual technology, or process option) is whether there is a significant difference between the technologies or process options when evaluated against the screening criteria (effectiveness, implementability, and cost). Technologies and process options that are judged to have significant differences are screened separately, and the retained technologies or process options will be developed into separate remediation alternatives to allow full evaluation and comparison.

Process options retained for any given technology that are screened together (i.e., not evaluated separately) are considered equally suitable (at the screening level of evaluation). Selection of representative process options is performed during the detailed development of alternatives, so that best engineering judgment may be used to select and combine appropriate technologies and process options into cohesive, integrated remediation alternatives.

5.4 ASSEMBLY AND SCREENING OF REMEDIATION ALTERNATIVES

Assembly and screening of alternatives was reported in Section 5 of the Phase I/II FS (DOE-RL 1994e). Remediation alternatives were developed to achieve the following goals:

- Protection of human health and the environment
- Attainment of ARARs
- Cost-effectiveness
- Satisfaction of the statutory preference for treatment.

To meet these goals, a range of alternatives was developed using the following strategies:

- No action (required by the NCP)

- Limited action (e.g., institutional controls)

- Reduction of potential site risks primarily through containment

- Reduction of potential site risks primarily through removal and treatment of contaminants. Treatment for contaminant destruction is not available for radionuclide contaminants; sludge from groundwater treatment would require disposal.

To address varying degrees of active remediation, two categories of active remedial alternatives were developed: "extensive" alternatives and "selective" alternatives (see Section 5.2 and Figure 5-1). The following initial list of alternatives was assembled for the 300-FF-5 Operable Unit.

Alternative 1	No Action
Alternative 2	Institutional Controls
Alternative 3	Selective Hydraulic Containment
Alternative 4	Selective Hydraulic Containment with In-Situ Flushing
Alternative 5	Extensive Hydraulic Containment
Alternative 6	Extensive Hydraulic Containment with Selective In-Situ Flushing
Alternative 7	Selective Slurry Wall Containment
Alternative 8	Selective Slurry Wall Containment with Minimal Extraction
Alternative 9	Selective Slurry Wall Containment with In-Situ Flushing
Alternative 10	Extensive Slurry Wall Containment
Alternative 11	Extensive Slurry Wall Containment with Minimal Extraction
Alternative 12	Extensive Slurry Wall Containment with Selective In-Situ Flushing
Alternative 13	Selective Hydraulic Containment with a River Cutoff Wall
Alternative 14	Selective In-Situ Flushing with a River Cutoff Wall
Alternative 15	Selective Aquifer Dredging
Alternative 16	Extensive Aquifer Dredging

A summary of the screening-level evaluation of these alternatives is presented in Table 5-6. The following alternatives were not retained in the Phase I/II FS for the stated reasons:

- Alternative 6 (Extensive Hydraulic Containment with Selective In-Situ Flushing) was not retained because of the difficulties of implementation associated with effectively and reliably operating hydraulic containment and in-situ flushing for the extensive remediation area. Alternative 5 (Extensive Hydraulic Containment) would eventually achieve the same remediation goals and would be simpler to operate.

- The slurry wall alternatives with no groundwater extraction (Alternatives 7 and 10) were not retained because they do not provide treatment to remove contaminants and because elevated contaminant concentrations inside the slurry wall will remain indefinitely.

- Alternative 12 (Extensive Slurry Wall Containment with Selective In-Situ Flushing) was not retained because Alternative 11 (Extensive Slurry Wall Containment with Minimal Extraction) provides similar effectiveness and is easier to implement and costs less.

- The two river cutoff wall alternatives (Alternatives 13 and 14) were not retained because Alternative 3 (Selective Hydraulic Containment) and Alternative 4 (Selective Hydraulic Containment with In-situ Flushing) would be equally effective and easier to implement and costs less. The decrease in the rate of groundwater extraction (and corresponding decrease in cost) afforded by a river cutoff wall is not expected to be large enough to justify the significant cost of the wall.

- The two excavation alternatives (Alternatives 15 and 16) were not retained because other retained alternatives have equal or better long-term effectiveness, have less short-term risks, and are less disruptive to the environment. Also, the effectiveness of Alternatives 15 and 16 does not justify their poor implementability and very high cost.

Subsequent to the Phase I/II FS report, it was determined that in-situ flushing (Alternatives 4 and 9) could also be screened out. These two alternatives were rejected by comparing them to Alternatives 3 and 8, which also provide active remediation. All four of these alternatives would achieve the same long-term effectiveness; the difference is the length of time required to achieve remediation. It is possible that Alternatives 3 and 8 could achieve remediation goals in a relatively short time, and there is no guarantee that in-situ flushing would achieve remediation goals more quickly. However, in-situ flushing would incur significantly higher capital and operating costs. A change to Table 5-5 from the Phase I/II FS involves grout walls which are retained for this FS as an option to consider for vertical barriers near buildings for stability concerns.

The CERCLA process allows selection of a single representative process option from a technology type to be combined into alternatives for further analysis. While grout walls passed the technology screening along with slurry walls, slurry walls were chosen as the representative process option for the containment type alternatives. Grout walls are no more effective than slurry walls and are generally more costly. The grout walls may be used, however, where buildings or other obstructions prevent the use of slurry walls.

If an active remediation alternative is selected, the progress of aquifer cleanup will be monitored and evaluated. If it then appears that remediation is progressing too slowly, in-situ flushing could be reconsidered as a means of accelerating cleanup. In-situ flushing could be implemented by simply adding wells and treatment equipment to Alternative 3 or 8. Alternatives 4 and 9 were screened out, but in-situ flushing was retained for possible future use if active remediation is selected.

The following alternatives were retained for further development and evaluation in Chapter 6.0.

Alternative 1	No Action
Alternative 2	Institutional Controls
Alternative 3	Selective Hydraulic Containment
Alternative 5	Extensive Hydraulic Containment
Alternative 8	Selective Slurry Wall Containment with Minimal Extraction
Alternative 11	Extensive Slurry Wall Containment with Minimal Extraction.

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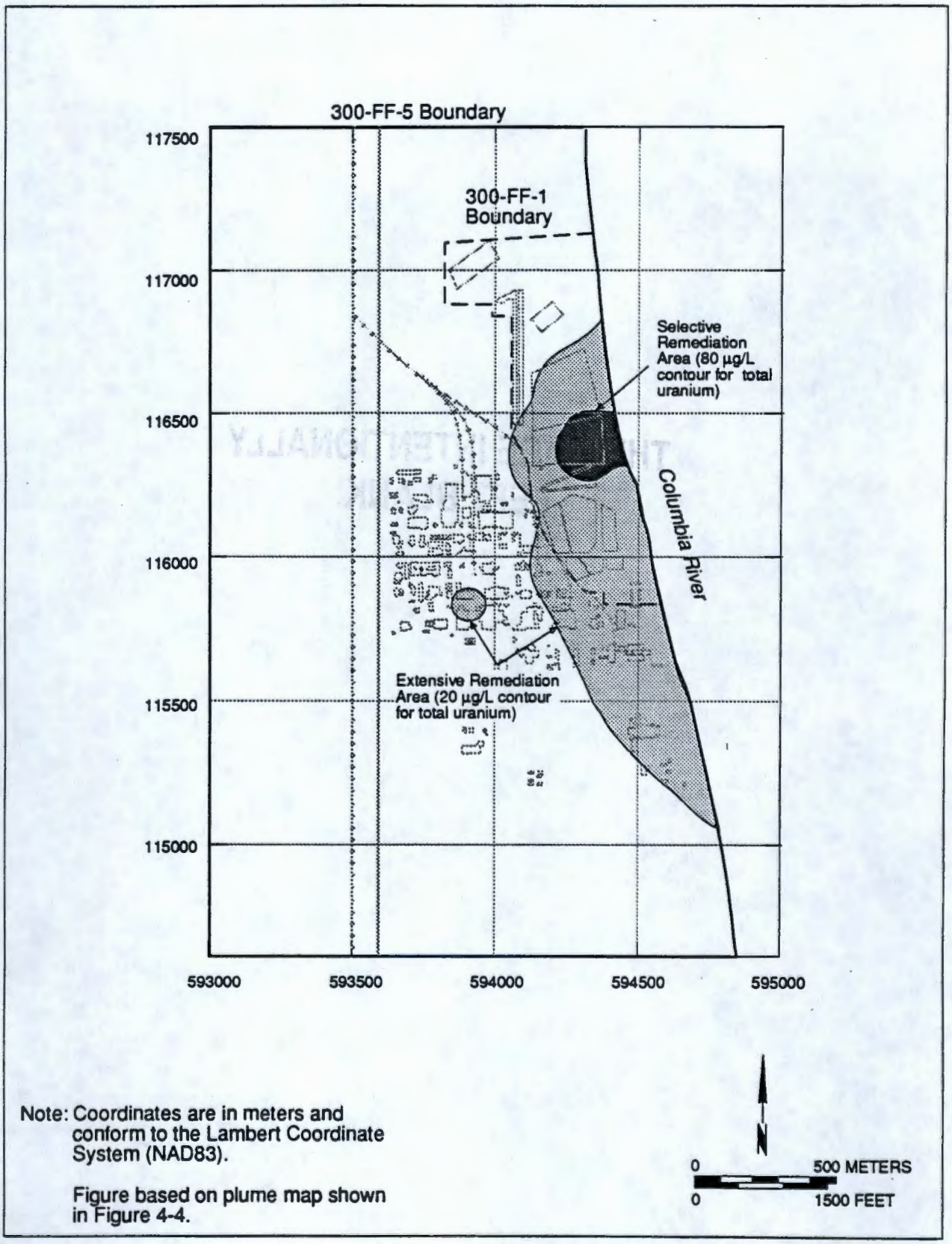

Note: Coordinates are in meters and conform to the Lambert Coordinate System (NAD83).

Figure based on plume map shown in Figure 4-4.

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Figure 5-1. Extensive and Selective Remediation Areas.

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Table 5-1. Acceptable Concentrations for Radionuclides at the 300-FF-5 Operable Unit.

Contaminant		Maximum Groundwater Concentration		Drinking Water 40 CFR 141 (WAC 246-290)	Radiation Protection Standards 10 CFR 20[b] (WAC 246-221)	DOE Order 5400.5[c]	Risk-Based Concentration[d]
		Phase I RI Sampling	Supplemental RI Sampling	Proposed MCL[a]			
U-234	pCi/L	120	25	--	300	20	13
U-235	pCi/L	17	7.7	--	300	24	13
U-238	pCi/L	93	33	--	300	24	7.1
Total Uranium	µg/L	270	150	20	--	--	--

a Proposed MCL (56 FR 33050, July 18, 1991).
b *Concentration Limits for Radionuclides in Liquid Effluent Released to Unrestricted Areas* (10 CFR 20, Appendix B, Table II).
c Based on a dose limit of 4 mrem/yr (effective dose equivalent) for drinking water, assuming ingestion of 2 L/day, 365 days/yr.
d Calculated using HSBRAM industrial scenario parameters for an incremental cancer risk of 10^{-6}, assuming ingestion of 1 L/day, 250 days/yr.
-- Not listed.

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Table 5-2. Acceptable Concentrations for Non-Radioactive Contaminants at the 300-FF-5 Operable Unit.

Contaminant		Maximum Detected Groundwater Concentration		Drinking Water Standards 40 CFR 141 (WAC 246-290)	Washington State Model Toxics Cleanup Act (MTCA, WAC 173-340-720)		Washington State Surface Water Quality Standards (WAC 173-201A)		Risk-Based Concentration[a]
		Phase I RI Sampling	Supplemental RI Sampling	MCL	Method B	Method C	Acute Freshwater	Chronic Freshwater	
		(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)
Nickel		0.12	0.14	0.1	0.32	0.7	0.9[b]	.01[b]	2.0
1,2-Dichloroethene	cis	0.15 (total)	0.18 (total)	0.07	0.08	0.18	--	--	1.0
	trans			0.1	0.16	0.35	--	--	2.0
Trichloroethene		0.014	0.011	0.005	0.004	0.04	--	22	0.006

[a] Calculated using HSBRAM industrial scenario parameters for an incremental cancer risk of 10^{-6} and a hazard index of 1.
[b] Calculated using hardness of 62.5 mg/L or pH of 7.95.
-- Criteria not listed.

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Table 5-3. Preliminary Remediation Goals.

Constituent	Concentration	Basis
1,2-Dichloroethene	0.07 mg/L[a]	MCL
Trichloroethene	0.005 mg/L	MCL
Nickel	0.1 mg/L	MCL
Uranium-234	13 pCi/L	10^{-6} risk (HSBRAM parameters)
Uranium-235	13 pCi/L	10^{-6} risk (HSBRAM parameters)
Uranium-238	7.1 pCi/L	10^{-6} risk (HSBRAM parameters)
Uranium, total	20 μg/L	Proposed MCL

[a]for cis-1,2-DCE

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Table 5-4. Areas and Volumes for 300-FF-5 Remediation Alternatives.

Parameter		Selective Remediation	Extensive Remediation
Area of contamination[a]	m^2	50,000	558,000
	ft^2	540,000	6,000,000
Volume of contaminated aquifer soil[b]	m^3	300,000	3,348,000
	yd^3	392,000	4,380,000
Volume of contaminated groundwater[c]	m^3	90,000	1,004,400
	MM gal[d]	24	265
Length of contaminant plume along river	m	200	1,700
	ft	650	5,600

[a]Based on total uranium concentration contours: 80 μ/L for selective and 20 μ/L for extensive.
[b]One pore volume, assuming 6 m (20 ft) of contaminated saturated thickness.
[c]Assuming a porosity of 0.3.
[d]Million gallons.

Conversion Factors:

1 m = 3.28 ft
1 m^2 = 10.76 ft^2
1 m^3 = 1.31 yd^3
1 m^3 = 264 gal

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Table 5-5. Summary of Screening of Remediation Technologies and Process Options. (3 sheets)

Technology/Process Option	Screening Comments	Retained (Yes/No)
Institutional Controls and Monitoring	Effective and feasible. Groundwater monitoring is a necessary component of all alternatives.	Yes
Containment		
Horizontal Barriers	Not necessary because existing aquitard serves as a horizontal barrier.	No
Vertical Barriers		
Slurry Walls	Proven and feasible technology.	Yes
Grout Walls		
Grout Injection	Less effective and more costly than slurry walls.	Yes
Deep Soil Mixing	No more effective than slurry walls but more expensive.	Yes
Sheet Piling	Not implementable under site conditions; less effective than slurry walls.	No
Cryogenic Walls	Less established and more expensive than slurry walls.	No
Hydraulic Containment	Feasible.	Yes
Removal		
Groundwater Extraction		
Wells	Established and feasible.	Yes
Interceptor Trenches	Established and feasible.	Yes
Aquifer Soil Dredging/Excavation		
Excavation with Dewatering	Well-developed and feasible.	Yes
Mechanical Dredging	Well-developed and feasible.	Yes
Hydraulic Dredging	May not be effective for the large cobbles present in aquifer soils.	No
Disposal		
Treated Groundwater		
Surface Water Discharge	Feasible.	Yes
Subsurface Discharge	Feasible.	Yes
Sludge and Soils		
Onsite Disposal	Disposal facility in 200 Area is planned.	Yes
Offsite Disposal	Less preferred under CERCLA guidance than onsite disposal; no regional offsite facility available for low-level radioactive waste.	No

Table 5-5. Summary of Screening of Remediation Technologies and Process Options. (3 sheets)

Technology/Process Option	Screening Comments	Retained (Yes/No)
Ex-Situ Treatment of Groundwater		
Gravity Separation	Well-established and feasible.	Yes
Filtration	Well-established and feasible.	Yes
Ion Exchange	Established technology; effective for low concentrations of metals and uranium.	Yes
Reverse Osmosis	Effective for concentrating metals in wastewater.	Yes
Ultrafiltration	Limited to removal of compounds with very high molecular weights.	No
Membrane-Based Coupled Transport	Technology still in development phase.	No
Electrodialysis	More expensive and less established than ion exchange and reverse osmosis.	No
Freeze Crystallization	More expensive and less established than ion exchange and reverse osmosis.	No
Evaporation/Distillation	More expensive and less established than ion exchange and reverse osmosis.	No
Electrolysis	More expensive and less established than ion exchange and reverse osmosis.	No
Precipitation	Effective treatment method for secondary waste streams.	Yes
Air Stripping	Effective for removal of volatile organic compounds.	Yes
Carbon Adsorption	Effective for removal of organic compounds.	Yes
Enhanced Oxidation	Concentrations of organic compounds too low to be effective; not applicable to metals and radionuclides.	No
Chemical Oxidation/Reduction	More expensive than other effective technologies.	No
Biological Treatment	Not established for treatment of chlorinated organic compounds; not effective for metals.	No
Thermal Treatment	Only removes organic compounds; too expensive for low concentrations.	No

Table 5-5. Summary of Screening of Remediation Technologies and Process Options. (3 sheets)

Technology/Process Option	Screening Comments	Retained (Yes/No)
Ex-Situ Treatment of Aquifer Soils	Ex-situ treatment technologies for aquifer soils are presented in the 300-FF-1 FS. Treatment technologies for ex-situ treatment of aquifer soils would be limited to those retained for 300-FF-1 soils.	
In-Situ Treatment		
Vapor Extraction	Not feasible for volatile organic compounds found at the base of the aquifer.	No
In-situ Flushing	Potentially effective and feasible.	Yes
In-situ Precipitation/Fixation	Unproven technology for in-situ application.	No
In-situ Biological Treatment	Effectiveness unproven for in-situ treatment of chlorinated compounds and not effective for metals or radionuclides.	No

Note: Grout walls were eliminated in the Phase I/II FS but are retained in this FS as an option to consider for vertical barriers near buildings, for stability concerns.

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Table 5-6. Summary of Screening of Remediation Alternatives. (4 sheets)

Alternative No.	Name	Description	Effectiveness	Implementability	Cost	Retained (Yes/No)
1	No Action	1. Perform long-term performance monitoring as required by CERCLA. 2. Discontinue monitoring when groundwater quality meets remediation goals.	Low: Exposure not prevented; natural recovery expected to result in attainment of remediation goals in a reasonable timeframe.	Good: No action required	Low (monitoring costs only)	Yes
2	Institutional Controls	1. Implement institutional controls and monitoring for groundwater. 2. Continue institutional controls and monitoring until groundwater quality meets remediation goals.	Moderate: Exposure prevented; natural recovery expected to result in attainment of remediation goals in a reasonable timeframe.	Good: Most controls already in place.	Low	Yes
3	Selective Hydraulic Containment	1. Extract groundwater from the selective remediation area. 2. Treat recovered groundwater to achieve an effluent quality suitable for reinjection. 3. Reinject treated groundwater to decrease onsite migration of contaminants from other areas (e.g., tritium and technetium). 4. Implement institutional controls and monitoring for groundwater. 5. Continue groundwater extraction, institutional controls, and monitoring until groundwater quality meets remediation goals.	Moderate: Removes and treats highly-contaminated groundwater (accelerates natural recovery process).	Good: Common technology.	Moderate	Yes
4	Selective Hydraulic Containment with In-Situ Flushing	1. Inject a solution to leach uranium from the aquifer soils in selective remediation area. 2. Extract groundwater to recover the leaching solution and provide hydraulic isolation (containment) of groundwater. 3. Treat the recovered groundwater to achieve an effluent quality suitable for reinjection. 4. Implement institutional controls and monitoring for groundwater. 5. Continue leaching, extraction and treatment, institutional control, and monitoring until groundwater quality meets remediation goals.	Moderate: Removes and treats highly-contaminated groundwater (accelerates natural recovery); benefits of in-situ flushing are uncertain.	Moderate: Uranium flushing technology is untested and may be relatively complex to operate.	Moderate	No
5	Extensive Hydraulic Containment	1. Extract and reinject groundwater to hydraulically contain contaminant migration into the Columbia River where the groundwater concentration of uranium exceeds the MTCA Method B cleanup level. 2. Treat recovered groundwater to achieve an effluent quality suitable for reinjection. 3. Reinject treated groundwater to decrease onsite migration of contaminants from other areas (e.g., tritium and technetium). 4. Implement institutional controls and monitoring for groundwater. 5. Continue groundwater extraction and treatment, institutional controls, and monitoring until groundwater quality meets remediation goals.	High: Prevents release of contaminants above MTCA Method B standards to Columbia River. May accelerate contaminant migration from off-site.	Moderate: Difficult to implement and operate reliably because of river stage interactions.	High	Yes

Table 5-6. Summary of Screening of Remediation Alternatives. (4 sheets)

Alternative No.	Name	Description	Effectiveness	Implementability	Cost	Retained (Yes/No)
6	Extensive Hydraulic Containment with Selective In-Situ Flushing	1. Extract and reinject groundwater in the extensive remediation area. 2. Extract groundwater to recover the leaching solution and provide hydraulic isolation (containment) of groundwater. 3. Treat the recovered groundwater to achieve an effluent quality suitable for reinjection. 4. Implement institutional controls and monitoring for groundwater. 5. Continue leaching, extraction and treatment, institutional control, and monitoring until groundwater quality meets remediation goals.	High: Prevents release of contaminants above remediation goals. May accelerate contaminant migration from off-site. Faster remediation than Alternative 5.	Difficult: Difficult to implement and operate reliably because of river stage interactions and complexities associated with the in-situ flushing system.	High	No
7	Selective Slurry Wall Containment	1. Install a slurry wall around the selective remediation area. 2. Implement institutional controls and monitoring for groundwater. 3. Continue institutional controls and monitoring indefinitely.	Low: Reduces mass flux rate into the river but does not actively remove contamination.	Moderate: Some construction difficulties for slurry wall.	Moderate	No
8	Selective Slurry Wall Containment with Minimal Extraction	1. Install a slurry wall around the selective remediation area. 2. Extract sufficient groundwater to ensure no outward leakage through containment (i.e., to provide an inward gradient). 3. Treat extracted groundwater to achieve an effluent quality suitable for reinjection. 4. Reinject treated groundwater outside the slurry wall. 5. Implement institutional controls and monitoring for groundwater. 6. Continue groundwater extraction and treatment, institutional controls, and monitoring until groundwater quality meets remediation goals.	High: Removes and treats highly-contaminated groundwater (accelerates natural recovery process).	Moderate: Some construction difficulties for slurry wall; more complex than slurry wall alone	Moderate	Yes
9	Selective Slurry Wall Containment with In-Situ Flushing	1. Install a slurry wall around the selective remediation area. 2. Inject a solution to leach uranium from the contained aquifer soils. 3. Extract groundwater to recover the leaching solution and provide hydraulic isolation (containment) of groundwater. 4. Treat recovered groundwater to achieve an effluent quality suitable for reinjection. 5. Implement institutional controls and monitoring for groundwater. 6. Continue leaching, extraction and treatment, institutional control, and monitoring until groundwater quality meets remediation goals.	High: Removes and treats highly-contaminated groundwater (accelerates natural recovery); benefits of in-situ flushing are uncertain.	Difficult: Some construction difficulties for slurry wall; uranium flushing technology is untested and may be relatively complex to operate.	Moderate	No
10	Extensive Slurry Wall Containment	1. Install a slurry wall to around the extensive remediation area. 2. Implement institutional controls and monitoring for groundwater. 3. Continue institutional controls and monitoring indefinitely.	Low: Reduces mass flux rate into the river but does not actively remove contamination.	Moderate: Some construction difficulties for slurry wall.	High	No

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Table 5-6. Summary of Screening of Remediation Alternatives. (4 sheets)

Alternative No.	Alternative Name	Description	Effectiveness	Implementability	Cost	Retained (Yes/No)
11	Extensive Slurry Wall Containment with Minimal Extraction	1. Install a slurry wall to around the extensive remediation area. 2. Extract sufficient groundwater to ensure no outward leakage through containment (i.e., to provide an inward gradient). 3. Treat extracted groundwater to achieve an effluent quality suitable for reinjection. 4. Reinject treated groundwater outside the slurry wall. 5. Implement institutional controls and monitoring for groundwater. 6. Continue groundwater extraction and treatment, institutional controls, and monitoring until groundwater quality meets remediation goals.	Very High: Removes and treats groundwater with contaminant levels above remediation goals (accelerates natural recovery process).	Moderate: Some construction difficulties for slurry wall; more complex than slurry wall alone.	High	Yes
12	Extensive Slurry Wall Containment with Selective In-Situ Flushing	1. Install a slurry wall around the extensive remediation area. 2. Inject a solution to leach uranium from the contained aquifer soils. 3. Extract groundwater to recover the leaching solution and provide hydraulic isolation (containment) of groundwater. 4. Treat recovered groundwater to achieve an effluent quality suitable for reinjection. 5. Implement institutional controls and monitoring for groundwater. 6. Continue leaching, extraction and treatment, institutional control, and monitoring until groundwater quality meets remediation goals.	Very High: Removes and treats groundwater with contaminant levels above MTCA Method B (accelerates natural recovery process); benefits of in-situ flushing are uncertain.	Difficult: Slurry wall construction may not be feasible; uranium flushing technology is untested and may be relatively complex to operate.	High	No
13	Selective Hydraulic Containment with a River Cutoff Wall	1. Install a slurry wall parallel to the Columbia River to decrease river flow to the groundwater extraction system. 2. Extract and reinject groundwater from the selective remediation area. 3. Treat recovered groundwater to achieve an effluent quality suitable for reinjection. 4. Implement institutional controls and monitoring for groundwater. 5. Continue groundwater extraction, institutional controls, and monitoring until groundwater quality meets remediation goals.	Moderate: Removes and treats highly-contaminated groundwater (accelerates natural recovery process).	Difficult: Construction difficulties for slurry wall; difficult to implement and operate reliably because of river stage interactions.	Moderate	No
14	Selective In-Situ Flushing with a River Cutoff Wall	1. Install a slurry wall parallel to the Columbia River to decrease river flow to the groundwater extraction system. 2. Inject a solution to leach uranium from the aquifer soils in the selective remediation area. 3. Extract groundwater to recover the leaching solution and provide hydraulic isolation (containment) of groundwater. 4. Treat the recovered groundwater to achieve an effluent quality suitable for reinjection. 5. Implement institutional controls and monitoring for groundwater. 6. Continue leaching, extraction and treatment, institutional control, and monitoring until groundwater quality meets remediation goals.	Moderate: Removes and treats highly-contaminated groundwater (accelerates natural recovery process); benefits of in-situ flushing are uncertain.	Difficult: Construction difficulties for slurry wall; difficult to implement and operate reliably because of river stage interactions; uranium flushing technology is untested and may be relatively complex to operate.	Moderate	No

Table 5-6. Summary of Screening of Remediation Alternatives. (4 sheets)

Alternative No.	Alternative Name	Description	Effectiveness	Implementability	Cost	Retained (Yes/No)
15	Selective Aquifer Excavation	1. Demolish surface structures. 2. Extensive remediation of 300-Area soils operable units (300-FF-1, 300-FF-2, and 300-FF-3). Remedial actions for these units cannot include capping or other containment and should consist of unsaturated soil excavation and treatment to be compatible with this 300-FF-5 alternative. 3. Install a slurry wall at the outermost extremity of soil removal (including excavation laybacks). 4. Install a groundwater extraction and treatment system and dewater the excavation. 5. Excavate or dredge aquifer soils in the selective remediation area. Because of upward groundwater flow from the underlying semi-confined aquifer, groundwater treatment would operate continuously during soil removal. 6. Reinject treated groundwater upgradient of the site. 7. Reduce the volume of contaminated soil by soil washing, if feasible. 8. Dispose of contaminated soil in the ERSDF. 9. Backfill the excavation with clean soil.	Moderate: Removes and treats highly-contaminated groundwater (accelerates natural recovery process); provides the quickest remediation; increases short-term risk to human health and the environment by increasing the potential for exposure.	Difficult: Requires excavation of source operable units; generally low implementability.	Very high	No
16	Extensive Aquifer Excavation	1. Demolish surface structures. 2. Extensive remediation of 300-Area soils operable units (300-FF-1, 300-FF-2, and 300-FF-3). Remedial actions for these units cannot include capping or other containment and should consist of unsaturated soil excavation and treatment to be compatible with this 300-FF-5 alternative. 3. Install a slurry wall at the outermost extremity of soil removal (including excavation laybacks. 4. Install a groundwater extraction and treatment system and dewater the excavation. 5. Excavate or dredge aquifer soils in the extensive remediation area. Because of upward groundwater flow from the underlying semi-confined aquifer, groundwater treatment would operate continuously during soil removal. 6. Reinject treated groundwater upgradient of the site. 7. Reduce the volume of contaminated soil by soil washing, if feasible. 8. Dispose of contaminated soil in the ERSDF. 9. Backfill the excavation with clean soil.	Moderate: Removes and treats highly-contaminated groundwater (accelerates natural recovery process); provides the quickest remediation; increases short-term risk to human health and the environment by increasing the potential for exposure.	Difficult: Requires excavation of source operable units; generally low implementability.	Very high	No

6.0 FEASIBILITY STUDY DETAILED ANALYSIS OF REMEDIATION ALTERNATIVES

This section describes in detail the remediation alternatives retained after the initial screening reported in Chapter 5.0. It lists the final alternatives and evaluates each against the seven CERCLA criteria.

The following alternatives were retained after screening (Chapter 5.0), and constitute the final alternatives for detailed development and evaluation.

Alternative 1	No Action
Alternative 2	Institutional Controls
Alternative 3	Selective Hydraulic Containment
Alternative 5	Extensive Hydraulic Containment
Alternative 8	Selective Slurry Wall Containment with Minimal Extraction
Alternative 11	Extensive Slurry Wall Containment with Minimal Extraction

For ease of reference, these six alternatives have been renumbered, and the names have been simplified.

Alternative A	No Action
Alternative B	Institutional Controls
Alternative C	Selective Hydraulic Containment
Alternative D	Extensive Hydraulic Containment
Alternative E	Selective Slurry Wall Containment
Alternative F	Extensive Slurry Wall Containment

This FS presents conceptual design of treatment technologies included in the alternatives. These designs are representative of designs that would be developed during final, detailed design after the remedy is selected. However, because some of the data that would be obtained during final design is not available at this time (e.g., treatability data for groundwater treatment), the final design of the selected alternative could vary from the designs presented here. Several design assumptions were made to fully develop the alternatives for evaluation. These design assumptions illustrate how the technologies would be used in the alternatives. However, the design assumptions used here are not necessarily the same as the design basis that would be used for the final, detailed design.

6.1 DETAILED EVALUATION CRITERIA

CERCLA and the NCP require evaluation of remediation alternatives in terms of nine criteria [40 CFR 300.430(e)(9)]:

- Overall protection of human health and the environment
- Compliance with ARARs
- Long-term effectiveness and permanence

- Reduction in toxicity, mobility, and volume
- Short-term effectiveness
- Implementability
- Cost
- State acceptance
- Community acceptance.

The FS evaluates the alternatives against the first seven criteria. The evaluation against the remaining two criteria, state and community acceptance, is based on state and public comments on the FS and the Proposed Plan and are documented in the ROD for the operable unit. Assessments of natural resources (DOE 1993) and NEPA criteria, per the DOE Secretarial Policy on the NEPA (June 1994), also have been included in the evaluation.

The information used in selecting a preferred alternative is presented in this FS for use by the decision makers. For this site, the decision makers are the signatories to the Tri-Party Agreement (DOE, EPA, and Ecology). Following review of this FS, DOE, EPA, and Ecology will prepare a Proposed Plan identifying the preferred alternative, which is provided with the FS for public review and comment. The final decision will be documented in the ROD for the operable unit.

The seven FS criteria are discussed below. The definitions used are consistent with those in CERCLA and the NCP but have been refined to minimize the overlap of considerations in the criteria. This allows decision makers to consider each criterion independently and minimizes double-counting of criteria. NEPA evaluation criteria are summarized in Section 6.1.8.

6.1.1 Overall Protection of Human Health and the Environment

This criterion addresses the degree to which each alternative is protective of human health and the environment, considering both long-term and short-term risks. Overall protectiveness is a "threshold" criterion in that alternatives that do not achieve adequate protection of human health or the environment are eliminated from further consideration. The ability of the alternatives to achieve remedial action objectives is part of the evaluation for this criterion (as well as part of long-term effectiveness). Environmental protection includes minimizing impacts to natural resources.

For this FS, an alternative is considered to be protective of human health and the environment if the alternative results in groundwater contaminant concentrations following completion of remedial action that are below remediation goals, and/or prevents exposure of human and ecological receptors to groundwater with contaminant concentrations above remediation goals.

This criterion is derived from the evaluation of the other criteria (e.g., long-term effectiveness and permanence, and short-term effectiveness). It is not an independent criterion, but rather a summary of the overall evaluation. Because of this overlap, and because overall protectiveness is a threshold criterion (i.e., minimum requirement), this criterion is evaluated for individual alternatives but not used in comparative evaluation of the alternatives.

6.1.2 Compliance with Applicable or Relevant and Appropriate Requirements

This criterion addresses whether or not the alternative meets ARARs. As with overall protectiveness, compliance with ARARs is a threshold criterion that must be met for an alternative to be selected, unless a waiver is obtained. Several of these ARARs address the protection, restoration, or enhancement of fish and wildlife habitat and other natural resources.

Some alternatives include allowing groundwater concentrations above MCLs to naturally flush from the unconfined aquifer to the Columbia River. However, the concentrations of contaminants in the river do not pose unacceptable risks to human health or the environment. In addition, exposure to contaminated groundwater would be prevented via institutional controls (except for no action). Therefore, all alternatives except Alternative A (No Action) are considered to meet ARARs.

6.1.3 Long-Term Effectiveness and Permanence

This criterion addresses risks remaining at the site after implementation of the remediation alternative has been completed, and the reliability of the alternatives at reducing risks over an extended period of time. Long-term effectiveness can be measured by the degree to which remedial action objectives are met. Permanence involves estimating the longevity of the remedy, (e.g., the life span of institutional controls or containment) and the chances of remedy failure.

Current environmental conditions are assessed against the long-term impacts of the remedial alternatives. In this assessment, consideration is given to whether lasting environmental losses would be incurred for the sake of short-term cleanup gains, including whether environmental restoration options would be precluded if a remedial alternative is implemented. An evaluation of the residual risk to natural resources remaining after conclusion of the remedial activities would be conducted.

Risks during the implementation period are addressed under short-term effectiveness. The period during which natural flushing occurs is covered by short-term effectiveness for Alternative A (No Action) and Alternative B (Institutional Controls). Because of the long time period involved, long-term maintenance and monitoring of slurry wall remedial action (including operation and maintenance of a groundwater extraction and treatment system) are considered under long-term effectiveness. For the other alternatives, where the time to completion of remedial action is short, risks during operation, maintenance, and monitoring of the remedy are considered under short-term effectiveness.

The benefits of treatment options in improving the effectiveness of an alternative are considered under this criterion. The preference for treatment, above and beyond improved effectiveness, is addressed under the treatment criterion (Section 6.1.4).

Long-term effectiveness addresses both residual human health and ecological risk. However, for this site there is no need to evaluate alternatives for these risks separately. The alternatives for this operable unit provide long-term effectiveness by eliminating or controlling pathways of exposure for human health risks in the same manner as ecological risks. Therefore, there would be no difference in the comparative analysis between alternatives if these risks were evaluated separately.

6.1.4 Reduction of Toxicity, Mobility, and Volume through Treatment

This criterion addresses the degree to which a remediation alternative reduces the toxicity of contaminants (e.g., via destruction or detoxification), the ability of contaminants to migrate in the environment, or the quantity of contaminated material. This criterion expresses the preference for treatment under CERCLA. Effectiveness and reliability of the treatment, which are addressed under long-term effectiveness and permanence, are not addressed under this criterion.

Treatment cannot destroy radionuclides, the primary contaminants of concern for this operable unit. However, treatment can remove contaminants from the groundwater for disposal in a secure landfill. Removal of contaminants from groundwater reduces the volume of contaminated groundwater and decreases the mobility of these contaminants in the environment. For the slurry wall containment alternatives (E and F), treatment would also include volume reduction to reduce the volume of soil for landfill disposal.

6.1.5 Short-Term Effectiveness

This criterion addresses short-term effects on human health and the environment while the alternative is being implemented. This criterion also assesses the effectiveness and reliability of mitigative measures taken during remediation to protect the potentially affected environment, such as impacts to sensitive habitats or species. The period during which natural flushing occurs is covered by short-term effectiveness for Alternative A (No Action) and Alternative B (Institutional Controls). Because of the long time period involved, long-term maintenance and monitoring of slurry wall remedial action (including operation and maintenance of a groundwater extraction and treatment system) are considered under long-term effectiveness. For the other alternatives, where the time to completion of remedial action is short, risks during operation, maintenance, and monitoring of the remedy are considered under short-term effectiveness.

All of these short-term factors were considered in the evaluations of the alternatives.

- Risk to the surrounding community (including risks associated with off-normal, credible accidents)
- Risk to site workers (including risks associated with off-normal, credible accidents)
- Risk to Hanford workers outside the operable unit
- Risk to the environment (short-term ecological risk)
- The time required before remedial action objectives are achieved.

Risk to remediation workers is based on the number of workers required, the potential for accidents or exposure during remediation, and the time required to complete the remedial action. The primary differences for the alternatives are based on the extent of handling of contaminated soil and groundwater and the potential for accidents. Estimates of potential accidents and fatalities were made for each alternative. The estimates are based on accident and fatality rates for general construction and manufacturing in the United States (U.S. Department of Labor 1992). Radiation exposure should

be well below acceptable limits, such as the occupational exposure limit in DOE Order 5480.11 of 5 rem/yr total effective dose equivalent. The alternatives have been qualitatively ranked for potential radionuclide exposure based on the relative degree of handling of soil contaminated with radionuclides.

6.1.6 Implementability

This criterion addresses the degree of difficulty in implementing each alternative. Implementability can be subdivided into technical feasibility, administrative feasibility, and availability of services and materials. Implementability issues become more significant as the complexity of the alternative increases and as the reliance on innovative technology increases. Implementability issues are important because they address the potential for delays, cost overruns, and failure.

Known implementation difficulties with quantifiable cost impacts (e.g., need for personal protective gear and associated loss of productivity) are included in the cost estimates. The implementability criterion focuses on less quantifiable known and potential difficulties. Implementability is evaluated considering the following:

- **Technical Feasibility.** Technical feasibility addresses the potential for problems during implementation of the alternative and related uncertainties. The evaluation includes the likelihood of delays resulting from technical problems and the ease of modifying the alternative, if required.

- **Administrative Feasibility.** The degree of difficulty anticipated resulting from regulatory constraints and the degree of coordination required between various agencies.

- **Availability of Services and Materials.** The availability of experienced contractors and personnel, equipment, and materials needed to implement the alternative (e.g., construction of groundwater extraction system). Availability of disposal capacity is also included in the evaluation. However, it was assumed that sufficient disposal capacity would be available on the Hanford Site (i.e., the ERDF).

6.1.7 Cost

This criterion is used to consider the costs of performing each alternative, including capital, operation and maintenance, and monitoring costs. Alternative costs are compared on a net present value basis. Known implementation difficulties that have quantifiable cost impacts (e.g., personal protective gear and associated loss of productivity) are included in the cost estimates.

The cost estimates are based on the alternative descriptions and design assumptions stated in the descriptions of the alternatives (Sections 6.2 and 6.3). Unit costs are based on typical costs for similar commercial work, adjusted for the unique requirements of the Hanford Site. Unit costs were obtained in 1994 or were adjusted to 1994 from earlier estimates. The cost estimates for the alternatives are presented on a net present value basis. The net interest rate of 5% is the rate recommended by the EPA for FS cost estimates.

EPA guidance suggests a target accuracy of +50% / -30% (EPA 1988b). The cost estimates in this FS were developed to meet this target. However, this accuracy is only good for the specified design assumptions (see Sections 6.2 and 6.3). Changes in design assumptions could result in costs outside the +50% / -30% range. The key uncertainty in these cost estimates is the quantity of groundwater to be treated, in terms of both flow rate and also the time until remediation goals are met. These uncertainties are discussed in Section 6.2.4 and Appendix F. To address the uncertainties in the cost estimates, including the groundwater flow rates, a stochastic (probabilistic) approach was used. The uncertainty/sensitivity analysis for the cost estimates is presented in Appendix G.

6.1.8 National Environmental Policy Act Considerations

In accordance with the DOE Secretarial Policy on the NEPA (June 1994), DOE CERCLA documents must incorporate NEPA values to the extent practicable. This section discusses environmental consequences, including potential impacts, associated with remediation of the 300-FF-5 Operable Unit, many of which are not typically addressed in CERCLA documents. The Council on Environmental Quality NEPA regulations (40 CFR 1502.16) specify that environmental consequences of the proposed action and alternatives must be evaluated. NEPA specifies the following evaluation criteria:

- Direct effects
- Environmental effects of alternatives
- Irreversible and irretrievable commitment of resources
- Urban quality and historic and cultural resources
- Means to mitigate adverse environmental impacts not adequately covered under previous categories
- Energy requirements including conservation potential
- Possible conflicts between the proposed action and objects of local, regional, state, federal, and tribal land use plans, policies and controls for the area
- Unavoidable adverse impacts
- Relationship between short-term uses and the maintenance and enhancement of long-term productivity
- Impacts of connected actions, indirect impacts, and cumulative impacts.

Historical and cultural resources are addressed in Section 6.2.7, and mitigation of adverse impacts is discussed in Section 6.2.8. The remaining NEPA criteria are addressed in Section 6.4.6.

6.2 COMMON DESIGN COMPONENTS

General aspects of remedial action components common to more than one alternative are discussed in this section. These components are monitoring, hydraulic containment, slurry wall containment, flow rate estimation, groundwater treatment, remediation of chlorinated organic compounds, and discharge of treated groundwater. Alternative-specific details of these components are provided in the individual descriptions of the alternatives (Section 6.3). Institutional controls are part of all alternatives except Alternative A (No Action), and are described in Section 6.3.2.1.

6.2.1 Monitoring

Monitoring is included as part of all alternatives, including the "no action" alternative. Separate monitoring programs will be used for the short term (during remedial action) and the long term (following completion of remediation). Detailed monitoring plans will be developed for the selected remedy during final design.

Short-term monitoring is conducted during remediation to (1) ensure that there are no adverse offsite effects from remediation, (2) provide quality control, (3) evaluate the performance of the remedy, and (4) to protect worker health and safety. For Alternative B (Institutional Controls), short-term monitoring would primarily consist of groundwater monitoring to verify the expected rapid decrease in groundwater contaminant concentrations.

Long-term monitoring is conducted to allow timely maintenance of fencing, slurry walls, and other permanent physical components of the alternative. Monitoring of the slurry wall alternatives (E and F) would be included in long-term monitoring because of the extended time frame for completion of groundwater cleanup. The only long-term monitoring anticipated for the other alternatives would be for chlorinated organic compounds (i.e., TCE and DCE) to verify that concentrations of these compounds do not exceed acceptable levels (i.e., MCLs) at any exposure point (i.e., the Columbia River). Radionuclide contaminant concentrations would be below remediation goals before commencement of long-term monitoring for alternatives not involving slurry walls.

Containment would be monitored by routine monitoring of groundwater elevations and by routine but less frequent sampling and analysis for key contaminants. For hydraulic containment alternatives (C and D), monitoring would be frequent (e.g., hourly or daily) during remedial action, and would also include river elevations. Frequent monitoring for hydraulic containment would be needed to adjust for the wide daily variations in river elevation and to adjust pumping rates to optimize the performance of both the hydraulic containment and the treatment system. For slurry wall containment, monitoring could be less frequent (e.g., weekly or monthly) and would not need to include the river. Monitoring of containment would be incorporated into the operation/maintenance/monitoring program for the groundwater extraction and treatment system.

Monitoring of source control remedies (i.e., remediation of waste and contaminated vadose zone soil) is included in the 300-FF-1 and 300-FF-2 Operable Units, and may include groundwater monitoring of residual contamination. The groundwater monitoring programs for these two operable units should be integrated with the monitoring program for the 300-FF-5 Operable Unit to be more comprehensive and cost-effective.

Monitoring would include sampling and analysis of groundwater from well 399-4-12, which is the only current use of or human exposure to 300 Area groundwater. Monitoring will also be conducted of groundwater discharges to the Columbia River to demonstrate that water quality criteria are maintained and that no unacceptable risks are resulting from discharge to the Columbia River. Other water quality monitoring would be performed as necessary to ensure that contaminant concentrations remain below acceptable limits.

6.2.2 Hydraulic Containment

Hydraulic containment would prevent discharge of contaminated groundwater from the 300 Area to the Columbia River by intercepting contaminated groundwater in an extraction system parallel to the river bank. The area of contaminated groundwater to be contained varies with the alternative (see Section 5.2 and Figure 5-1). Extracted groundwater would be pumped from the extraction system to a treatment system (see Section 6.2.6) through collection piping. This piping would be buried at least 1 m (3 ft) below grade to prevent freezing. Because the hydraulic containment relies on active groundwater removal (in contrast to passive containment by a slurry wall), some redundancy in wells, pumps, and controls would be necessary for reliable operation of the system (i.e., to maintain containment during equipment failure).

Remedial action objectives for the 300-FF-5 Operable Unit do not include remediation of contaminants migrating into the 300 Area from sources outside the 300 Area. Groundwater extraction would target only contamination from 300 Area operations. Hydraulic containment would be designed to minimize capture of groundwater from the tritium plume entering the operable unit from the northwest and the technetium-nitrate plume entering from the southwest.

The design and operation of a hydraulic containment system needs to account for dynamic interactions between the 300-FF-5 system and the river, while at the same time minimizing capture of upgradient plumes. The elevation (stage) of the river varies up to 2.4 m (8 ft) daily (Campbell et al. 1993), affecting groundwater elevations. A careful balance would be required to contain contaminated groundwater, minimize onsite migration of contaminants from upgradient plumes, and minimize capture of river water. Groundwater parameters affecting extraction rates are discussed in Appendix F.

With hydraulic containment, contaminant concentrations would fall below remediation goals as the aquifer is flushed. The difference between hydraulic containment and natural flushing (i.e., with the no-action and institutional controls alternatives) is that contaminated groundwater is collected and treated rather than discharged to the Columbia River. The time required for achieving remediation goals with hydraulic containment would be approximately the same as with natural flushing, because the extraction system would be designed for interception rather than for accelerated recovery (the groundwater extraction method is discussed below).

Groundwater Extraction Method

Groundwater extraction could be accomplished using wells or an interception trench. The extracted groundwater would be treated (Section 6.2.6) to remove contaminants to levels acceptable for discharge to the Columbia River. Either approach would be designed primarily to intercept contaminated groundwater before it reaches the river. Attempting to accomplish remediation faster

than natural flushing by pumping more than required for interception would require a major and costly increase in the number of extraction wells and in the treatment system capacity but would only marginally reduce the time until remediation goals are met. Accelerated flushing would not be cost effective in the hydraulic containment alternatives.

For groundwater extraction with wells, the wells would be placed at regular intervals along the river, approximately 30 to 46 m (100 to 150 ft) from the river edge. The wells would be far enough from the river to avoid collection of river water, but close enough to minimize the escape of contaminated groundwater and the volume of groundwater extracted for treatment. This FS assumes a well spacing of 30 m (100 ft).

Figure 6-1 shows the cross-section of a typical extraction well. The screened interval would extend approximately 3 m (10 ft) below the water table. The capture zone of the well would extend below the screened interval, so that the entire depth of contaminated groundwater (estimated to be 6 m [20 ft]) would be captured. Screening the wells for the entire depth of contamination would result in extraction of excessive clean groundwater from below the contaminated zone. A well system would be relatively easy to construct because it uses materials, technologies, and skills readily available at the Hanford Site. Many monitoring wells have already been installed in the 300 Area.

For groundwater extraction using a trench, a perforated collection pipe would be placed in a trench approximately 3 m (10 ft) below the water table (Figure 6-2). The trench would be aligned along the river bank, approximately 50 m (160 ft) from the river's edge, avoiding 300-FF-1 waste units. The collection pipe would be packed in coarse backfill. Excavated aquifer soil should be suitable for this purpose, and its use would avoid the cost of importing clean backfill and the need to dispose of contaminated aquifer soil. The capture zone of the trench would extend below the collection pipe, so that the entire depth of contaminated groundwater (estimated to be 6 m [20 ft]) would be captured. Placing the pipe above the bottom of the contaminated groundwater depth is advisable to avoid extracting excessive quantities of clean groundwater from below the contaminated zone. Pump stations (Figure 6-3) along the trench would transfer the contaminated groundwater from the trench pipe to the groundwater treatment system.

During final design of a hydraulic containment system, additional groundwater sampling and analysis would be performed to determine the exact thickness of the contaminated zone. Pump testing and numerical three-dimensional groundwater modeling would then be used to determine the appropriate screened interval (or collection pipe elevation) to minimize capture of clean water while preventing escape of contaminated groundwater.

Because the extraction wells partially penetrate the unconfined aquifer, the greater the spacing between wells, the higher the pump rate required to achieve the required groundwater capture. A closer well spacing allows less drawdown by the wells, resulting in lower gradients and thus lower extraction rates required to maintain containment. Closer well spacing decreases the capital and operating costs for groundwater treatment. Well spacing would be determined by optimizing the tradeoff between the cost of the extraction system and the cost of the treatment system.

The key advantage of a trench over wells is that it minimizes the groundwater extraction rate for a given capture zone. A trench system would come closer than a well system to the theoretical minimum extraction rate (i.e., to the flow rate of contaminated groundwater without an interception system), resulting in less capital and operating costs for the groundwater treatment system. However,

the trench system would be more expensive to construct than a well system. A preliminary comparison of the total present value cost of well and trench systems (assuming a 6-year period of operation) indicated that the total cost of a trench system would be slightly less than a well system.

Trenching would cause greater environmental disturbance than installing a well system. The excavation for the trench would be 30 to 40 m (100 to 130 ft) wide at the top and approximately 12 m (40 ft) deep. This would disrupt ecological habitat in the immediate vicinity of the trench and would occur near the sensitive riparian zone. Especially for extensive remediation, there would be a significant chance of encountering Native American artifacts that would stop or hinder trench installation. If such cultural resources are found, the cost of working around the resource site(s) could easily cause the trench system cost to exceed the well system cost. Therefore, for this FS, well extraction has been assumed.

6.2.3 Slurry Wall Containment

A slurry wall is used to contain contaminated groundwater by providing a vertical barrier against horizontal groundwater migration. The area of contaminated groundwater to be contained varies with the alternative (see Section 5.2 and Figure 5-1). The slurry wall would key into the Ringold Lower Mud at a depth of approximately 36 m (120 ft), which would provide a bottom for the contained region.

The slurry wall would be constructed by excavating a trench, using a bentonite slurry to keep the trench open, and backfilling the trench with a soil-bentonite mixture. Typically, soils excavated from the trench are used to mix with bentonite for the backfill. However, the very coarse nature of the 300 Area soils would interfere with achieving the necessary permeability of the wall. To achieve the necessary permeability, it was assumed that approximately 50% of the excavated soil would be replaced by imported soil rich in silt and/or clay from nearby sources (e.g., McGee Ranch). Some of the soil from trench excavation (i.e., from the top depths of the unconfined aquifer) could be contaminated to a degree unsuitable for use in trench backfill. Based on soil washing test results for 300-FF-1 (ART 1994), wet screening of any contaminated soil from trench excavation could separate the coarse, relatively clean soil from more contaminated sand and fines. The contaminated sand and fines would be dewatered and disposed in the ERDF or other suitable Hanford disposal site (see Section 6.2.6). The remainder of the soil (e.g., gravel) would have contaminant concentrations below 300-FF-1 remediation goals and would be combined with similar soils from 300-FF-1 remediation for onsite placement as "clean" soil (DOE-RL 1994f). It was assumed that approximately 5% of contaminated soil from trench excavation would require disposal. Water from the wet screening would be stored for treatment in the groundwater treatment system included in the alternative.

The shallow portion of the trench (e.g., to a depth of 3 m [10 ft]) would be excavated by backhoe in advance of the main trench excavation to identify utilities, cultural resources, or other buried materials that would interfere with wall construction and/or require adjusting the wall alignment in the field. An archaeological monitor would be present during all phases of backhoe excavation. The initial trenching would be performed before the main slurry wall equipment is mobilized, or well in advance of the deep excavation, to allow time to make adjustments and thereby avoid costly delays.

Core samples of the wall would be part of the construction quality assurance (CQA) program to verify achievement of the target wall permeability (e.g., 10^{-6} cm/sec). Ongoing performance of slurry wall containment would be monitored by measuring groundwater elevations in piezometers installed inside and outside the slurry wall.

Groundwater would be extracted from within the slurry wall to maintain an inward gradient. The inward gradient would ensure that no contaminated groundwater escapes containment. The extracted groundwater would be treated and discharged. The extraction rate would be the minimum needed to maintain the inward gradient. The upward gradient of the underlying, confined aquifer would ensure that no contamination would migrate downward.

Although this FS refers to the use of a slurry wall, portions of the wall might be constructed using other techniques that result in a low-permeability barrier, such as mixing in place (auger wall construction) or cement-bentonite admix. It is expected that most of the wall would be constructed using the slurry technique, and that other techniques would be used to address difficulties in localized portions of the wall where the slurry technique is not the best approach.

The following difficulties are associated with slurry wall construction:

- The 36.6 m (120 ft) depth required for this operable unit is deep for a slurry wall. However, slurry walls have been constructed to greater depths. Excavation would take place with a backhoe down to a depth of approximately 18.3 m (60 ft); below this depth a crane with a clamshell bucket would be used, which is slower and therefore more expensive.

- Soils in the 300 Area are coarse and highly permeable, which would require a greater quantity of slurry than normal to construct a wall due to slurry losses. However, slurry losses are not expected to be a major difficulty or prevent use of the technique.

- Short jogs in slurry walls are difficult and expensive to make. The active excavation surface is sloped to the depth of the wall and results in a minimum length of wall in any given direction. Short jogs thus result in higher costs because of extra lengths of wall construction. Short jogs would be minimized in the design. However, subsurface boulders that are too large to remove could be encountered. A mix-in-place wall would be considered to install the wall around such boulders.

- Native American artifacts could be encountered during trench excavation (especially for extensive remediation). If such cultural resources are found, the slurry wall alignment would need to avoid the artifact area. Geophysical investigations, pilot excavations, and/or other techniques would be used to identify any such artifacts before wall construction is begun. An archaeological monitor would be present during all phases of trenching operations.

- There are significant difficulties associated with building a slurry wall through the developed portion of the 300 Area, which contains a dense concentration of buildings and buried pipes and utilities. Contaminated soils are also expected to be encountered

during excavation in this area. These concerns only apply to Alternative F (Extensive Slurry Wall Construction), and are discussed in the analysis of that alternative (Section 6.3.6).

Despite the potential difficulties, a slurry wall or other, similar low-permeability vertical wall could be constructed for this operable unit. None of the anticipated difficulties are expected to prevent construction of the barrier wall, although they add significant uncertainty to the cost estimate. Potential difficulties would be addressed in detail during final design of the wall. It could be desirable to build a pilot wall to investigate uncertainties or test the feasibility or cost effectiveness of wall construction.

Slurry wall containment is easier to control and somewhat more reliable than hydraulic containment, because it is basically a passive system. However, hydraulic containment can also be designed to perform reliably. The primary differences between slurry wall containment and hydraulic containment are (1) the time during which contaminant concentrations exceed remediation goals in the contained area, (2) potential difficulties in constructing a slurry wall for this operable unit, and (3) capital and operating costs.

Compared to hydraulic containment, which has much higher extraction rates, wall alternatives would take much longer to achieve remediation goals (i.e., for contaminant concentrations to decrease to below MCLs) within the wall assuming extraction at the minimum rate. The time required to achieve remediation goals is believed to be approximately proportional to the extraction rate. On this basis, the time until contaminant concentrations within the slurry wall drop below remediation goals with slurry walls could exceed 100 years. Therefore, the slurry wall alternatives do not meet the RAO of reducing groundwater concentrations to acceptable levels by 2018. However, contaminants are completely contained within the wall during this time. Because clay soils (including bentonite) have an ion-exchange capacity for adsorption of metals (API 1984), a slurry wall should have some capacity for removal and/or retardation of radionuclides in groundwater passing through the wall. However, because an inward gradient would be maintained by pumping, no contaminated groundwater would pass through the wall. If it were desirable to decrease contaminant concentrations within the wall more rapidly, the extraction rate could be increased (with a corresponding increase in the capital and operating cost of the treatment system). One advantage of the slurry wall is that any extraction rate may be selected because of the passive containment provided by the wall. In contrast, the high extraction rates required for hydraulic containment are driven by aquifer properties.

The cost of constructing a slurry wall would be high. However, because of the much lower flow rates for groundwater treatment (compared to hydraulic containment), the slurry wall cost would offset capital and operating costs of the much larger groundwater treatment system required for hydraulic containment. These costs tradeoffs are shown in the cost estimates for the alternatives. The relative costs of the alternatives are discussed in Section 6.4.5. Detailed cost estimates are presented in Appendix G.

6.2.4 Groundwater Treatment

Several of the remediation alternatives involve extraction and treatment of groundwater. A process flow diagram for a typical groundwater treatment system is shown in Figure 6-4. The capacity (size) of the system will vary between alternatives.

The treatment capacity affects the number and sizes of the system components, which are discussed under the individual alternatives in Section 6.3. This treatment system is representative of treatment processes that should be effective for removing uranium and other metal radionuclides. For final design, treatability studies would be necessary to determine the site-specific effectiveness of, and provide design data for, the various treatment subsystems: filtration, ion exchange, precipitation, clarification, and filter pressing. Tritium cannot be removed by any available treatment method and would pass through this treatment system unaffected. The components of the groundwater treatment system are discussed in the following paragraphs.

Flow Rate Estimates

Flow rates of extracted groundwater were estimated for selective and extensive remediation for hydraulic and slurry wall containment options. These flow rates were used in sizing equipment for extracting and treating contaminated groundwater, and for estimating the costs of the remedial alternatives.

For hydraulic containment, seasonal variation in aquifer gradients and flow must be considered. Transient variations in flow rate (e.g., daily) would be absorbed in influent storage of the groundwater treatment system. However, storage to equalize long-term variations (weekly or longer) would be prohibitively expensive. Therefore, if contaminated groundwater is not to escape (i.e., to the river), the groundwater extraction and treatment system must have the capacity to handle the maximum seasonal flow. It was assumed that escape of groundwater with contaminant concentrations above remediation goals (e.g., 20 μg/L total uranium) would be unacceptable for extensive hydraulic containment (Alternative D). For this reason, the groundwater extraction and treatment system for extensive hydraulic containment was sized to handle the maximum monthly average flow rate (in January).

The flow rate for the maximum month is much greater than the yearly average flow rate, and would result in significantly greater capital cost over a system sized based on yearly average flow. For selective hydraulic containment, escape of some contaminated groundwater (e.g., above 20 μg/L total uranium) is assumed acceptable. Therefore, it was assumed that the extraction and treatment system could be sized for yearly average flow to be more cost effective.

There is significant uncertainty in these flow rate estimates. The uncertainties in the flow rates have been estimated using a stochastic (probabilistic) approach. Figures 6-5 and 6-6 present the resultant probability distribution functions (PDFs), along with the corresponding deterministic estimates, for flow rates for the following cases:

- Selective hydraulic containment (yearly average)
- Extensive hydraulic containment (maximum monthly average and yearly average)
- Selective slurry wall containment (yearly average)
- Extensive slurry wall containment (yearly average).

Details of the methodology and assumptions in estimating the flow rates and uncertainties are presented in Appendix F.

Feed Tank (Equalization)

Extracted groundwater would be sent to a feed tank. This tank would provide equalization of influent, to dampen variations in flow and groundwater quality between the extraction wells. The feed tank would also receive recycled water from other parts of the treatment system (i.e., the clarifier and filter press). An equalization period of 8 hours was selected to allow sufficient storage while minimizing costs.

Sand Filters

The groundwater would first be treated to remove solids by sand filters. Solids filtration will remove some of the uranium and other metals, which tend to adsorb to soil particles. The sand filters would protect the ion-exchange columns: suspended solids can foul the ion-exchange resin and either decrease removal efficiency or require replacement of the expensive resin. When the pressure drop across the filters exceeds a design level (due to buildup of solids), the filters would be backwashed with clean effluent from the treatment system. The high-solids backwash would be pumped to the flocculation/precipitation system for removal and disposal of the solids. One or more extra columns would be included in the system, so that the treatment system could continue to treat the design flow while a sand filter is being backwashed. Alternatively, sand filters are available that provide continuous backwashing during filter operation. The selection of backwash method is made during detailed design.

Ion Exchange

The primary removal of uranium and other contaminants from the groundwater would be by ion exchange following the sand filters. Ion exchange has been widely applied to the treatment of high flows of waste waters with dilute concentrations of metals. The contaminant ions are exchanged with ions on the resin (e.g., Na^+). When the exchange capacity for a bed is reached, the resin is regenerated by washing with a solution that reverses the ion exchange. The spent regenerant contains the contaminants in much higher concentrations than the feed. Thus, ion exchange may be viewed as a concentration process. Ion-exchange resins are easily fouled by suspended solids and organic compounds. Solids will have been removed in the sand filters; negligible organic compounds are anticipated in the influent.

The ion-exchange resin selected for this system would preferentially remove uranium over the other ions in the groundwater. The ion-exchange columns would be regenerated with acidic, basic, or salt solutions (depending on the resin used). For example, a solution of sodium chloride and soda ash is used for regeneration of ion-exchange systems used in mining uranium. Based on the concentrations of other metal contaminants (e.g., nickel), it is expected that no additional treatment will be needed for the treated groundwater to meet discharge limits. The other metal contaminants are already at very low concentrations and are found over much smaller areas than uranium. Nickel is found in only one well at concentrations above the MCL. The analytical results for this well (399-1-16A) vary between slightly below and occasionally above the MCL.

The groundwater would be pumped through two ion-exchange columns in series. For large-capacity treatment systems, several two-column ion-exchange subsystems would be operated in parallel to provide the required capacity. The first ion-exchange column would be operated to exhaustion; i.e., until it no longer removes a high percentage of the contaminants. The second

column would polish the groundwater to achieve discharge limits. For uranium, the discharge limit has been assumed to be the MCL of 20 μg/L. When the first column is exhausted, it would be taken offline and regenerated. The second column would then become the primary column, and a fresh (regenerated) column would be connected as the new polishing column. Consequently, one or more extra columns are needed to allow regeneration of columns without lowering the treatment capacity. For smaller treatment systems associated with the slurry wall alternatives, two ion- exchange columns would be sufficient. A single column could handle the low flowrate while the second column was being regenerated.

Storage and Discharge of Treated Effluent

Clean effluent from the ion-exchange units would be discharged directly to the Columbia River or returned to the aquifer via a groundwater infiltration system (see Section 6.2.7). A portion of the treated water would be collected in a storage tank for use in preparing the regenerant solution for the ion-exchange columns and for backwashing the sand filters.

Precipitation and Flocculation

The same equipment would be used for batch treatment of filter backwash and ion-exchange regenerant. Backwashing and regeneration would be scheduled in offset cycles to allow this double use.

Suspended solids would be removed from the filter backwash by flocculation. A flocculent polymer would be added to the mix tank with rapid mixing, followed by slow mixing to allow the solids to coalesce. The water would go from the mixing tank to the clarifier, where the solids would be removed from the water by gravity separation.

Dissolved uranium and other metals would be removed from spent ion-exchange regenerant as solid precipitates. Spent ion-exchange regenerant would be collected in the mix tank. The precipitation additive(s) would be added with rapid mixing, followed by slow mixing to allow the precipitating solids to coalesce. A flocculation polymer would be added to aid settling. The water would go from the mixing tank to the clarifier, where the solids would be removed from the water by gravity separation. Several precipitation additives would be considered in a treatability study. Lime is the most common precipitant in general use, primarily because of its low cost, producing insoluble metal hydroxides. However, lime tends to be inefficient in terms of the volume of sludge produced. An additive (or combination of additives) would be selected based on cost and on the volume of sludge (which would require landfill disposal). Caustic soda (NaOH) is expensive but produces less sludge. Iron co-precipitation has been successfully used to remove uranium and radium in surface water runoff from uranium mill tailings, and to remove uranium from nitrate-containing wastes at the Oak Ridge Y-12 Plant (EPA 1989). In these processes, iron compounds are added to the waste stream, and precipitation is induced by raising the pH of the solution with lime or sodium hydroxide.

Sludge Dewatering and Disposal

Sludge from the clarifier containing the suspended solids, and precipitated uranium and other metals would be dewatered using a filter press. The filter press squeezes water from the sludge, decreasing the volume and weight of sludge for disposal. Either a recessed-plate (plate-and-frame) or a belt filter press could be used. A recessed-plate press is operated in batch mode, whereas, a belt

press is operated semicontinuously. A recessed-plated press is more labor intensive; a belt press is much easier to operate for high sludge volumes. A recessed-plate press typically achieves higher solids content than a belt press (40% to 60% vs 20% to 40%). In addition, the recessed-plate presses are available in sizes more appropriate for low volumes of sludge.

After dewatering, the sludge would go to a secure landfill on the Hanford Site (e.g., the ERDF) for disposal (see Section 6.2.6). The sludges from groundwater treatment could require fixation (chemical stabilization) to meet leachate criteria for disposal. However, most of the sludge will consist of suspended solids with low contaminant concentrations and nonradioactive metal hydroxides and carbonates. Radioactive contaminants will be present in relatively low concentrations. Therefore, fixation is not expected to be necessary and has not been included in the cost estimates. Sludge disposal costs would be very small compared to other operating costs; this uncertainty is not important to remedy selection.

Chlorinated Volatile Organic Compounds

TCE and/or 1,2-DCE have been detected in several localized wells at very low concentrations (see Section 4.2.3). Unless these areas are specifically targeted for selective extraction, concentrations of these compounds in extracted groundwater would be diluted to well below significant risk levels. Therefore, remedial action targeting this contaminated groundwater should not be necessary. However, monitoring for chlorinated VOCs would continue.

If required, groundwater contaminated with TCE and DCE could be targeted for extraction and treatment. This extraction system would be independent of the main extraction system. It would extract from the bottom of the unconfined aquifer, rather than from the top thickness targeted by the main extraction system. The system could extract from the vicinity of well 399-1-16B, because this is the only well where MCLs are exceeded for these organic compounds. The limited extent indicates that the source(s) of these contaminants has little impact on the unconfined aquifer. Fluctuating contaminant concentrations indicates that flushing or transport is indeed occurring.

It is assumed that chlorinated VOCs (i.e., TCE and DCE) will not be targeted for extraction, so treatment to remove organic compounds will not be necessary. The cost estimates do not include treatment costs for organic compounds. If required, TCE, DCE, and other chlorinated VOCs could be removed by liquid-phase carbon adsorption, as shown in Figure 6-7. Spent carbon would be disposed in the ERDF or other suitable Hanford disposal facility. This treated groundwater could be discharged to the Columbia River without further treatment (i.e., the extraction and treatment systems for chlorinated VOCs would be separate from the system for radionuclides, and not connected to it).

6.2.5 Discharge of Treated Water

Treated groundwater that meets effluent discharge standards may be discharged to surface water, returned to the aquifer via infiltration from a surface trench, or reinjected using wells. Infiltration trenches and reinjection wells were not used in the alternatives because they would increase the capacity required for the treatment system; i.e., some of the treated water reinjected would be recaptured in the extraction system, which would necessitate increased extraction rates to continue to capture contaminated groundwater. In addition, reinjection would have minimal effectiveness in diverting the tritium and technetium-nitrate plumes.

The alternatives assume surface discharge to the Columbia River. Discharge to the river would be required to meet the substantive requirements of federal and state surface water discharge regulations. Tritium concentrations in the contaminated groundwater that would be extracted are currently below the anticipated discharge criteria (i.e., the tritium MCL), and are anticipated to stay below the MCL for the duration of extraction and treatment. However, should tritium levels rise excessively before 300-FF-5 remediation goals are acheived, the treated groundwater would need to be reinjected into the groundwater, or a waiver would be required for surface water discharge.

6.2.6 Waste Transportation and Disposal

The specific mode of waste transport will be determined during final design for the selected remedy. However, three potential modes of transport are considered for evaluation purposes: truck and trailer, rail, and tractor. Transportation resources at the Hanford Site are discussed in Section 2.2.6. Potential transportation impacts are evaluated in Section 6.4.6.1.

Disposal of contaminated soil or sludge resulting from 300-FF-5 remediation would occur at the ERDF in the 200 Area. If the ERDF is not allowed to receive RCRA designated waste resulting from remediation, then hazardous waste (if generated) would be disposed in the W025 landfill.

The ERDF is a planned permanent disposal facility (landfill) intended for wastes from Hanford Site remediation. It is presently in the design stage and is scheduled to be operational in September 1996. As currently envisioned, it will consist of a series of cells within one large trench expected to initially accommodate about 4,600,000 m^3 (6,000,000 yd^3) with a final total capacity of about 21,400,000 m^3 (28,000,000 yd^3). It will have facilities for receiving and handling various types of materials, including bulk solids.

6.2.7 Cultural Resource Considerations

All remedial activities will be conducted in accordance with Hanford Site Cultural Resources Management Plan (Chatters 1989). DOE procedures require site evaluations and surveys prior to conducting intrusive activities, except in areas of known fill. All cultural sites require evaluation of eligibility for listing on the National Register of Historic Places. Detailed evaluation of specific potential impacts on cultural resources will be performed during remedial design for the selected alternative. Plans for mitigation of potential impacts will be developed and submitted to state and federal agencies and Native American communities for review. Remediation alternatives will avoid significant adverse impacts to cultural resources.

Most of the remediation alternatives developed for the 300-FF-5 Operable Unit are anticipated to be affected by the presence of cultural resources. As discussed in Section 2.2.6.3, archaeological, historic, and religious resources are known to occur in the 300 Area, and only limited portions of the operable unit have been formally surveyed. Mitigation to avoid impacts to significant cultural resources affects the implementability and cost of the remediation alternatives. The 300-FF-5 Operable Unit is within 400 m (1,312 ft) of the Columbia River, which is an area of high cultural sensitivity to the Native American communities. It also has a high potential for the presence of buried cultural deposits.

Remediation technologies, particularly slurry walls and, to a lesser extent, groundwater extraction networks, disturb soils and surface areas potentially exposing previously unknown cultural resources. Slurry wall construction and groundwater extraction using an interception trench require excavating soils. Groundwater extraction using extraction wells also will require excavation of soil because the system distribution header is expected to be buried underground to prevent freezing. Implementation of these technologies at the 300-FF-5 Operable Unit would require more planning than is typical for similar activities where cultural resources are not present. For example, additional time and cost is incurred because all cultural sites discovered require evaluation of eligibility for listing on the National Register of Historic Places, and artifacts require data recovery. Discovery of Native American human remains during construction requires work stoppage efforts to protect the items discovered, and notification in writing to the Secretary of Interior and appropriate Indian tribe(s). Construction activity may not resume until 30 days after certification of all notification activities. These protective measures are promulgated under the Native American Graves Protection and Repatriation Act.

The initial planning will involve consultations between the DOE-RL Historic Preservation Officer, the Washington State Historic Preservation Officer, and concerned Native American tribal groups and governments. The remediation strategy and implementation plan requires approval from these parties before any intrusive activities are conducted. Areas of known or areas of known high probability of cultural resources should be avoided. However, avoidance may not be feasible in all cases. Implementation plans include a full surface survey for impacted areas. Surveys include mapping of artifacts and data recovery for surface and subsurface materials. Pre-excavation of shallow soils along the route potentially impacted by remediation technologies could be used to supplement the surface cultural surveys and would enhance detection of subsurface cultural resources. Early identification of subsurface cultural resources would minimize construction shutdowns that result when cultural resources are inadvertently uncovered. Construction shutdowns increase costs, cause expensive equipment and manpower to sit idle, and prolong construction time. Pre-excavation also allows for potential re-alignment of the proposed remediation technology. Onsite archaeological monitor(s) would be present, and when archaeologically significant sites are uncovered, Environmental Restoration Contractor cultural resources staff and tribal cultural resources personnel will be notified immediately, and mitigative measures will be implemented. All site workers involved will first be trained in the recognition of culturally significant materials and be expected to watch for them during construction.

Remediation activities in areas with known cultural resources or high probability of occurrence demand specific actions to protect the resource, and to address the needs of many interested parties. Whenever possible, avoidance of cultural resources is preferred. However, as noted previously, avoidance may not be feasible in all cases. Implementation of slurry wall and groundwater extraction network technologies at the 300-FF-5 Operable Unit will cost more and take significantly longer than typical at locations where cultural resources are not present.

6.2.8 Mitigative Measures

Impacts to the affected environment and resources caused by remediation of the 300-FF-5 Operable Unit will be mitigated to the extent possible. Mitigation of impacts has been incorporated into individual alternatives. Mitigation measures will include at least the following:

- Implement institutional controls to minimize hazards to workers, the public, and the environment during remediation, transport for treatment or disposal, and following final remediation.
- Evaluate borrow locations for suitability prior to use.
- Exercise emergency preparedness and prevention planning.
- Use existing roadways for waste transport.
- Plan traffic for worker commuting and waste transport.
- Control dust, including ceasing of operations during periods of high winds or other inclement weather that may cause negative impacts.
- Implement surface water management controls to minimize potential contaminant release resulting from overland flow.
- Restore habitat restoration including use of native soils and native vegetation to the extent possible.
- Reuse water (e.g., equipment cleaning).
- Reuse onsite resources including reclaimed materials.
- Establish buffer zones and temporal restrictions will be used to minimize conflicts with wildlife.
- Schedule construction activities around critical times for potentially impacted wildlife, such as during nesting or migratory periods.
- Train workers to recognize and respond to archaeologically, historically, and culturally significant resources.
- Ensure archaeologists and tribal members are present for remedial actions in culturally sensitive areas. Tribal members will be able to assist with identification and ensure proper care is provided, if human remains are found.

The remaining NEPA criteria are addressed in Section 6.4.6.

6.3 INDIVIDUAL ANALYSIS OF ALTERNATIVES

This section develops and describes the remediation alternatives in sufficient detail for the FS evaluation. Each alternative is then individually evaluated against the seven CERCLA criteria described in Section 6.1. Each alternative is also evaluated qualitatively to identify issues relative to natural resources (and the physical and biological functions they provide). Estimates of short-term worker risks for the alternatives are presented in Table 6-1. Estimated costs of the alternatives are summarized in Tables 6-2 and 6-3. Details of the cost estimates are presented in Appendix G. The comparative evaluation of the alternatives is presented in Section 6.4 and summarized in Tables 6-4 through 6-7.

Natural resource assessment information is provided for a more complete understanding of the environmental implications of choosing among the remedial alternatives. Natural resources are, as defined in 43 CFR 11.14(z), "land, fish, wildlife, biota, air, water, ground water, drinking water supplies, and other such resources belonging to, managed by, held in trust by, appertaining to, or otherwise controlled by the United States (including resources of the fishery conservation zone established by the Magnuson Fishery Conservation and Management Act of 1976), any State or local government, and foreign government, any Indian tribe, or, if such resources are subject to a trust restriction on alienation, any member of an Indian tribe. These natural resources have been categorized into the following five groups: surface water resources, ground water resources, air resources, geologic resources, and biological resources."

6.3.1 Assessment of Resource Categories

This section identifies the affected natural resources associated with the 300-FF-5 Operable Unit. The Columbia River forms the eastern boundary of the operable unit and the northern, western and southern boundaries have been located to represent the potential extent of groundwater contamination migrating from the two source operable units (300-FF-1 and 300-FF-2). The 300-FF-5 Operable Unit is a groundwater operable unit containing no waste sources, but which underlies and is downgradient of the two source operable units noted above. The majority of the waste generating activities whose discharges could affect the 300-FF-5 Operable Unit include fuel fabrication operations, water treatment and disposal operations, support operations (e.g., convertible coal/oil powerhouse), and disposal of sanitary waste from the various facilities in the 300 Area.

A detailed description of the 300-FF-5 Operable Unit ecological resources, species of special concern, sensitive environments, and wildlife refuges is given in Sections 2.2.7, 2.2.8, 2.2.9, and 2.2.10, of this report.

6.3.1.1 Surface Water. The Columbia River is the most significant surface water body at the Hanford Site. It is used as a source of drinking water, industrial process water, and a variety of other uses within the region. The water quality is classified as Class A (Excellent) according to the state of Washington.

Contaminants of potential concern in surface water identified in the Phase I RI (DOE-RL 1994d) for the 300-FF-5 operable unit were TCE, ^{99}Tc, tritium, ^{234}U, ^{235}U, and ^{238}U. Concentrations were observed to be highest close to the riverbank and lowest away from the riverbank. Concentrations also increased toward the downstream end of the 300-FF-5 Operable Unit.

The source of these contaminants was groundwater flow from springs into the river. The maximum detectable total uranium concentration was 37 pCi/L and the minimum was 2.4 pCi/L. The other contaminants were low and are not considered a potential contributor of risk. This initial sampling event occurred during a low-flow period. A second sampling event was conducted during a more typical flow regime (Hulstrom 1994a) and showed only slightly detectable uranium (< 1 pCi/L).

6.3.1.2 Groundwater. Contaminants of potential concern in groundwater were uranium, nickel, TCE, DCE, chloroform, coliform, nitrate, ^{99}Tc, ^{90}Sr, tritium, and copper. Coliform, chloroform, nitrate, ^{99}Tc, ^{90}Sr, tritium, and copper were eliminated in Chapter 4.0 as contaminants of concern. There is uncertainty as to the nature of the TCE and DCE source in the unconfined aquifer. In contrast to the other contaminants, maximum levels of the two compounds occur at the bottom of the unconfined aquifer, despite upward hydraulic gradients. No direct evidence has been collected to establish that the source of the two compounds occurs in any form other than dissolved contamination. The groundwater contamination for this operable unit consists of three main plumes and is discussed in detail in Section 2.3.1.

Contaminated groundwater is the source for potential river contamination as discussed previously. A second area of concern is the uptake of contamination by rooted riparian vegetation. Brandt et al. (1993b) reported slightly elevated concentrations of uranium in mulberry and reed canarygrass found in the riparian zone of the operable unit. The most likely mechanism is from groundwater to the root system.

6.3.1.3 Air Resources. Air quality on the Hanford Site is generally considered good as discussed in Section 2.2.5. Actions that could result in generation of contaminated dust or dust emissions will tend to increase the exposure of air resources to contaminants. Such exposure potential will be a factor to consider when comparing the remediation alternatives for the 300-FF-5 Operable Unit.

6.3.1.4 Saturated Soils and Sediments. Saturated soils and Columbia River sediments are within the operable unit boundary. Potential direct effects to saturated soils and sediments include the accumulation of contaminants that exceed a concentration that impairs their use to support plant and animal life. Analysis of sediments during the low flow river study did not show any significant accumulation of contaminants of concern. These findings are consistent with the coarse sediments found along the shoreline, which have low absorption coefficients for contaminants. Generally, contaminants are associated with fine grain sediments.

6.3.1.5 Vegetation Communities. Habitats that have been identified include: (1) shrub-steppe habitat, which occupies most of the land area and relies on annual precipitation, and (2) riparian habitat, which occurs along the shoreline of the Columbia River, relying on root zone wetting by river water or spring seeps.

The principal vegetative communities of the 300 Area consists of shrub-steppe with the dominant species being antelope bitterbrush and Sandberg's bluegrass. Diversity in this habitat is lower than in the riparian zone. The riparian vegetation in the vicinity of the 300-FF-5 Operable Unit consists mostly of a narrow zone of perennial herbs with a few scattered deciduous trees and shrubs. The dominant riparian vegetation includes white mulberry and peachleaf willow, reed canarygrass and bulbous bluegrass, and a large variety of forbs. A total of 18 locations of persistentsepal yellowcress were discovered in and around the operable unit.

Riverine habitat includes the sloughs, backwaters, wetted shorelines, islands, and riparian trees that are associated with the river floodplain and covered by water for the majority of the year. Riparian habitat includes the shoreline-river interface where species that are tolerant of fluctuating surface-water elevations persist. Woody plants are scarce on the Hanford Site, but the shorelines of the Columbia River support a thin band of trees and shrubs, mostly willows (*Salix* spp.).

6.3.1.6 Wildlife Habitats. The riparian zone of the Columbia River supports a variety of both terrestrial and riparian wildlife and maintains the highest biological diversity of the site. It serves as both feeding and breeding grounds for many species of wildlife. In addition, riparian vegetation provides both a source of food and shelter for several biological species. Riparian vegetation is a key source of nutrients for the Columbia River.

For a variety of wildlife species, riverine and riparian habitants are seasonally important, and provide nesting and foraging opportunities, and thermal and travel cover (Books 1985). Willow thickets trap food for waterfowl [e.g., Canada geese (*Branta canadensis*)] and shorebirds [e.g., killdeer (*Charadrius vociferus*), spotted sandpiper (*Actitis macularia*)], and provide nesting habitat for a number of bird species. Terrestrial and aquatic insects are abundant in emergent grasses and provide forage for fish, waterfowl, and shorebirds. Beaver (*Castor canadensis*) and muskrats (*Ondatra zibethica*) rely on shoreline habitat for foraging and denning materials. Mink (*Mustela vison*), raccoon (*Procyon lotor*), bald eagles (*Haliaeetus leucocephalus*), and osprey (*Pandion haliaetus*) feed on fish, especially spawned salmon, along the Hanford Reach. Mule deer (*Odocoileus hemionus*) forage on the leaves and twigs of mulberry trees and other browse plants during the summer months. Planted trees, mostly black locust (*Robinia pseudoacacia*), Siberian elm, and white poplar (*Populus albus*) located near the shoreline are used as night roosts and as daytime perches by bald eagles in winter (Eisner 1991). Some shoreline trees are used as nesting sites by great blue herons (*Ardea herodias*), black-billed magpies (*Pica pica*), northern orioles (*Icterus galbula*), and raptors such as Swainson's hawks (*Buteo swainsoni*), red-tailed hawks (*Buteo jamaicensis*), and great horned owls (*Bubo virginianus*).

Habitat Rating Based on Existing Information

Based on site knowledge and experience a subjective evaluation of the habitat present in the 300-FF-5 Operable Unit was conducted to identify the quality of existing habitat. A rating system ranging from low to medium to exceptional or high quality was used. The ratings identify the adequacy of the habitat and its ability to support a diversity of wildlife. The evaluation also considered the potentially affected habitat surrounding the 300-FF-5 Operable Unit.

Based on existing information, the 300-FF-5 Operable Unit terrestrial habitat was rated as low quality.

The riparian habitat was rated as high quality. Protection of this habitat should be a key consideration when evaluating the various remedial actions that may pose an impact. Potential ecological risk to the riparian zone is a key factor in the evaluation of remedial alternatives.

6.3.1.7 Wildlife Populations. The most abundant wildlife species are grasshopper, horned lark, western meadowlark, Great Basin Pocket Mouse, cottontail rabbit, and jackrabbit. Fifty-three species of birds have been documented on summer and winter surveys conducted within the operable unit. Two upland game birds and five waterfowl species were observed. A number of ducks and Canada

geese use portions of the operable unit for nesting and remain year round. Several species of reptiles occur within the operable unit.

Four bird species of concern are known to occur in the vicinity of the operable unit. These species include Swainson's hawk, Forster's tern, long-billed curlew, and burrowing owl.

Fifteen mammal species were observed during surveys within the operable unit or immediately upriver, with an additional 15 known from other studies to occur in the Hanford riparian zone along the Columbia River. No threatened, endangered, or candidate mammals have been documented in the operable unit vicinity, and none were identified in the most recent survey (Brandt 1993b).

6.3.1.8 Aquatic Life. Forty-four fish species have been identified within the Hanford Reach of the Columbia River. Chinook, sockeye, and coho salmon, and steelhead trout use the river as a migration route to and from upstream spawning areas. Fall chinook salmon, steelhead trout, and potentially the America shad spawn in the river, but not in the areas adjacent to the 300-FF-5 Operable Unit.

The aquatic populations consist of phytoplankton species, macrophytes, zooplankton and freshwater benthic taxa.

6.3.2 Alternative A - No Action

6.3.2.1 Description. This alternative is required under CERCLA [40 CFR 300.430(e)(6)] to provide a baseline for comparison to the other alternatives. This alternative assumes that there would be no institutional controls for the operable unit (i.e., the institutional controls currently in place would be lost and that no remedial action would be performed). As required under CERCLA, monitoring would be conducted to verify the effectiveness of the remedy (see Section 6.2.1).

With this alternative, it is estimated that natural flushing would decrease radionuclide concentrations in groundwater to below remediation goals in approximately 3 to 10 years (from late 1993) (see Section 4.3.4). Nickel, TCE, and DCE could remain in a small, localized region of the water table aquifer at concentrations around the MCL for a longer time. Uranium was well below MCLs in the near-shore river water during average river stage conditions, but was detected in springs and near-shore river water above MCLs during an extreme low river stage condition. Nickel and DCE are not detectable in river springs and near-shore river water even during the extreme low flow conditions. TCE was detected, but below MCLs, in the springs and river during the extreme low stage conditions. This extreme low river stage does not occur frequently during the year. Monitoring would continue as long as groundwater contaminant concentrations exceed remediation goals.

The risk to aquatic and riparian receptors was estimated and found to be lower than the minimum acceptable exposure limits in DOE Order 5400.5 and International Atomic Energy Agency (IAEA), 1992, which limit radiological dose to 1 rad/day for aquatic organisms. This estimate was obtained under low river flow conditions. Under normal flow conditions the risk would be even less.

6.3.2.2 Evaluation. Overall Protection of Human Health and the Environment. This alternative does not meet this threshold criterion because it is assumed that the institutional controls currently in place are no longer effective. Loss of existing controls would allow the potential for exposure to contaminated groundwater. However, current risks are negligible, and remediation goals (i.e., concentrations below MCLs) would be achieved by natural flushing of the aquifer in an estimated 3 to 10 years (from late 1993).

The risk of additional impacts from remedial actions to natural resources (e.g., wildlife, vegetation communities) will be avoided since no action is planned.

Compliance with ARARs. This alternative meets this criterion because remediation goals are achieved through natural processes within a reasonable time frame. (The MCLs would apply at the end of the remedial action.)

The most significant ARARs for aquatic systems are DOE Order 5400.5, and IAEA, 1992, which limit radiological dose to aquatic organisms to 1 rad/day. Current migration of uranium into the river does not exceed this dose rate.

Long-Term Effectiveness and Permanence. Groundwater concentrations of radionuclides would be reduced to below MCLs via natural flushing of the aquifer, achieving remediation goals for uranium in an estimated 3 to 10 years (from late 1993). Concentrations of nickel, TCE, and/or DCE may remain in isolated locations slightly above MCLs. Because exposure would not be prevented and contaminated discharges to the river would not be limited, remedial action objectives for these contaminants would not be achieved. The no-action alternative will not cause any adverse impacts to natural and cultural resources.

Reduction in Toxicity, Mobility or Volume through Treatment. No treatment is provided with this alternative.

Short-Term Effectiveness. The risks involved with this alternative are any short-term risk involved with potential exposure to contaminated groundwater in the short time before remediation goals are achieved, assuming existing institutional controls are lost. It is estimated that natural flushing of the aquifer will decrease radionuclide concentrations in groundwater below MCLs in 3 to 10 years (from late 1993). During this time, contaminated groundwater would discharge to the Columbia River in concentrations gradually decreasing to below remediation goals. However, the current discharge does not present unacceptable risk. Concentrations of nickel, TCE, and/or DCE may remain in isolated locations slightly above MCLs. Concentrations of operable unit contaminants are not found in significant concentrations at any point with reasonable potential for exposure to human or ecological receptors. There are no measurable river or offsite impacts. Contaminants from the operable unit are at acceptable levels in the river during average river stages.

Implementability. The no-action alternative is easily implementable .

Cost. The only cost associated with this alternative is ongoing groundwater monitoring and limited surface water monitoring to ensure that human health and the environment are not adversely impacted. Periodic monitoring of wildlife, fish, and vegetation will be required to ensure natural

resources are not being impacted. The estimated cost for this alternative is $0.9 million, with a range of $0.3-$1.7 million (see Tables 6-2, 6-3, and Appendix G). There are no additional restoration costs associated with this alternative.

6.3.3 Alternative B - Institutional Controls

6.3.3.1 Description. This alternative consists of implementing and maintaining institutional controls to prevent exposure to contaminated groundwater. Institutional controls reduce or eliminate risk by preventing exposure to contaminants. Institutional controls are typically part of any remedy for a CERCLA site where contaminated materials remain after completion of remedial action, and are incorporated into all of the alternatives except Alternative A (No Action). Monitoring (described in Section 6.2.1) would be performed to verify the effectiveness of the selected remedy.

Institutional controls for this operable unit would include the following:

- Restrictions on groundwater withdrawal and use
- Restrictions on exposure to near-shore river water
- Deed restrictions
- Fencing
- Warning signs
- Security patrols
- Monitoring as described in Section 6.2.1.

Institutional controls, including the components listed above, are likely to be part of the 300-FF-1 and 300-FF-2 Operable Unit remedies. A comprehensive set of institutional controls appropriate for the entire 300 Area would be implemented to cover the selected remedies for the 300-FF-1, 300-FF-2, and 300-FF-5 Operable Units.

Groundwater controls would consist of restricting withdrawal and use of contaminated groundwater as necessary to reduce risk to humans. Restrictions on groundwater withdrawal and use would eliminate potential exposure and risk identified in the hypothetical future industrial use scenario used in the baseline risk assessment (DOE-RL 1994d). With respect to the affected natural resources, risk would be minimized. Restrictions for 300-FF-5 groundwater would be imposed that continue existing controls and place additional limits on groundwater usage as necessary.

Operable unit groundwater is not currently used for drinking water. The only current use of 300 Area groundwater is for fish experimentation, from well 399-4-12. The estimated risk for well 399-4-12 results from chloroform at concentrations typical and acceptable for municipal water supply systems. Therefore, it appears acceptable to continue the current use of this well. Monitoring of the water quality from this well would be used to ensure that human exposure to the well water does not pose unacceptable risk.

Contaminated groundwater reaching the Columbia River does not result in unacceptable risk for average river stage conditions. Contaminants are sometimes detectable in very low concentrations in springs and near-shore river water. Therefore, institutional controls would restrict access to this

area to prevent exposure to potentially affected wildlife, and vegetation communities, and thereby reduce risk. These restrictions would be implemented by fencing, warning signs, and security patrols (described in the following paragraphs).

Deed restrictions could be used to implement restrictions on groundwater use. DOE site controls are sufficient for implementation of institutional controls as this time. In the event the site is released from DOE control, deed restrictions and other legal covenants would be used to ensure continued implementation of the controls. Deed restrictions would prohibit groundwater withdrawal or use and limit activities that could result in exposure to contaminants or disrupt the remedy. Operation and maintenance of any groundwater extraction and treatment system would remain under DOE control as long as it is in use.

The Hanford Patrol historically has patrolled the entire Hanford Site and restricted access as necessary. The duties of the Hanford Patrol have now largely been relegated to the Benton County Sheriff's Department. The Hanford Patrol and the Sheriff's Department effectively restrict site access, protect the groundwater monitoring system from potential vandalism, and reduce potential exposure to contaminated groundwater. They would also enforce site access restrictions (if any) near discharge points to the Columbia River. In the event DOE releases control of the 300 Area, periodic site inspections would continue (by DOE or others, as appropriate) to ensure continued effective operation of the selected remedy.

Fencing is already used on the Hanford Site to restrict access and would be maintained around the operable unit during the period of institutional controls. Additional fencing would be added if necessary to prevent exposure to contaminants from the operable unit. Fences would be posted with warning signs that discourage trespassing, identify activity restrictions, and warn of site contamination.

With this alternative, it is estimated that natural flushing would decrease radionuclide concentrations in groundwater to below remediation goals in approximately 3 to 10 years. Nickel, TCE, and DCE could remain in groundwater near well cluster 399-1-16 at concentrations around the MCL for a longer time. Nickel and chlorinated organic compounds would not reach the Columbia River in concentrations exceeding MCLs. Monitoring would continue as long as groundwater contaminant concentrations exceed remediation goals. The effectiveness of this alternative would be reviewed after 5 years (as required under CERCLA). Should natural flushing not perform as expected, or if the alternative proved ineffective, then the remedy would be reconsidered, and appropriate additional remedial action would be taken.

6.3.3.2 Evaluation. Overall Protection of Human Health and the Environment. This alternative meets this threshold criterion. Current risks are below acceptable limits, and remediation goals would be achieved by natural flushing of the aquifer, which would reduce contaminant concentrations to below MCLs in the near future. Concentrations of nickel, TCE, and/or DCE may remain in isolated locations slightly above MCLs, but continued institutional controls and monitoring would prevent exposure and thereby achieve remedial action objectives. Short-term exposure to contaminated groundwater would be prevented using institutional controls and monitoring until remediation goals are achieved.

Risks at the site, including near-shore river water, are currently below acceptable limits. The only identified potential unacceptable risk resulting from contaminated groundwater from the

300 Area is for exposure to chloroform from well 399-4-12, which is solely used for non-potable industrial purposes. The concentration of chloroform in this well is below the MCL and within the normal, acceptable range for municipal water supplies.

Protection of the environment is demonstrated by sampling results that show contaminant concentrations in near-shore river water are well below acceptable limits where discharges occur at ground-surface and subsurface discharges in the Columbia River. Additional documentation is provided by downstream water quality monitoring at the city of Richland water supply intake, where 300-FF-5 Operable Unit contaminants are at background levels. In addition, monitoring of wildlife, fish, and shoreline vegetation will be available through the Hanford Sitewide Monitoring Program.

Compliance with ARARs. This alternative meets this threshold criterion. Exposure to groundwater with contaminant concentrations above MCLs would be prevented, including in near-shore river water affected by contaminated groundwater. Groundwater is not currently used for drinking water, and such use would be prevented until remediation goals are achieved. Remediation goals would be achieved within a reasonable time frame. This alternative therefore meets MTCA, if applicable. In addition, dose to aquatic receptors is estimated to be within the acceptable levels in DOE Order 5400.5, and IAEA (1992), which limits radiological dose to 1 rad/day.

An ACL may be required because, even though potential risks in near-shore river water are below acceptable limits, contaminants from the operable unit are detectable under some conditions in near-shore river water. However, operable unit contaminants are not above background levels farther out in the river, in the 300 Area water intake, and in the city of Richland water supply.

Long-Term Effectiveness. Groundwater concentrations of radionuclides would be reduced to below MCLs via natural flushing of the aquifer; remediation goals for these contaminants would be acheived in an estimated 3 to 10 years (from late 1993). Concentrations of nickel, TCE, and/or DCE that slightly exceed MCLs in a limited area would remain for a longer time period, but continued institutional controls and monitoring would prevent exposure and thereby achieve remedial action objectives. Exposure to contaminated groundwater prior to achieving remediation goals is addressed under short-term effectiveness. Impacts to affected natural and cultural resources would be avoided or minimized as a result of this action.

Reduction in Toxicity, Mobility or Volume through Treatment. This alternative does not include treatment to reduce toxicity, mobility or volume. Because radionuclides cannot be destroyed, elimination of exposure pathways, provided by institutional controls, is the primary means to reduce risk resulting from radionuclides for this alternative.

Short-Term Effectiveness. Short-term impacts would consist of dischatge of groundwater with contaminant concentrations (uranium) above remediation goals to the Columbia River for an estimated 3 to 10 years (from late 1993). During this time, exposure to contaminated groundwater would be prevented by institutional controls and monitoring. In addition, risks at the site (including near-shore river water) are currently below remediation goals. Disturbances to natural and cultural resources would be minimized by imposing appropriate buffer zones and temporal restrictions and by the presence of appropriate cultural resource experts. Concentrations of contaminants in the Columbia River, the only point of exposure to the public and ecological receptors, are well within acceptable levels during average river stage conditions. Risk to remediation workers would be very

low (see Table 6-1). There are no measurable offsite impacts (i.e., contaminants from the operable unit are at background levels in downstream 300 Area and city of Richland river water intakes).

Implementability. Institutional controls and monitoring are readily implementable and are presently used throughout the Hanford Site, including the 300-FF-5 Operable Unit. For example, site access is currently restricted, and 300-FF-5 groundwater is not currently used for agricultural or domestic activities. There are no technical problems with implementing institutional controls and monitoring, and only limited demands on services, natural and cultural resources, and materials are required. Implementation of this alternative requires primarily administrative actions.

Cost. The estimated cost for this alternative is $1.4 million with a range of $0.6 to 2.4 million (see Tables 6-2, 6-3, and Appendix G). Most of the cost is associated with monitoring; therefore, this alternative is only slightly more expensive than no action. There are no additional restoration costs associated with this alternative.

6.3.4 Alternative C - Selective Hydraulic Containment

6.3.4.1 Description. The purpose of this alternative is to meet remediation goals by cost-effectively combining extraction and treatment of the most contaminated groundwater (to prevent discharge to the Columbia River) with natural flushing of the remainder of the aquifer. For this FS, a total uranium concentration of 80 μg/L was assumed to define the selective remediation area (see Figure 5-1 and Section 5.2). This concentration represents the area for relatively cost-effective groundwater extraction and treatment, should it be required. This alternative would include the following key components:

1. Construction and operation of a groundwater extraction and treatment system to prevent discharge of groundwater from the selective remediation area to the Columbia River. Operation of the extraction and treatment system would continue until groundwater contaminant concentrations are below remediation goals (i.e., 20 μg/L total uranium).

2. Use of natural aquifer flushing and institutional controls outside of the contained area to achieve remediation goals.

3. Use of institutional controls (described in Section 6.3.3) and monitoring (described in Section 6.2.1) to prevent or minimize exposure to contaminants as long as groundwater contaminant concentrations in the operable unit are above remediation goals.

Groundwater would be extracted for treatment using wells (see Section 6.2.2). The alignment of the extraction system is shown in Figure 6-8. Groundwater treatment would be performed as discussed in Section 6.2.6. Water treatment would remove contaminants to levels suitable for discharge to the Columbia River. The treatment system would generate radioactive sludge requiring landfill disposal (e.g., at the ERDF).

A process flow diagram for groundwater treatment for this alternative is provided in Figure 6-9. The system would have a design capacity of approximately 300 gal/min (1,140 L/min)

(Section 6.2.4 and Appendix F) and operate at the design flow rate. Seasonal fluctuations in groundwater and river gradients would mean that in some months, for a short period of time, the system might not capture all of the target area. However, consistent with the purpose of this alternative, the cost-effective choice of design to average conditions has been used. The cost estimate for Alternative D (Extensive Hydraulic Containment) shows the cost implications of requiring a design capacity for maximum flow rates.

Feed storage would have the capacity for 8 hours of flow at the average flow rate, to account for periodic fluctuations in groundwater and river gradient that affect the flow rate required to maintain hydraulic containment. Two sand filters, sized for the design flow rate, would operate in parallel, with one in operation while the other is being backwashed. Three ion-exchange columns are included to allow regeneration of one column while the other two are operating in series. Most of the contaminants would be removed in the primary column; the secondary column would provide polishing to ensure achievement of low discharge limits. When the primary column becomes exhausted, it would be regenerated; the secondary column would become the primary column, and the freshly regenerated column would become the secondary (polishing) column. The third column provides a margin of safety by keeping two columns in operation at all times. In addition, the additional column allows the treatment system to continue at full capacity even with failure of one column. This margin of safety is important for reliability because hydraulic containment would fail if the system could not maintain design flows. In contrast, treatment for slurry wall containment only assumes two columns. However, containment is not lost for slurry wall alternatives if the treatment system fails.

6.3.4.2 Evaluation. Overall Protection of Human Health and the Environment. This alternative meets this threshold criterion. Current risks are below acceptable limits, and remediation goals would be achieved by a combination of groundwater extraction of the most contaminated groundwater and natural flushing of groundwater with low contaminant concentrations. Short-term exposure to contaminated groundwater would be prevented using hydraulic containment, institutional controls, and monitoring until remediation goals are achieved.

This alternative will increase the short-term level of protection of the environment by reducing uranium discharges into the river although such discharges currently meet acceptable ecological protection standards. However, it will require construction activities and placement of a series of extraction wells. Although construction and operations are limited to an area of approximately 200 m (656 ft) along the river, these activities are likely to impact vegetation, wildlife, and cultural resources over the 3 to 10 year period necessary to achieve remediation goals.

Compliance with ARARs. This alternative meets this threshold criterion because exposure to groundwater that has contaminant concentrations above MCLs would be prevented, including in near-shore river water affected by contaminated groundwater, which will also reduce biotic transport. Groundwater is not currently used for drinking water, and such use would be prevented until remediation goals are achieved. Remediation goals would be achieved within a reasonable time frame. This alternative therefore meets MTCA, if applicable.

An ACL may be required because, even though potential risks in near-shore river water are below acceptable limits, contaminants from the operable unit are detectable under some conditions in near-shore river water. However, operable unit contaminants are well below MCLs in the near-shore river during average conditions, in the 300 Area water intake, and in the city of Richland water

supply. This alternative may require mitigation and/or restoration planning to protect wildlife, vegetation communities, and cultural resources. Direct and indirect effects to these resources from construction activities may be unavoidable.

Long-Term Effectiveness and Permanence. Groundwater concentrations of uranium would be reduced to below MCLs upon completion of remedial action, in an estimated 3 to 10 years (from late 1993). Concentrations of nickel, TCE, and/or DCE may remain in isolated locations slightly above MCLs, but continued institutional controls and monitoring would prevent exposure and thereby achieve remedial action objectives. Exposure to contaminated groundwater prior to achieving remediation goals is addressed under short-term effectiveness. Thus, the long-term effectiveness of this alternative is the same as for all alternatives with regard to human health, and would also be the same for the environment if short-term natural resource impacts are mitigated in a timely manner.

Reduction in Toxicity, Mobility or Volume through Treatment. This alternative provides containment, extraction, and treatment of the most highly contaminated groundwater, reducing the volume of contaminants discharged to the Columbia River. These contaminants would be concentrated in a sludge for ERDF disposal.

Short-Term Effectiveness. Short-term impacts would consist of discharge of contaminated groundwater outside the selective remediation area to the Columbia River for an estimated 3 to 10 years (from late 1993). This groundwater has contaminant concentrations that are low but above remediation goals. The most contaminated groundwater would be collected and treated. During this time, exposure to contaminated groundwater would be prevented by institutional controls and monitoring. In addition, risks at the site (including near-shore river water) are currently below acceptable limits. There would be moderate risk to remediation workers resulting from construction and operation of a moderate-size groundwater extraction and treatment system (see Table 6-1). There are no measurable offsite impacts (i.e., contaminants from the operable unit are at background levels in nearby river water intakes).

Based on this alternative, there will be a reduction in the quality of the site for natural and cultural resources through physical destruction of habitat and potential disturbance of cultural artifacts. Short-term impacts to natural resources are likely because of construction and related activities. It is possible that waterfowl and terrestrial birds will be affected because of increased human activity along the shoreline. If this activity occurs during breeding seasons, local populations of some species may be adversely affected through avoidance of the area or abandonment of nests.

Implementability. There are potential difficulties in operation of hydraulic containment because of highly variable river elevations. However, hydraulic control is not required over a large area, and difficulties can be accounted for in the design and operation of the system. The limited extraction area would minimize the potential for interaction with contaminant plumes from outside the operable unit.

The implementation of this alternative must consider potential disturbances to wildlife and birds inhabiting the area during construction and operation. It might be necessary to reduce activities during certain seasons of the year. It is also possible that worker activity will impact shoreline vegetation. Because this area is culturally sensitive, cultural artifacts may be uncovered during construction, resulting in impacts to cultural resources. A plan will be required to deal with these issues as they arise.

Cost. The estimated cost for this alternative is $13 million, with a range of $6 to $39 million (see Tables 6-2, 6-3, and Appendix G). In addition, this alternative will require site mitigation or restoration of affected natural and cultural resources. Costs associated with these activities can be substantial because of the use of the habitat by a variety of wildlife and the potential for discovery of cultural artifacts. All of these issues will need to be considered in the remedial design and planning.

6.3.5 Alternative D - Extensive Hydraulic Containment

6.3.5.1 Description. The purpose of this alternative is to meet remediation goals by containment of all groundwater that has concentrations above remediation goals to prevent discharge to the Columbia River. This purpose is the same as for Alternative F (Extensive Slurry Wall Containment), but active hydraulic containment is used instead of passive slurry wall containment. This alternative would include the following key components:

1. Construction and operation of a groundwater extraction and treatment system to prevent discharge of groundwater from the extensive remediation area to the Columbia River. Operation of the extraction and treatment system would continue until groundwater contaminant concentrations are below remediation goals (i.e., 20 μg/L total uranium).

2. Use of natural aquifer flushing and institutional controls outside of the contained area to achieve remediation goals.

3. Use of institutional controls (described in Section 6.3.3) and monitoring (described in Section 6.2.1) to prevent or minimize exposure to contaminants as long as groundwater contaminant concentrations in the operable unit are above remediation goals.

Groundwater would be extracted for treatment using wells (see Section 6.2.2). The alignment of the extraction system is shown in Figure 6-10. Groundwater treatment would be performed as discussed in Section 6.2.4. Water treatment would remove contaminants to levels suitable for discharge to the Columbia River. The treatment system would generate radioactive sludge requiring landfill disposal (e.g., at the ERDF).

A process flow diagram for groundwater treatment for this alternative is provided in Figure 6-11. The system would have a design capacity of approximately 3,900 gal/min (14,820 L/min) (Section 6.2.4 and Appendix F), based on treatment of the maximum expected monthly average flow of groundwater in the aquifer. This high design capacity is necessary to achieve the purpose of this alternative, which is to capture and treat all groundwater with contaminant concentrations above remediation goals. The average flow rate would be approximately 2,600 gal/min (9,880 L/min).

As with selective hydraulic containment (Alternative C), feed storage would have the capacity for 8 hours of flow at the average flow rate, to account for periodic fluctuations in groundwater and river gradient that affect the flow rate required to maintain hydraulic containment. To keep the size of individual equipment items to readily available sizes, many sand filters and ion- exchange columns have been assumed. Fewer columns would require larger sizes that may require special ordering. The larger number of columns also provides operational flexibility. Because normal operational flow

The larger number of columns also provides operational flexibility. Because normal operational flow rates would be significantly less than the design capacity of the system, extra columns for backwashing and regeneration would not be needed. The larger number of columns needed for the maximum flow rate would also enhance reliability for operation at the normal flow rate.

6.3.5.2 Evaluation. Overall Protection of Human Health and the Environment. This alternative meets this threshold criterion. Current risks are below acceptable limits, and remediation goals would be achieved by collecting and treating all groundwater that has contaminant concentrations above remediation goals.

Overall protection of natural resources for Alternative D is similar to the discussion presented for Alternative C. However, the area for well placement is extensive and covers most of the site shoreline (Figure 6-10), although wells will be 30 to 46 m (100 to 150 ft) from the river. Groundwater extraction wells will be 30 m (100 ft) apart. It is likely that this high density will impact wildlife, vegetation, and other natural and cultural resources along the riparian zone through construction activity and physical requirements of land for well pads. This alternative will result in impacts to natural and cultural resources which would require appropriate mitigation planning.

Compliance with ARARs. This alternative meets this threshold criterion by containing groundwater that has contaminant concentrations above MCLs and preventing discharge of this contaminated groundwater to the Columbia River. Nickel, TCE, and DCE may not be completely extracted from the aquifer and could remain beyond the active extraction time for uranium. Because TCE has been detected once at a very low concentration (below MCLs) in near-shore river water, an ACL could be required to comply with ARARs. DCE has not been detected in the near-shore river water. Nickel concentration in the river along the 300 Area is indistinguishable from upstream background levels. This alternative may require mitigation and/or restoration planning to protect wildlife, vegetation communities, and cultural resources. Direct and indirect effects to these resources from construction activities may be unavoidable.

Long-Term Effectiveness and Permanence. Groundwater concentrations of radionuclides would be reduced to below MCLs upon completion of remedial action, in an estimated 3 to 10 years (from late 1993). Concentrations of nickel, TCE, and/or DCE may remain in isolated locations slightly above MCLs, but continued institutional controls and monitoring would prevent exposure and thereby achieve remedial action objectives. Thus, the long-term effectiveness of this alternative is the same as for all alternatives with regard to human health, and would also be the same for the environment if short-term natural resource impacts are mitigated in a timely manner.

Reduction in Toxicity, Mobility or Volume through Treatment. This alternative provides containment, extraction, and treatment of all groundwater that has contaminant concentrations above remediation goals, resulting in the maximum reduction in the volume of contaminants discharged to the Columbia River. These contaminants would be concentrated in a sludge for ERDF disposal.

Short-Term Effectiveness. There would be moderate to high risk to remediation workers for this alternative resulting from construction and operation of a very large groundwater treatment system (see Table 6-1). The time required to achieve remediation goals is estimated to be 3 to 10 years (from late 1993). Concentrations of nickel, TCE, and/or DCE may remain in isolated locations slightly above MCLs for decades, but continued institutional controls and monitoring would prevent exposure and thereby achieve remedial action objectives.

This treatment alternative will likely cause a reduction in the quality of the site for natural and cultural resources through physical destruction of habitat and disturbance of cultural artifacts. It is highly likely that ecological receptors will be exposed to additional physical impacts (i.e., noise, intrusion to habitat and special breeding areas, temporary displacement). Since it will take 3 to 10 years to implement this alternative, impacts are likely to persist during this period, and without mitigation, could alter behavior patterns of some wildlife species. Alternative D will involve transport of contaminated sludge from the 300-FF-5 Operable Unit to ERDF, which can increase risk to habitat and wildlife from physical activities such as excavation and transport of material. Since these activities will occur near the river, wildlife breeding during these activities could be disrupted through noise and the presence of workers.

Implementability. This alternative would be relatively difficult to implement. The difficulties result from the many extraction wells (over 50 wells) and the large groundwater extraction and treatment system capacity (approximately 4,000 gal/min [15,200 L/min] for maximum month, 2,600 gal/min [9,880 L/min] average for the year) required to contain the extensive remediation area. There are potential difficulties in operation of hydraulic containment because of highly variable river elevations, especially over such a large area. There is potential for accelerating the approach of contaminant plumes from outside the operable unit.

The large number of extraction wells will require both a mitigation and restoration plan to avoid impacts where possible and minimize unavoidable adverse impacts that do occur. Because of the high density of wells, this alternative will not be easily implemented without major impacts to natural and cultural resources. This is a sensitive area for cultural resources and implementation may encounter frequent interruptions due to discovery of cultural artifacts. Once implemented, Alternative D will most likely result in degraded habitat within close proximity to the river shoreline. Because of the close proximity to the river, long-term maintenance and monitoring will be required during and after remediation.

Cost. The estimated cost for this alternative is $60 million, with a range of $25 to $287 million (see Tables 6-2, 6-3, and Appendix G). This alternative will require significant habitat mitigation and restoration costs to address natural and cultural resource impacts.

6.3.6 Alternative E - Selective Slurry Wall Containment

6.3.6.1 Description. The purpose of this alternative is to meet remediation goals by combining containment of the most contaminated groundwater (to prevent discharge to the Columbia River) with natural flushing of the remainder of the aquifer. For this FS, a total uranium concentration of 80 μg/L was assumed to define the selective remediation area (see Figure 5-1 and Section 5.2). This concentration represents the area for relatively cost-effective groundwater extraction and treatment, should it be required. This wall would also contain the nickel, TCE, and DCE plumes. The objective of this alternative is the same as Alternative C (Selective Hydraulic Containment), but it relies on passive containment by a vertical, low-permeability wall instead of active hydraulic containment. This alternative would include the following key components:

1. Construction of a slurry wall around the selective remediation area.

2. Use of natural aquifer flushing and institutional controls outside of the contained area to achieve remediation goals.

3. Construction and operation of a groundwater extraction and treatment system for radionuclides. The system would extract and treat the minimum volume of groundwater necessary to maintain an inward gradient within the slurry wall (i.e., groundwater elevations lower inside the slurry wall than outside). Operation of the extraction and treatment system would continue until groundwater contaminant concentrations are below remediation goals (i.e., 20 μg/L total uranium). The extraction system would not target the nickel, TCE, and DCE because these contaminants are confined to a small area when compared to the area of the extraction system, they will likely be below acceptable limits when extracted with the larger volume of groundwater specified for the system). If their concentrations from extraction are unacceptable, TCE and DCE could be targeted and extracted with deep wells and then separately treated before being discharged.

4. Use of institutional controls (described in Section 6.3.3) and monitoring (described in Section 6.2.1) to prevent or minimize exposure to contaminants as long as groundwater contaminant concentrations in the operable unit are above remediation goals.

General considerations for slurry wall construction are discussed in Section 6.2.3. The approximate slurry wall alignment for this alternative is shown in Figure 6-12; the exact wall alignment would be determined during final design. The estimated wall length is 915 m (3,000 ft). Because the slurry wall would be constructed near or through near-surface contaminated areas, close coordination with 300-FF-1 remediation activities would be necessary. The slurry wall would not extend into the 300-FF-2 Operable Unit.

Groundwater would be extracted for treatment using wells (see Section 6.2.2). Groundwater treatment would be performed as discussed in Section 6.2.4. Water treatment would remove contaminants to levels suitable for discharge to the Columbia River. The treatment system would generate radioactive sludge requiring landfill disposal (e.g., at the ERDF).

A process flow diagram for groundwater treatment for this alternative is provided in Figure 6-13 (which also applies to Alternative F - Extensive Slurry Wall Containment). The system would have a design capacity of 7 gal/min (34 L/min) (see Section 6.2.4 and Appendix F) and operate at the design flow rate.

An 8-hour retention time has been assumed for feed storage needs. To avoid the need for two sand filters for this small treatment system, a single continuous-backwash filter has been assumed. Alternately, two sand filters in parallel could be used, with one in operation while the other is being backwashed. The two ion-exchange columns would normally operate in series. Most of the contaminants would be removed in the primary column; the secondary column would provide polishing to achieve low discharge limits. When the primary column becomes exhausted, the secondary column (with most of its capacity yet unused) would operate alone while the exhausted column is being regenerated. The regenerated column would then be returned to operation as the secondary column.

6.3.6.2 Evaluation. Overall Protection of Human Health and the Environment. This alternative partially meets this threshold criterion. Current risks are below acceptable limits, and remediation goals would be achieved by a combination of groundwater containment and natural flushing of groundwater that has very low contaminant concentrations. Exposure to contaminated groundwater would be prevented using slurry wall containment, institutional controls, and monitoring until remediation goals are achieved. Groundwater extraction would eventually reduce groundwater contaminant concentrations to below remediation goals, but would take a long time (possibly exceeding 100 years). This alternative does not meet the RAO of achieving acceptable groundwater concentrations by year 2018.

This alternative will likely cause a major impact to natural and cultural resources through construction and operation of the slurry wall (Figure 6-12). It will directly impact the Columbia River shoreline, riparian habitat, and wildlife species. Because of the size of the selective slurry operation, it will be difficult to avoid impacts to habitat, wildlife, and cultural resources.

Compliance with ARARs. This alternative partially meets this threshold criterion because exposure to groundwater that has contaminant concentrations above MCLs would be prevented, including the near-shore river water affected by contaminated groundwater. However, the remedial timeframe of 100 years may not meet the MTCA requirement for remediation in a reasonable timeframe. Groundwater is not currently used for drinking water, and such use would be prevented until remediation goals are achieved.

An ACL may be required because, even though potential risks in near-shore river water are within acceptable limits, contaminants from the operable unit may be discharging under some conditions in near-shore river water above MCLs. However, operable unit contaminants are well below MCLs in the river during average river stage conditions, in the 300 Area water intake, and in the city of Richland water supply.

Impacts from construction and maintenance of the slurry wall containment system are expected to adversely impact the natural and cultural resources near and within the riparian zone, which would require appropriate mitigation planning.

Long-Term Effectiveness and Permanence. Inside the slurry wall, remedial action objectives would be achieved primarily via long-term containment combined with institutional controls and monitoring. Over time, contaminant concentrations would decrease, and remediation goals would eventually be met. Outside the slurry wall, groundwater concentrations of radionuclides would be reduced to below MCLs via natural flushing of the aquifer, achieving remediation goals for these contaminants in an estimated 3 to 10 years (from late 1993). Concentrations of nickel, TCE, and/or DCE may remain in isolated locations inside the slurry wall slightly above MCLs, but continued institutional controls and monitoring would prevent exposure and thereby achieve RAOs. Exposure to contaminated groundwater prior to achieving remediation goals is addressed under short-term effectiveness.

Reduction in Toxicity, Mobility or Volume through Treatment. This alternative provides containment, extraction, and treatment of the most highly contaminated groundwater, and reduces the volume of contaminants discharged to the Columbia River. These contaminants would be concentrated in a sludge for ERDF disposal.

Short-Term Effectiveness. This alternative will contain the highest concentrations of all contaminants (uranium, nickel, TCE, and DCE) within the slurry wall, eliminating their discharge to the Columbia River. Short-term impacts would consist of discharge of uranium-contaminated groundwater outside the selective remediation area to the Columbia River for an estimated 3 to 10 years (from late 1993). This groundwater has contaminant concentrations that are low but above remediation goals. The most contaminated groundwater would be collected and treated. During this time, exposure to contaminated groundwater would be prevented by institutional controls and monitoring. In addition, risks at the site (including near-shore river water) are currently below acceptable limits.

There would be moderate to high risk to remediation workers resulting from construction and operation of a moderate-length slurry wall and a small groundwater extraction and treatment system (see Table 6-1). There are no measurable offsite impacts (i.e., contaminants from the operable unit are at background levels in nearby river water intakes).

Because of the minimum extraction rates, flushing of the area within the slurry wall would proceed slowly. It would therefore take a long time (possibly more than 100 years) for contaminant concentrations to fall below remediation goals. If necessary, flushing could be accelerated at increased cost by increasing the extraction rate.

Based on this alternative, there will likely be a reduction in the quality of the site for natural and cultural resources through physical destruction of habitat and potential disturbance of cultural artifacts. It is highly likely that ecological receptors will be exposed to physical impacts (e.g., noise, intrusion to habitat and special breeding areas, temporary displacement).

Implementability. There are potential difficulties involved in constructing a slurry wall at this site, as discussed in Section 6.2.3. Construction of a small groundwater extraction and treatment system would be relatively simple.

The construction of the containment wall will require a habitat mitigation and restoration plan to avoid impacts where possible and minimize unavoidable adverse impacts that do occur. This is a sensitive area for cultural resources and implementation of remediation may encounter frequent interruptions due to discovery of cultural artifacts. Once implemented, Alternative E will most likely result in degraded habitat within close proximity to and along the river shoreline. Because of the close proximity to the river, long-term maintenance and monitoring will be required during and after remediation.

Cost. The estimated cost for this alternative is $34 million with a range of $24 to $46 million (see Tables 6-2, 6-3, and Appendix G). In addition, this alternative will require significant habitat mitigation and restoration costs. The construction and related activities for the containment wall will be disruptive to wildlife and will impact vegetation and cultural resources. A habitat mitigation and restoration plan for addressing affected resources will be required.

6.3.7 Alternative F - Extensive Slurry Wall Containment

6.3.7.1 Description. The purpose of this alternative is to meet remediation goals by containment of all groundwater with concentrations above remediation goals to prevent discharge to the Columbia

River. The objective for this alternative is the same as for Alternative D (Extensive Hydraulic Containment), but it relies on passive containment by a vertical, low-permeability wall instead of active hydraulic containment. This alternative would include the following key components:

1. Construction of a slurry wall around the extensive remediation area.

2. Construction and operation of a groundwater extraction and treatment system for radionuclides. The system would extract and treat the minimum volume of groundwater necessary to maintain an inward gradient on the slurry wall (i.e., groundwater elevations lower inside the slurry than outside). Operation of the extraction and treatment system would continue until groundwater contaminant concentrations are below remediation goals (i.e., 20 μg/L total uranium).

4. Use of institutional controls (described in Section 6.3.3) and monitoring (described in Section 6.2.1) to prevent or minimize exposure to contaminants as long as groundwater contaminant concentrations in the operable unit are above remediation goals.

The slurry wall would enclose the extensive remediation area as completely as practical. Some areas may need to be outside the slurry wall. These areas are all on the edge of the 20 μg/L uranium contour (i.e., have contaminant concentrations only slightly above preliminary remediation goals) and could be neglected or collected separately. It was assumed that an extraction well pumping approximately 50 gal/min (190 L/min) would be installed in the vicinity of existing monitoring well 399-3-2, where there is a small area of groundwater with uranium concentrations above 20 μg/L. Unlike Alternative E, the slurry wall for this alternative would enclose the area of nickel, TCE, and DCE contamination. However, the extraction system would not target this area; therefore, special treatment for these contaminants would not be needed because any TCE or DCE in extracted groundwater would become mixed and diluted to levels already below discharge limits.

General considerations for slurry wall construction are discussed in Section 6.2.3. The approximate slurry wall alignment for this alternative is shown in Figure 6-14; the exact wall alignment would be determined during final design. The estimated wall length is 4,100 m (13,500 ft). Because the slurry wall would be constructed near or through near-surface contaminated areas, close coordination with 300-FF-1 and 300-FF-2 remediation activities would be necessary. For this alternative, part of the slurry wall for extensive remediation would pass through the developed portion of the 300 Area, which contains a dense concentration of buildings and buried piping and utilities. Some of the soils in this area are expected to be contaminated and require remediation (as part of the 300-FF-2 Operable Unit). Some of the potential difficulties associated with wall construction through the developed area are as follows:

- Utility lines would require decommissioning or rerouting before the wall is constructed. Decommissioning costs are part of 300-FF-2 remediation. However, costs of rerouting piping and utilities solely resulting from wall construction are included in the cost estimates for the slurry wall alternatives. The exact number, type, and locations of buried pipes and utilities would need to be determined before beginning wall construction through the developed area.

- The wall would need to pass within 15 m (50 ft) of some buildings, which in some soils can cause concerns about possible damage to building foundations. Geotechnical investigations and analysis would be needed to address this concern. If soil stability during wall construction is a concern in this area, that portion of the wall could be constructed (at greater cost) with cement-bentonite admix, which results in a wall with greater structural strength than a soil bentonite wall. For this FS, it has been assumed that a cement-bentonite wall will not be required for any major distance.

- Treatment and disposal of contaminated soil from the developed area is part of 300-FF-2 remediation, and is not included in the cost estimates for the 300-FF-5 Operable Unit. However, the design, planning, and scheduling of the remedial actions for the two operable units would require close coordination.

- Because of the above-listed difficulties, the unit cost of wall construction would be greater through the developed area than the rest of the wall. However, a precise estimate of the additional cost is not possible at this time. An estimate of the additional cost based on engineering judgement is included in the cost estimate for Alternative F (Extensive Slurry Wall Containment)

Techniques besides slurry construction, such as grout injection or mix-in-place construction, may be more appropriate for some sections of the vertical barrier wall, both inside and outside of the developed area. These techniques would be incorporated into wall construction during final design, to address specific problems or concerns identified during detailed design.

Groundwater would be extracted for treatment using wells (see Section 6.2.2). Groundwater treatment would be performed as discussed in Section 6.2.4. Water treatment would remove contaminants to levels suitable for discharge to the Columbia River. The treatment system would generate radioactive sludge requiring landfill disposal (e.g., at the ERDF).

A process flow diagram for groundwater treatment for this alternative is provided in Figure 6-13 (which also applies to Alternative E - Selective Slurry Wall Containment). Design and operation of this system would be the same as described in Section 6.3.6.1 for Alternative E. The only difference would be the increased capacity of the treatment system (i.e., larger equipment sizes). The system would have a design capacity of approximately 80 gal/min (304 L/min) (Section 6.2.4 and Appendix F) and operate at the design flow rate.

6.3.7.2 Evaluation. Overall Protection of Human Health and the Environment. This alternative partially meets this threshold criterion. Current risks are below acceptable limits, and remediation goals would be achieved by containing all groundwater that has contaminant concentrations above remediation goals. Exposure to contaminated groundwater would be prevented using slurry wall containment, institutional controls, and monitoring until remediation goals are achieved. Groundwater extraction would eventually reduce groundwater contaminant concentrations to below remediation goals, but would take a long time (possibly more than 100 years).

Natural resource impacts are likely to be greatest under this alternative. Because the slurry wall will be over 4,100 m (13,500 ft) in length, 36 m (120 ft) below the surface, and run along the operable unit boundary with the Columbia River, construction of the wall will result in major impacts to wildlife, vegetation, and cultural resources. It is highly likely that construction activities of this

magnitude will result in sediment releases to the Columbia River aquatic habitat. Significant habitat mitigation and restoration actions could be required.

Compliance with ARARs. This alternative partially meets this threshold criterion by containing all groundwater that has contaminant concentrations above MCLs, including nickel, TCE, and DCE, thereby preventing discharge of this contaminated groundwater to the Columbia River. However, the alternative may not meet the MTCA requirement for remediation in a reasonable timeframe.

Impacts from construction and maintenance of the slurry wall containment system are expected to adversely affect the natural and cultural resources near and within the riparian zone. Mitigation planning will be required.

Long-Term Effectiveness and Permanence. All groundwater with contaminant concentrations above remediation goals, including nickel, TCE, and DCE, would be contained in this alternative. Remedial action objectives for preventing exposure would be achieved primarily via long-term containment combined with institutional controls and monitoring. Over time, contaminant concentrations would decrease, and remediation goals would eventually be met, although this could take more than 100 years, which does not meet the RAO of acceptable groundwater concentrations by year 2018.

Reduction in Toxicity, Mobility or Volume through Treatment. This alternative provides containment, extraction, and treatment of all groundwater that has contaminant concentrations above remediation goals, resulting in the maximum reduction in the volume of contaminants discharged to the Columbia River. These contaminants would be concentrated in a sludge for ERDF disposal.

Short-Term Effectiveness. This alternative also includes containment of groundwater contaminated by nickel, TCE, and DCE, because these compounds are contained within the slurry wall. Active remediation of groundwater containing TCE and DCE in the other alternatives would require separate, targeted extraction wells. Because of the minimum extraction rates, flushing of the area within the slurry wall would proceed slowly. It would therefore take a long time (possibly more than 100 years) for contaminant concentrations to fall below remediation goals. If necessary, flushing could be accelerated at increased cost by increasing the extraction rate. There is relatively high worker risk for this alternative (see Table 6-1) resulting from construction of a very long slurry wall and construction and operation of a moderate-size groundwater extraction and treatment system.

Based on this alternative, there will be a reduction in the quality of the site for natural and cultural resources through physical destruction of habitat and potential disturbance of cultural artifacts. It is highly likely that ecological receptors will be exposed to physical impacts (e.g., noise, intrusion to habitat and special breeding areas, temporary displacement).

Implementability. This alternative would be relatively difficult to implement because of construction of a very long slurry wall and construction and operation of a moderate-size groundwater extraction and treatment system. There are additional difficulties in constructing a slurry wall through the developed portion of the 300 Area, as discussed in Section 6.3.7.1.

The construction of the containment wall will require a habitat mitigation and restoration plan to avoid impacts where possible and minimize unavoidable adverse impacts that do occur. Because of

the magnitude of this system, this alternative cannot be implemented without major impacts to natural and cultural resources. This is a sensitive area for cultural resources and implementation may encounter frequent interruptions due to discovery of cultural artifacts. Once implemented, Alternative F will most likely result in degraded habitat within close proximity to the river shoreline. Because of the close proximity to the river, long-term maintenance and monitoring will be required during and after remediation.

Cost. The estimated cost for this alternative is $100 million, with a range of $74 to $149 million (see Tables 6-2, 6-3, and Appendix G). In addition, this alternative will require the most significant habitat mitigation and restoration costs. The construction and related activities for the containment wall will be disruptive for wildlife and will impact natural and cultural resources. A habitat mitigation and restoration plan for addressing affected resources will be required.

6.4 COMPARATIVE EVALUATION OF ALTERNATIVES

In this section, the criteria evaluations of the alternatives presented in Section 6.3 are used to compare the alternatives. The comparative evaluation is intended for use by decision-makers in selecting a preferred alternative for remediation of the operable unit. The information to be used in selecting a preferred alternative is presented in this FS for use by the decision-makers. For this site, the decision-makers are the signatories to the Tri-Party Agreement: the DOE, EPA, and Ecology. Following review of this FS, the DOE, EPA, and Ecology will prepare a Proposed Plan identifying the preferred alternative, which is provided with the FS for public review and comment. The final decision will be documented in the ROD for the operable unit.

Overall protection of human health and the environment and compliance with ARARs are "threshold" criteria and require that each alternative meet these requirements in order to be eligible for selection. With respect to the affected natural and cultural resources, these criteria emphasize minimizing or avoiding impacts to natural and cultural resources. The comparative evaluation is based on the five remaining criteria: (1) long-term effectiveness and permanence, (2) reduction in toxicity, mobility and volume through treatment, (3) short-term effectiveness, (4) implementability, and (5) cost. The evaluation encourages source control actions that reduce risks, cleanup costs, and future liabilities.

6.4.1 Long-Term Effectiveness and Permanence

In all of the alternatives, including no action, groundwater concentrations of radionuclides will decrease to below remediation goals in the long term. Nickel, TCE, and DCE may remain within isolated portions of the aquifer at concentrations slightly above MCLs with all alternatives. The alternatives differ in the extent to which the RAOs are achieved, in the time required to achieve remediation goals, and in the short-term effectiveness of the alternative prior to achieving remediation goals. Table 6-4 summarizes the comparative evaluation and relative ranking of the alternatives for long-term effectiveness and permanence. Human and ecological risks at the site, including near-shore river water (during average river stages), are currently below acceptable limits. The only current potentially unacceptable risk that has been identified resulting from contaminated groundwater from the 300 Area is for exposure to chloroform at well 399-4-12, which is solely used for non-potable

industrial purposes. In addition, the concentration of chloroform in this well is below the MCL and within the normal, acceptable range for municipal water supplies.

Nickel, TCE, and DCE are found only in isolated areas in concentrations above MCLs (very near well cluster 399-1-16). However, the potential for exposure to these isolated concentrations is very low, even with no action. Concentrations of nickel, TCE, and/or DCE may remain in this isolated location slightly above MCLs for an extended time. Only Alternatives E (Selective Slurry Wall Containment) and F (Extensive Slurry Wall Containment) would provide long-term containment of nickel, TCE, and DCE contaminated areas.

The slurry wall containment alternatives (E and F) take the longest to achieve remediation goals (possibly more than 100 years), because of low groundwater extraction rates and prevention of natural flushing in part or all of the operable unit. However, slurry wall containment would provide effective and reliable control until remediation goals are achieved. However, these alternatives do not fulfill the RAO of achieving acceptable groundwater concentrations by year 2018.

Concentrations of operable unit contaminants are not found at significant levels at any point with reasonable potential for exposure to humans. Contaminant concentrations of most metals found in the wildlife, vegetation communities, and the aquatic environment were found to be below concentrations considered toxic. There are no measurable offsite impacts (i.e., contaminants from the operable unit are at background levels in nearby and downstream river water intakes). Protection of the environment is demonstrated by sampling results that show contaminant concentrations in near-shore river water are well below acceptable limits in the Columbia River during average river stage conditions. Additional documentation is provided by downstream water quality monitoring at the city of Richland water supply intake, where 300-FF-5 Operable Unit contaminants are at background levels.

For these reasons, the alternatives are considered to have different relative rankings for long-term effectiveness and permanence, but these differences are not considered significant. There are significant differences between the alternatives in the comparative evaluations for the other criteria that provide a defensible and sufficient basis for selection of a remedy for the 300-FF-5 Operable Unit. The alternatives are therefore ranked as follows for long-term effectiveness and permanence (best to worst):

1. Alternative B (Institutional Controls)
2. Alternatives A (No Action), C, and D (Hydraulic Containment) (tie)
3. Alternatives E and F (Slurry Wall Containment) (tie).

6.4.2 Reduction of Toxicity, Mobility, and Volume through Treatment

Table 6-5 summarizes the comparative evaluation and relative ranking of the alternatives for this criterion. The ranking for the alternatives for this criterion is straightforward, based on the quantity of contaminated groundwater that would be extracted and treated. The extensive remediation alternatives (D and F) contain and treat all groundwater that has radionuclide concentrations above MCLs, and tie for the most treatment provided. The selective remediation Alternatives (C and E) tie in intermediate ranking for providing selective extraction and treatment of contaminated groundwater.

Alternatives A (No Action) and B (Institutional Controls) do not provide treatment. The alternatives are therefore ranked as follows for this criterion (most to least treatment):

1. Alternatives D and F (Extensive Remediation) (tie)
2. Alternatives C and E (Selective Remediation) (tie)
3. Alternatives A (No Action) and B (Institutional Controls) (tie).

Extraction and treatment of groundwater decreases the discharge of contaminants from the groundwater, although there is no evidence that the current discharge presents unacceptable risks to human health or the environment. Treatment generates radioactive sludge for disposal in the ERDF or other suitable disposal facility, meaning that the net effect of treatment is preventing exposure via long-term containment, institutional controls, and monitoring at a location separate from the operable unit.

6.4.3 Short-Term Effectiveness

Based on estimates of potential accidents and radiation exposure (Table 6-1) the alternatives rank as follows for short-term risk to remediation workers (least risk to greatest risk):

1. Alternative A (No Action)
2. Alternative B (Institutional Controls)
3. Alternative C (Selective Hydraulic Containment)
4. Alternative D (Extensive Hydraulic Containment)
5. Alternative E (Selective Slurry Wall Containment)
6. Alternative F (Extensive Slurry Wall Containment).

This ranking for worker risk also corresponds to the relative short-term disturbance of ecological habitat within the operable unit, resulting from potential construction activities. There are impacts to the affected natural and cultural resources from the construction of the systems themselves (e.g., dynamic interactions between the operable unit and the river system for hydraulic containment, constructing a slurry wall over 4,100 m (13,500 ft) in length, 36 m (120 ft) below the surface near the riparian zone). Indirect impacts to the affected natural and cultural resources would be incurred via construction and operation of the facilities, and transportation of the generated radioactive sludge. However, wildlife habitat in the 300 Area has historically been disturbed by industrial and waste management activities and very little undisturbed habitat currently exists. The riparian zone along the river is valued habitat and is one of the primary Hanford Site research areas. Remedial action would occur outside the riparian zone and with any necessary mitigative measures to avoid unacceptable adverse impacts on the riparian zone. There are no plants or wildlife on the federal list of Endangered and Threatened species that are known to occur within the operable unit. However, several sensitive and candidate plant and animal species are present (Section 2.2.8). Appropriate habitat mitigation measures will be required to avoid or minimize impacts to natural resources, consistent with the Hanford Sitewide mitigation plan currently being prepared by DOE-RL in cooperation with the U.S. Fish and Wildlife Service and the Washington State Fish and Wildlife Department. As part of this plan, impacted natural resources will require mitigation or restoration. Mitigation measures for cultural resources must be developed in accordance with the Hanford Cultural Resources Management Plan.

None of the alternatives would result in significant offsite risk. However, there is the potential for direct, indirect and/or cumulative impacts on natural and cultural resources during implementation of remedial actions C, D, E and F. Concentrations of operable unit contaminants away from the operable unit are well below acceptable risk levels, and generally are at background levels. Even on the site, the estimated risks are below acceptable levels.

Contaminants are being discharged to the Columbia River. Therefore, even though the risk estimates do not indicate a problem, the relative short-term risks to the environment of the alternatives may be taken as the relative volumes of contaminated groundwater and concentrations of contaminants discharging to the river. On this basis, the alternatives are ranked as follows (least to most discharge of contaminants to the river):

1. Alternatives D and F (extensive remediation) (tie)
2. Alternatives C and E (selective remediation) (tie)
3. Alternatives A and B (natural flushing) (tie).

Alternatives B (Institutional Controls), C (Selective Hydraulic Containment), and D (Extensive Hydraulic Containment) will meet all RAOs in the short-term. Alternatives E (Selective Slurry Wall Containment) and F (Extensive Slurry Wall Containment) do not meet the RAO of achieving acceptable groundwater concentrations by year 2018. Alternative A would also not meet the remedial action objective of limiting human exposure to contaminated groundwater in the short-term. However, with respect to natural and cultural resources, Alternatives C, D, E, and F pose the greatest potential for short-term impacts and Alternatives A and B pose the least potential for short-term impacts.

Table 6-6 summarizes the comparative evaluation of the alternatives and presents an overall relative ranking of the alternatives for short-term effectiveness, considering the factors discussed above and the other components of this criterion discussed in Section 6.1.5.

6.4.4 Implementability

There is a significant difference in the implementability of the alternatives. Table 6-7 summarizes the comparative evaluation and relative ranking of the alternatives for this criterion, which are as follows (easiest to hardest):

1. Alternative A (No Action)
2. Alternative B (Institutional Controls)
3. Alternative C (Selective Hydraulic Containment)
4. Alternative E (Selective Slurry Wall Containment)
5. Alternative D (Extensive Hydraulic Containment)
6. Alternative F (Extensive Slurry Wall Containment).

Alternatives A (No Action) and B (Institutional Controls) are the most easily implemented and would result in the least impacts to natural and cultural resources. The remaining alternatives all have potential difficulties in varying degrees. None of these difficulties, however, would be expected to prevent implementation of the alternative.

The general difficulties associated with hydraulic containment are discussed in Section 6.2.2. The general difficulties associated with slurry walls are discussed in Section 6.2.3. Each technology has its advantages and disadvantages in terms of implementability; neither is considered to be superior to the other. These technologies have differences in short-term effectiveness and cost that are more significant than the differences in implementability. Furthermore, some of the differences in implementation of hydraulic and slurry wall containment have been included in the cost estimates for the alternatives.

There is approximately one order of magnitude difference in the area of containment and degree of remediation attempted by the selective and extensive remediation alternatives. Consequently, both selective remediation alternatives (C and E) would be much easier to implement than the extensive remediation alternatives. Alternative D (Extensive Hydraulic Containment) would require construction and operation of a very large groundwater extraction and treatment system (approximately 4,000 gal/min [15,200 L/min] capacity). Alternative F (Extensive Slurry Wall Containment) would require construction of a very long slurry wall, including portions through developed portions of the 300 Area where there would be additional difficulties (Section 6.3.7.1). These alternatives run the greatest risk of encountering cultural resources. Mitigation could result in extended delays.

6.4.5 Cost

Table 6-2 summarizes the deterministic estimates of capital and operating costs for the remediation alternatives. Details of the cost estimates are presented in Appendix G. To quantify uncertainties in the cost estimates, a probabilistic (stochastic) analysis was performed, which is summarized in Table 6-3 and presented in Appendix F. Higher percentiles represent increasing confidence that the cost estimate will not be exceeded if the remedial alternative is implemented.

The cost ranking of the alternatives, from least to most expensive, is as follows:

1. Alternative A (No Action).
2. Alternative B (Institutional Controls)
3. Alternative C (Selective Hydraulic Containment)
4. Alternative E (Selective Slurry Wall Containment)
5. Alternative F (Extensive Slurry Wall Containment)
6. Alternative D (Extensive Hydraulic Containment).

The primary determinant in this cost ranking is the degree of remedial action: natural flushing, selective active remediation, or extensive active remediation. Of secondary importance are the differences between costs for hydraulic and slurry wall containment technologies. In addition, associated costs for habitat mitigation or restoration of impacted natural and cultural resources will have to be considered. Hydraulic containment involves relatively large capital and operating costs for a groundwater extraction and treatment system. Slurry walls are costly to construct but save on capital and operating costs because less groundwater extraction and treatment are required. Based on the deterministic cost estimates for these alternatives, a slurry wall is cost-effective containment for extensive remediation, but not for selective remediation.

From both the deterministic and probabilistic estimated costs of the alternatives, it is clear that the least expensive alternatives are Alternative A (No Action) and B (Institutional Controls). The cost of these alternatives is dominated by the cost of monitoring, which is included in all of the alternatives. Therefore, regardless of the exact cost of monitoring, there is little uncertainty in the costs of these alternatives both in comparison to each other and in comparison to the other alternatives. Furthermore, habitat mitigation or restoration costs would be minimal for these alternatives because there would be little or no future impacts to natural and cultural resources.

The next most expensive alternatives are the selective remediation alternatives (C and E). For selective remediation, the deterministic cost estimate predicts that the cost of hydraulic containment would be approximately 35% of the cost of slurry wall containment. This estimate corresponds to the mode (most likely value) in the probability distribution function (PDF) for the cost ratio of Alternatives C and E (see Appendix G). There is an estimated 20% chance that slurry wall containment would be less expensive.

The most expensive alternatives are the extensive remediation alternatives (D and F). For extensive remediation, the deterministic cost estimate predicts that the cost of hydraulic containment would be approximately 60% of the cost of slurry wall containment. This estimate corresponds approximately to the mode (most likely value) in the PDF for the cost ratio of Alternatives D to F (see Appendix G). The Monte Carlo simulation predicts about a 20% chance that slurry wall containment would be less expensive. The uncertainty in the relative costs primarily results from uncertainty in the required extraction rate for hydraulic containment.

The probabilistic cost analysis indicated a much greater range of cost for hydraulic containment alternatives. This greater range reflects the high uncertainty in estimating the groundwater extraction and treatment rates (from aquifer hydraulic parameters) in which cost is sensitive for these alternatives. For slurry wall containment alternatives, the greatest uncertainty is in the length of time required to operate the system (potentially in excess of 100 years); beyond 20 or 30 years, however, operational cost (represented in present net value) is insensitive and does not increase significantly. The costs for slurry wall containment alternatives are very sensitive to the length and depth of the slurry wall. These parameters are much better defined.

6.4.6 NEPA Considerations

6.4.6.1 Transportation Impacts. Transportation impacts are considered in the evaluation of alternatives for the short-term effectiveness criterion. Except for Alternatives A (No Action) and B (Institutional Controls), all alternatives would have transportation impacts. It is anticipated that increased road traffic will result from employee commuting and from transport of excavation and treatment equipment to and from the operable unit. However, the magnitude of impact is anticipated to be minimal because remedial activities will not require a large number of workers; only a limited volume of waste would be transported from the operable unit. With the exception of Alternative F (Extensive Slurry Wall Containment), limited import of construction material is also anticipated. An estimated 17,000 vehicles/day travel Route 4 between the intersection with State Route 240 and the Wye Barricade. DOE has recognized the need to mitigate existing traffic congestion. The 240 Access road, anticipated to be completed in December 1994, will reduce traffic loads on Route 4 in the area of the operable unit. DOE also plans to expand Route 4 to four lanes from the Wye barricade to the 200 East Area. Considering these planned traffic improvements, potential increased

road traffic resulting from remediation of the 300-FF-5 Operable Unit will cause only minimal insignificant impacts to Hanford Site traffic.

The operation and design plans for the ERDF will accommodate the anticipated ranges of 300-FF-5 remediation waste potentially requiring disposal. Anticipated Hanford Site roadways and improvements, and extensions are anticipated to compensate for traffic impacts attributable to current or future remedial activities across the Hanford Site.

6.4.6.2 Ecological Impacts. Wildlife habitat in the 300-FF-5 Operable Unit has historically been disturbed by waste management activities and industrial development, so relatively little undisturbed habitat exists in the western and northern portions of the operable unit, the Columbia River, and along sections of the shoreline. Ecological impacts will occur in areas of the operable unit, at construction material borrow sites, and potentially along transportation routes. Potential impacts may include destruction of habitat, displacement of wildlife, and disturbance by human activities (including noise). Ecological impacts are evaluated under the FS criteria "overall protection of human health and the environment," "long-term effectiveness and permanence," and "short-term effectiveness" in Sections 6.3 and 6.4. Mitigative measures will be implemented to compensate for potential ecological impacts associated with remediation of the 300-FF-5 Operable Unit, and no net lost habitat is anticipated.

Except for Alternatives A (No Action) and B (Institutional Controls), all alternatives will involve removal of some existing vegetation for construction of wells, a treatment system, and/or a slurry wall. Slurry wall construction is anticipated to impact more vegetation than installation of an extensive extraction well network.

The riparian zone along the river is valued habitat. Riparian vegetation serves as primary food sources for a variety of browsing animals because the herbaceous plants stay succulent throughout the hot, dry summer months. Trees associated with this habitat are important because they create microclimates and provide nesting habitat for a number of bird species. Predominant vegetation along the riparian zone reported during 300-FF-5 biological surveys include many plant species indicative of wetland environments. Wetland delineations have not been performed within the operable unit. Although remediation of the 300-FF-5 Operable Unit may require construction activities in close proximity to the river, remedial actions are planned outside of the riparian zone and will incorporate mitigative measures necessary to avoid adverse impacts to this zone.

Ecological impacts are also anticipated at borrow sites used to supply backfill and barrier materials. Specific borrow sites have not been identified. However, the borrow sites used for 300 Area remediation would be the same as for ERDF and other site-wide remedial activities. The HRA-EIS (DOE 1994, in progress) identifies McGee Ranch, Gable Butte, and Borrow Pit 30 as three potential sources of construction materials. Slurry wall construction may require fine grained materials similar to those present at the McGee Ranch. The quantity of borrow material that could be needed for 300-FF-5 is small relative to other operable units (e.g., capping 300-FF-1). In addition, mitigative actions will be implemented at borrow sites to minimize ecological impacts.

Remediation of the 300-FF-5 Operable Unit is anticipated to generate waste requiring disposal at the ERDF, to be located in the 200 Area of the Hanford Site. Ecological impacts that may result from siting, construction, and operation of the ERDF are addressed in the RI/FS prepared for the

ERDF (DOE-RL 1994i) and are therefore not evaluated separately in this FS. Ecological impacts associated with operation of the W025 landfill are addressed in DOE-RL (1989).

6.4.6.3 Air Quality Impacts. Remediation alternatives proposed for the 300-FF-5 Operable Unit are not anticipated to create any long-term degradation of existing air quality. Some short-term impacts to air could result from construction activities. However, mitigative measures would be implemented to eliminate or control potential air emissions. None of the alternatives would result in a significant negative impact on air quality.

Dust may be visible in the 300-FF-5 Operable Unit due to excavation or groundwater extraction network installation, although this would be minimized by dust control measures, such as use of water sprays or other dust suppressants. Remedial work would also be stopped during periods of high wind as a means to control dust and potential contaminant release.

6.4.6.4 Impacts on Historical and Cultural Resources. Cultural resources have been identified in the area of the 300-FF-5 Operable Unit, and it is highly likely that additional sites exist adjacent to the Columbia River. Section 6.2.7 provides a detailed discussion of cultural resource considerations that affect alternatives requiring excavation of soils. With the exception of Alternative A (No Action) and B (Institutional Controls), remedial alternatives for the 300-FF-5 Operable Unit all require soil excavation, and therefore have high potential to affect archaeological, historical, and cultural resources. Alternative F (Extensive Slurry Wall Containment) has the greatest potential impact because it requires the most extensive excavation activity. Of the remaining Alternatives, D (Extensive Hydraulic Containment) has the next greatest magnitude of potential impact followed by E (Selective Slurry Wall Containment) and C (Selective Hydraulic Containment). Section 6.2.7 discusses how to implement intrusive alternatives to minimize potential impacts to cultural resources.

6.4.6.5 Socioeconomic Impacts. Any remedial action at the 300-FF-5 Operable Unit would create short-term increases in regional employment. However, increased employment would be of limited duration and only a small percentage of total regional employment. Any increased demand for housing associated with remediation of the 300-FF-5 Operable Unit would be negligible.

Cost estimates for the remedial alternatives are summarized in Tables 6-2 and 6-3. There is a wide range in potential remedial costs, depending on the remediation goal and alternative selected. However, the cost of 300-FF-5 remediation is a small part of the total cost of Hanford Site restoration and therefore, by itself, will have minimal impact.

6.4.6.6 Environmental Justice. Evaluation of environmental justice impacts, as required by Executive Order 12898, must consider a range of factors that may place disproportionate negative environmental impacts on minority and low income populations. DOE is in the process of developing official guidance on the implementation of the Executive Order. Environmental justice impacts from the proposed alternatives could consist of disproportionate human health risks from exposure to radioactive or hazardous materials, and disproportionate adverse socioeconomic impacts to minority or low income segments of the community.

Minority (especially Hispanic) populations and low income populations are present near the Hanford Site (Cushing 1994). Based on the information in this FS, the socioeconomic impacts of the proposed action would not be expected to be significant. Any human health impacts would be expected to be very small, and would not be expected to be disproportionately distributed.

6.4.6.7 Noise and Visual Resource Impacts. Noise and impacts on visual resources are considered in the evaluation of alternatives for the short-term effectiveness criterion (Sections 6.3 and 6.4). Minor impacts to visual resources are anticipated during remedial action. Some recreational users of the Columbia River may consider 300-FF-5 remedial activities as negative visual impacts. Considering the existing industrial nature of the 300 Area, this would not represent a change from existing conditions. Long-term visual changes to the operable unit as a result of site remediation would be minor.

The alternatives are anticipated to generate increased noise levels during the period of remediation. However, impacts will be short-term and minimal considering the existing industrial setting. For example, operation of heavy equipment will increase noise levels within the 300 Area. Increased noise associated with transportation of site workers should be negligible. The HRA-EIS performed noise analyses using potential noise sources associated with Hanford Site remedial activities such as heavy truck traffic and transport/operation of heavy construction equipment. The analyses predicted ambient noise levels and evaluated the potential impact to receptors at specified locations. The results from modeling worst-case scenarios indicated that noise impacts from Hanford Site remediation activities are not anticipated to affect the nearest residents. Wildlife are anticipated to be startled; however, noise impacts are anticipated to be temporary, and no residual effects are anticipated (DOE 1994, in progress). Noise mitigation would be provided should noise levels be a problem. All equipment and vehicles will be equipped with mufflers or other noise-reduction devices. There would be no long-term noise resulting from site remediation.

6.4.6.8 Irreversible and Irretrievable Commitment of Resources. Remediation of the 300-FF-5 Operable Unit may require commitment of several million dollars of Federal funds (Tables 6-2 and 6-3), depending on the alternative selected. Other irreversible commitment of resources may include the bentonite material required for slurry wall construction, structural and mechanical equipment required for installation of a groundwater extraction network, and consumables such as fuel, electricity, chemicals (e.g., polymers), and disposable personal protective equipment used during remediation.

The development and evaluation of remedial alternatives for the 300-FF-5 Operable Unit assumes that future land use would be industrial. Institutional controls would be required to prevent uses incompatible with the remedy, such as wildlife habitat, recreation, or residential development.

6.4.6.9 Impacts of Connected Actions, Indirect Impacts, and Cumulative Impacts. Remediation of the 300-FF-1 and 300-FF-2 Operable Units are connected actions for the 300-FF-5 Operable Unit. The design and evaluation of 300-FF-5 remediation alternatives assumes selection and implementation of an appropriate remedy for the other operable units. Additional connected actions for 300-FF-5 remediation includes use of borrow material for slurry wall construction and offsite disposal of contaminated soil or waste water treatment sludge. Most of the contaminated soil that would be encountered in 300-FF-5 remedial actions would be vadose zone soils that are part of the 300-FF-1 or 300-FF-2 Operable Units. However, some contaminated soil may be generated during slurry wall construction that would not otherwise be generated. Alternatives that involve groundwater treatment would also generate radioactive sludge for disposal.

The selection of the 300-FF-5 remedial action should consider the potential remedial actions at the 300-FF-1 and 300-FF-2 Operable Units to ensure compatibility and avoid overlap. Location of remedial systems for 300-FF-5, such as extraction and treatment systems or slurry walls, may impact

potential remedial activities within the source operable units. Coordination of remedial efforts in the 300 Area would be accomplished via the management structure established for the 300 Area operable units.

Borrow material would be obtained from existing sources if at all possible. Therefore, 300-FF-5 remediation does not necessarily require development of new borrow sources. However, fine-grained soil would need to be available for slurry wall construction. The quantity of borrow material would be very small compared to other anticipated borrow needs (see cost estimates in Appendix G for estimated quantities).

It has been assumed that ERDF will be available for disposal of wastes from 300-FF-5 remediation. Therefore, ERDF construction and operation is a connected action. If ERDF were not constructed, an alternative disposal facility would be required. Potential NEPA impacts for ERDF are addressed in the RI/FS prepared for ERDF (DOE-RL 1994i), and are not evaluated here. The cost estimates in Appendix G give estimated quantities for contaminated soil disposal during slurry wall construction. The quantity of sludge from wastewater treatment would vary between a few cubic yards/year and tens of cubic yards/year, depending on the alternative. The incremental quantity of sludge and contaminated soil generated during 300-FF-5 remediation will be a very small percentage of the overall quantity anticipated for ERDF.

Remediation of the 300-FF-5 Operable Unit is one relatively small part of the overall program for remediation of the Hanford Site. The total remedial program will have many indirect and cumulative impacts, most of them positive; these impacts are addressed in the HRA-EIS currently being finalized.

6.4.6.10 Potential Land-Use Conflicts. NEPA requires evaluation of potential conflicts between the proposed action and land-use plans of other agencies. This issue is not typically addressed under CERCLA. Remediation of the 300-FF-5 Operable Unit is consistent with the DOE plans for the 300 Area of the Hanford Site. One of the primary missions for the 300 Area specified in the Hanford 300 Area Management Plan (Daly et al. 1991) is to ensure timely implementation of cleanup projects and minimize/reduce the area of contamination.

Remediation of the 300-FF-5 Operable Unit is consistent with the recommendations of the Hanford Future Site Uses Working Group. The working group represents federal, tribal, state, and local governments and individuals from agriculture, labor, environmental, and public interest groups. The Working Group was charged with the task of articulating a range of visions for the future use of the Hanford Site. In Drummond (1992), the group recommended four options for future use of the 300 Area. Options 1, 2, and 4 identify the 300 Area for continued use and development as an industrial and research center. Option 3, however, provides Native Americans access and traditional use of the area for hunting, fishing, and food gathering. In general, access would be provided to the Columbia River, and cultural, religious, and archaeological districts would be protected. This option is consistent with Native American wishes to exercise their claimed treaty rights as prescribed by the treaties of 1855 on the Hanford Site. However, institutional controls (which are included in all remediation alternatives except no action) would include short-term access restrictions for a portion of the 300 Area. In addition, continued industrial use of the 300 Area would render portions of the 300 Area unsuitable for hunting and food gathering.

Remediation of the 300-FF-5 Operable Unit is consistent with the final EIS prepared by the National Park Service (NPS 1994). The National Park Service EIS recommends that Congress designate the river between river mile 396 and 346.5 and land within 0.4 km (0.25 mi) of both banks of the river as a National Wildlife Refuge and National Wild and Scenic River. The area within the National Park Service proposal was specifically selected to exclude the Hanford Site 300 Area because of "extensive cleanup activities" (NPS 1994).

Institutional controls are currently in effect within the 300-FF-5 Operable Unit and elsewhere throughout the Hanford Site. Continuance of access restrictions and other institutional controls has been incorporated into all alternatives evaluated in this FS and is the primary component of one alternative. Alternatives requiring institutional controls will continue to protect valuable cultural resources and are consistent with DOE current mission at the Hanford Site. As an indirect effect of historic use of institutional controls at the Hanford Site, many valuable ecological and cultural resources have been preserved. For example, hydroelectric development, agricultural activities, and domestic and industrial development have destroyed or covered the majority of archaeological and other cultural resources deposits throughout the region. However, access restrictions have hindered Native Americans from exercising claimed treaty rights. Institutional controls have also limited recreational use of the Hanford Site and at times prohibited public use of the Columbia River.

Remedial alternatives proposed for the 300-FF-5 Operable Unit will continue to restrict public access to the Columbia River shoreline. However, these access restrictions would be temporary because remediation goals are expected to be achieved in 3 to 10 years and could be removed at that time, if appropriate.

6.4.6.11 Unavoidable Adverse Impacts. Extensive remediation alternatives with unavoidable adverse impacts could occur to cultural resources located within the 300-FF-5 Operable Unit. These impacts may be considered unavoidable because the groundwater contaminant plumes are located near areas known to be cultural resources once used by Native Americans and Euro-American settlers. These technologies require placement ahead of the leading edge or within the contaminant plume. Technology placement is very important for effective and practical use. Alternatives A (No Action) and B (Institutional Controls) would have negligible impacts to cultural resources.

All of the remedial alternatives proposed for the 300-FF-5 Operable Unit except Alternative A (No Action) would continue to restrict public access to the Columbia River shoreline. However, this unavoidable impact would only last for an estimated 3 to 10 years.

Other impacts attributable to remediation of the operable unit are not considered significant and would be reduced to the extent possible through mitigative measures discussed in Section 6.2.8.

6.4.6.12 Relationship Between Short-Term Use and Long-Term Productivity of the Environment. Short-term impacts would be mitigated to the extent practicable, but most of the alternatives may cause impacts. For example, temporary increases in noise levels and disruption of habitat and wildlife would occur. Significant impacts to cultural resources are also anticipated. These impacts are proportional to the alternative selected, with Alternative F (Extensive Slurry Wall Containment) inducing the greatest overall short-term impact. However, the primary mission at the Hanford Site is to clean up the site, which enhances long-term productivity. Achievement of remediation goals would allow Hanford Site future land use plans to be implemented.

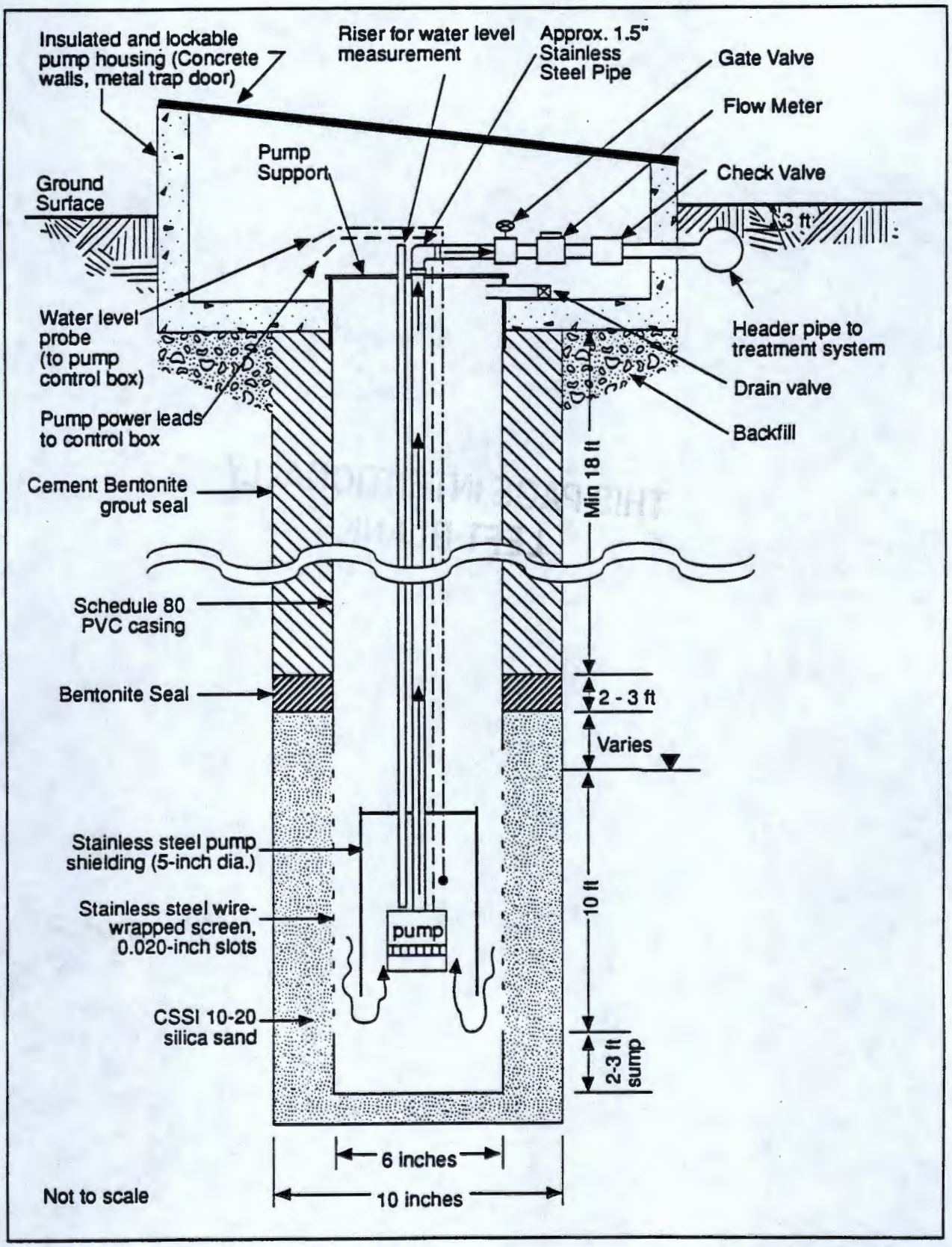

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Figure 6-1. A Schematic of a Typical Groundwater Extraction Well.

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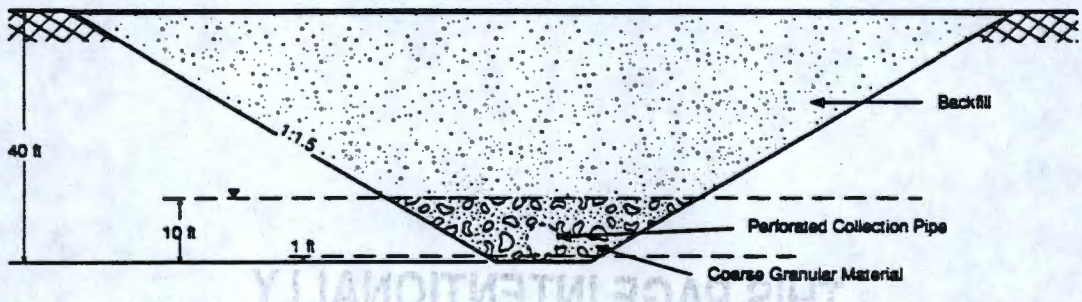
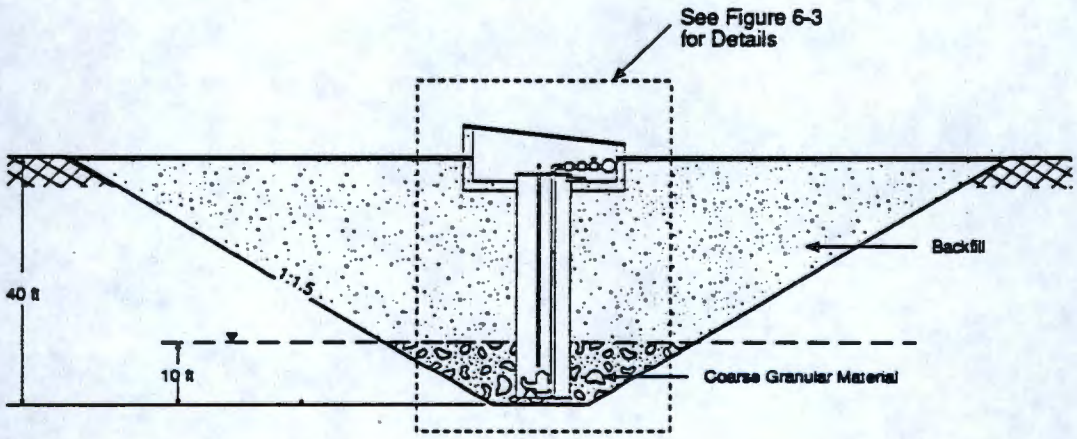


Typical Cross Section of an Extraction Trench



Cross Section of an Extraction Trench at Pump Station

Not to Scale

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Figure 6-2. Cross Section of a Groundwater Extraction Trench.

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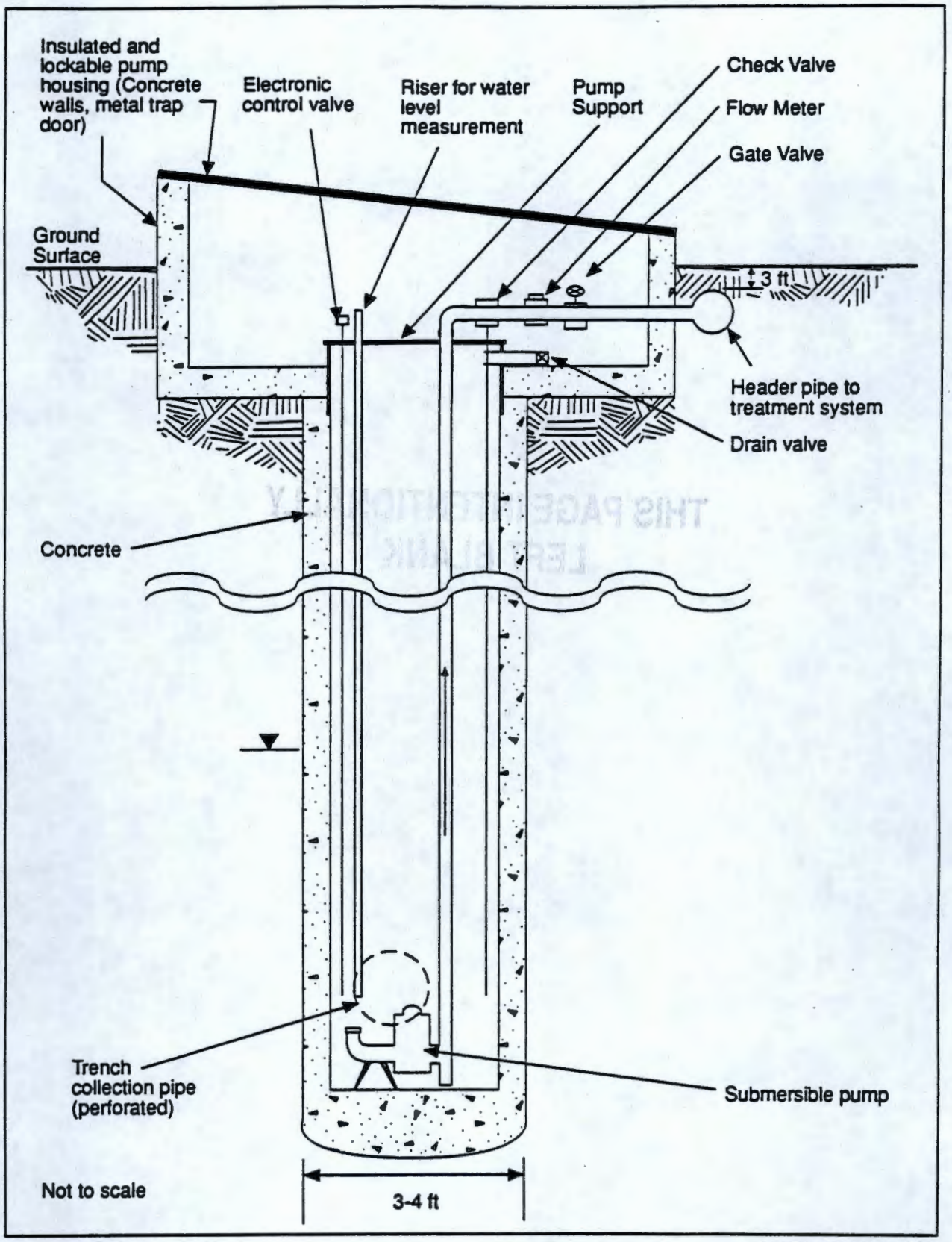

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Figure 6-3. Schematic Diagram of a Typical Extraction Trench Pump Station.

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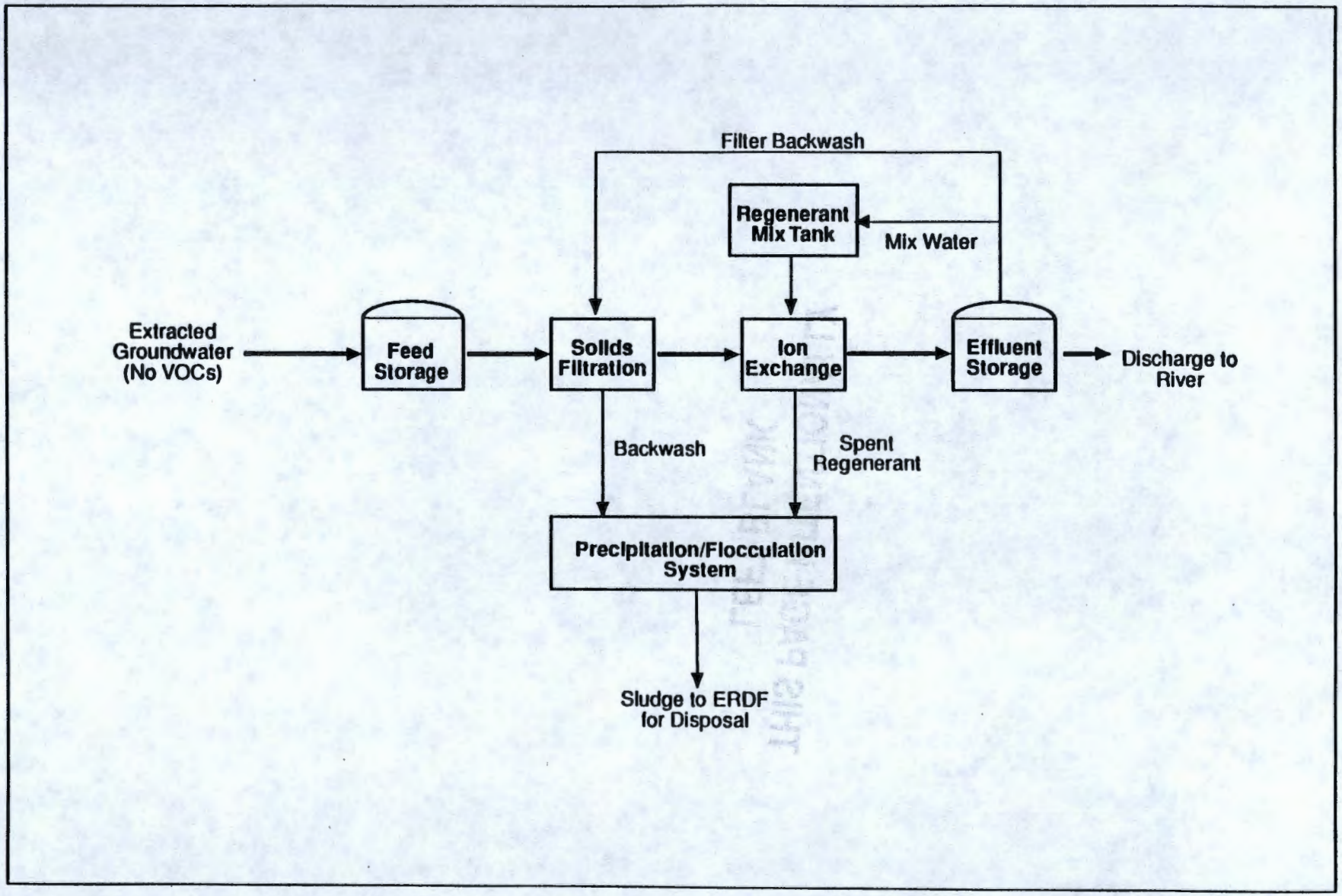

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Figure 6-4 General Process Flow Diagram for Groundwater Treatment.

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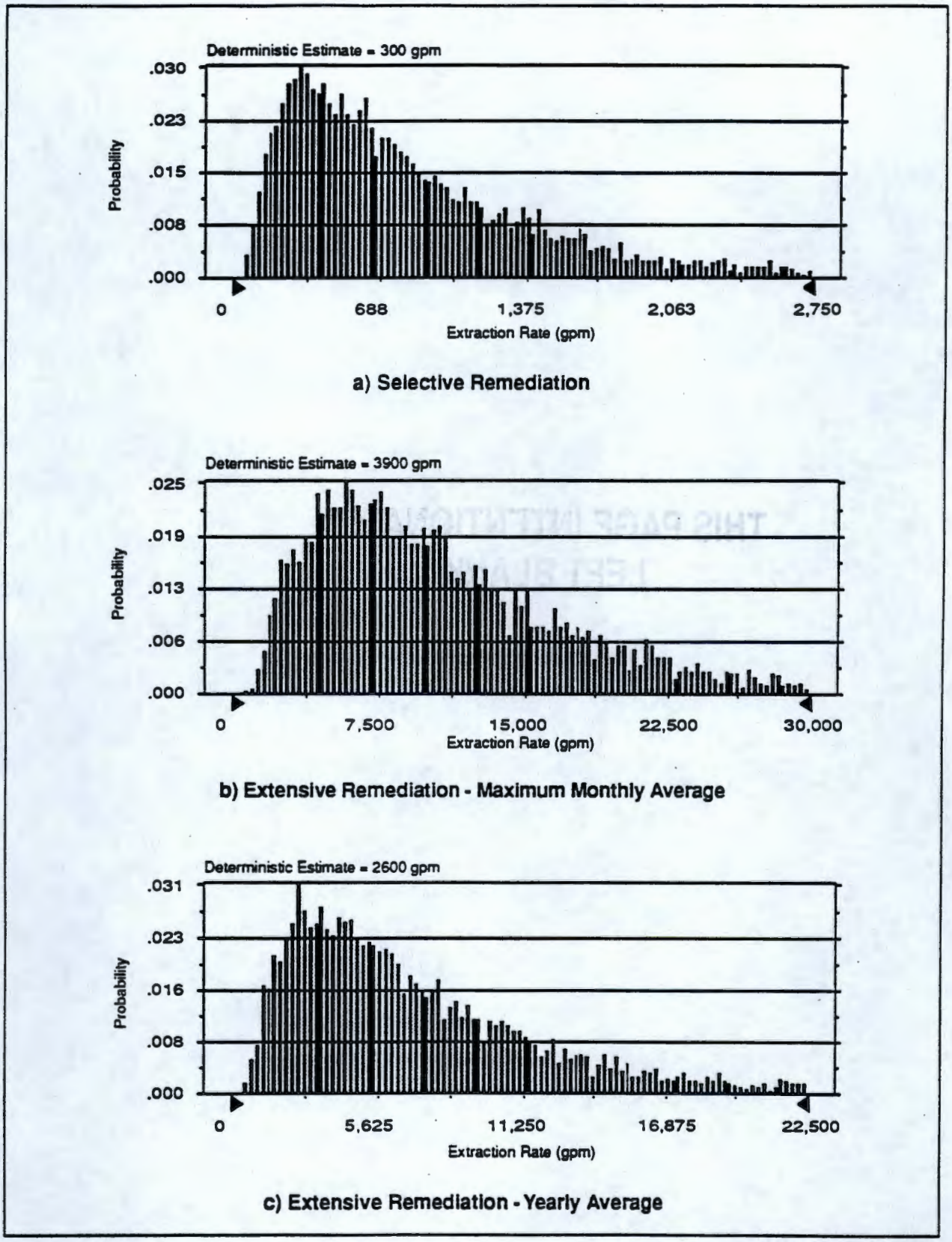

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Figure 6-5 Groundwater Extraction Rate Probability Distributions for Hydraulic Containment.

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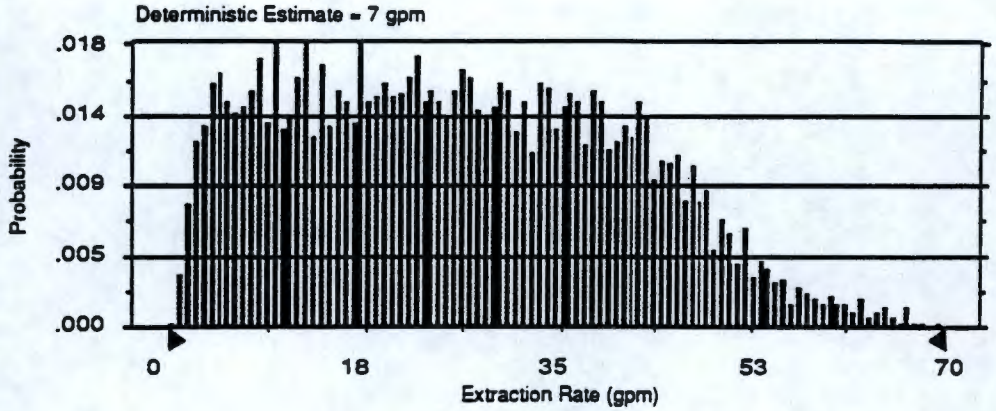
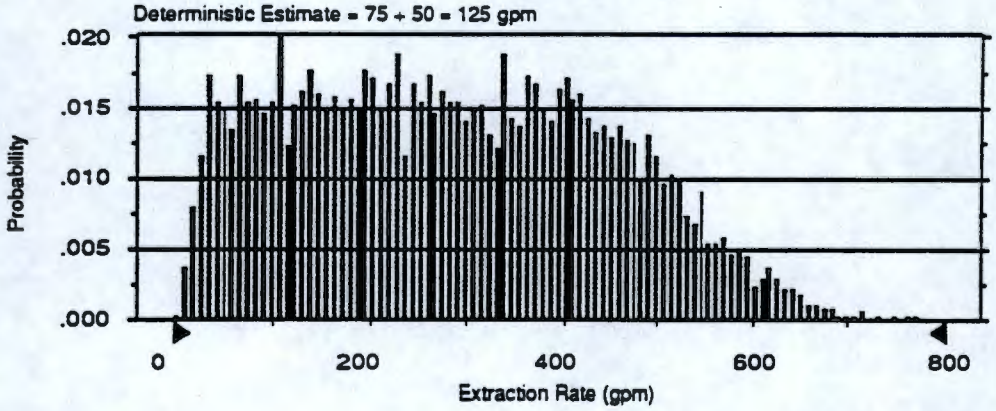


a) Selective Remediation



b) Extensive Remediation

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Figure 6-6 Groundwater Extraction Rate Probability Distributions for Slurry Wall Containment.

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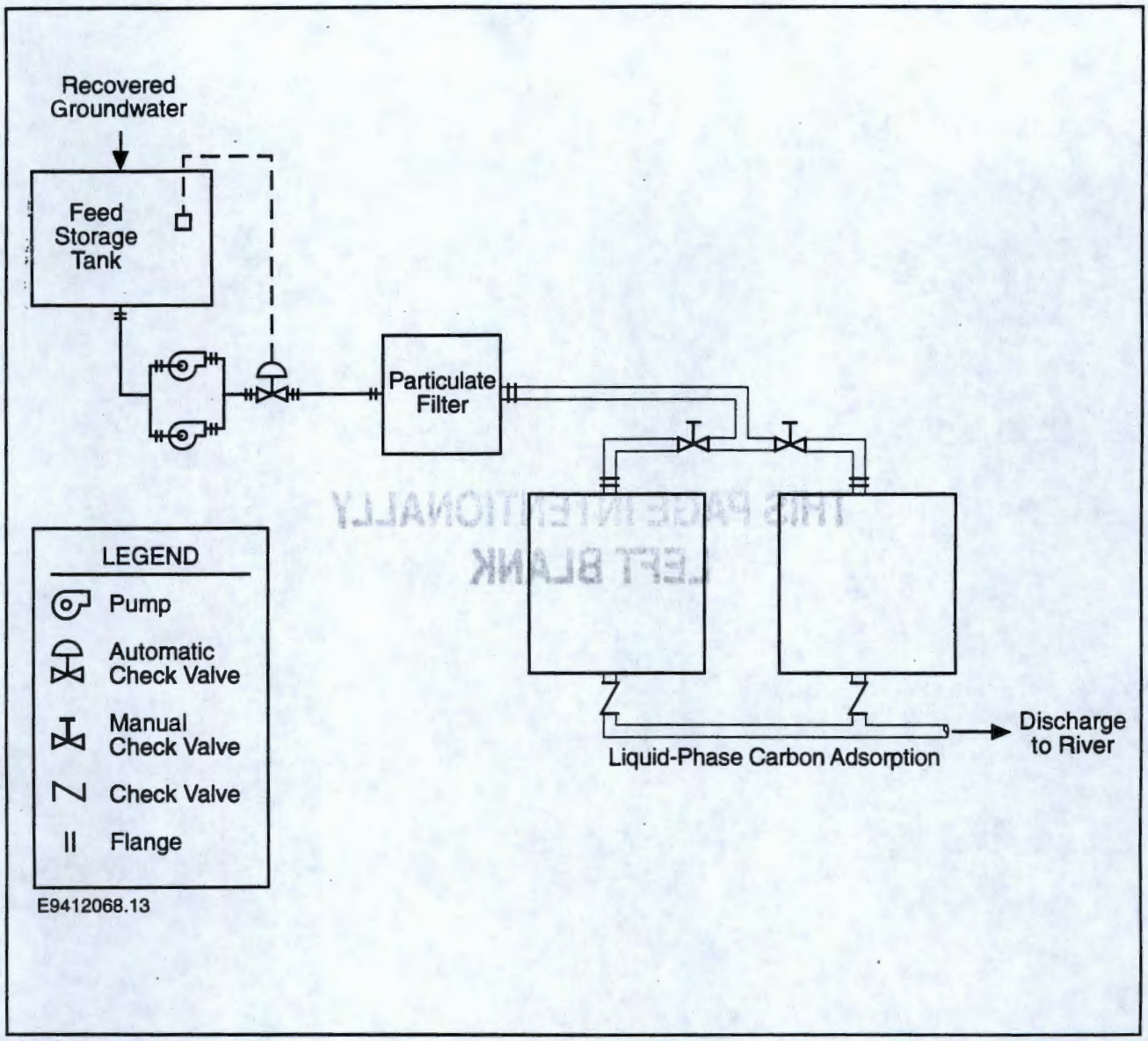

Figure 6-7. Wastewater Treatment System for Volatile Organic Compounds.

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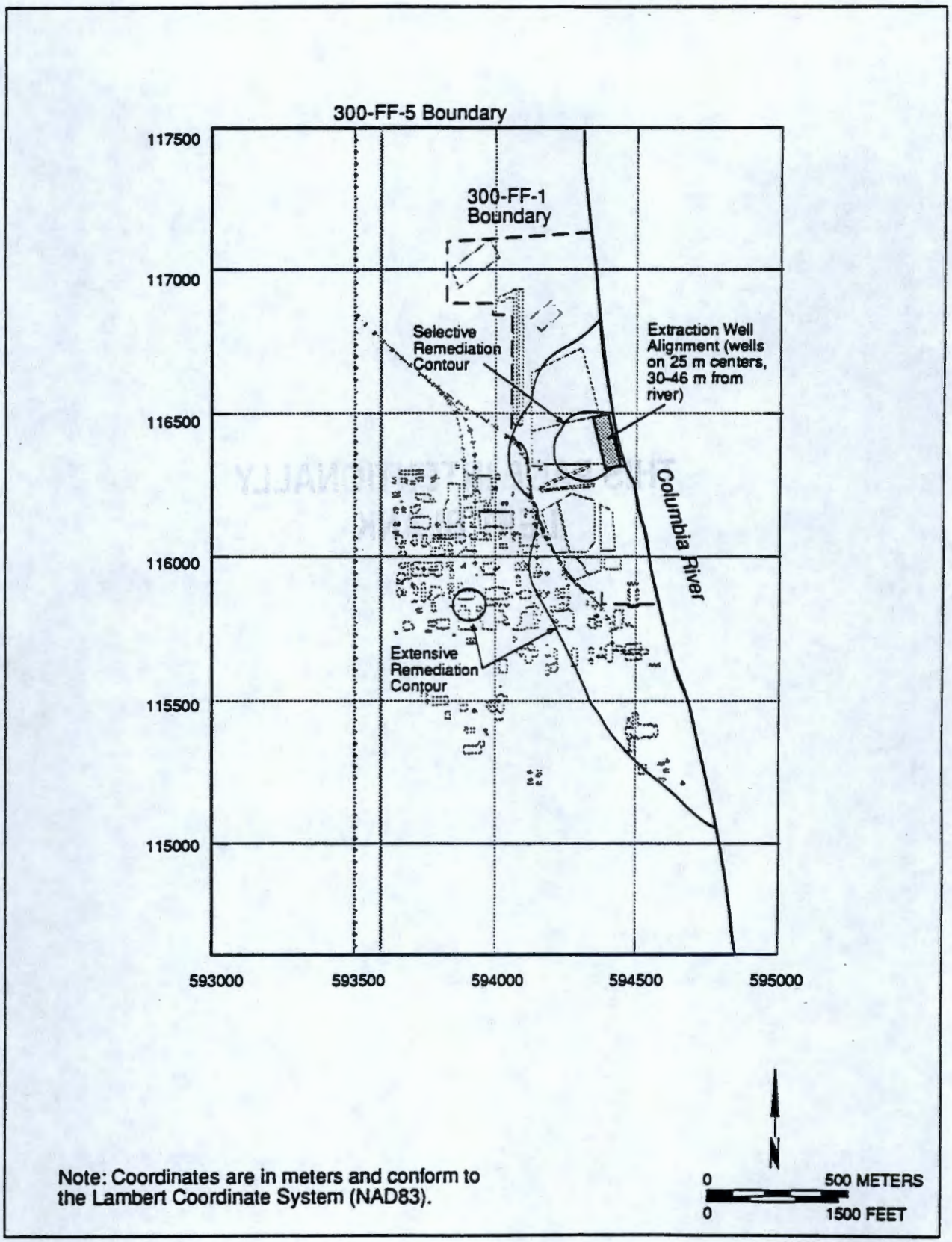

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Figure 6-8. Layout for Selective Hydraulic Containment.

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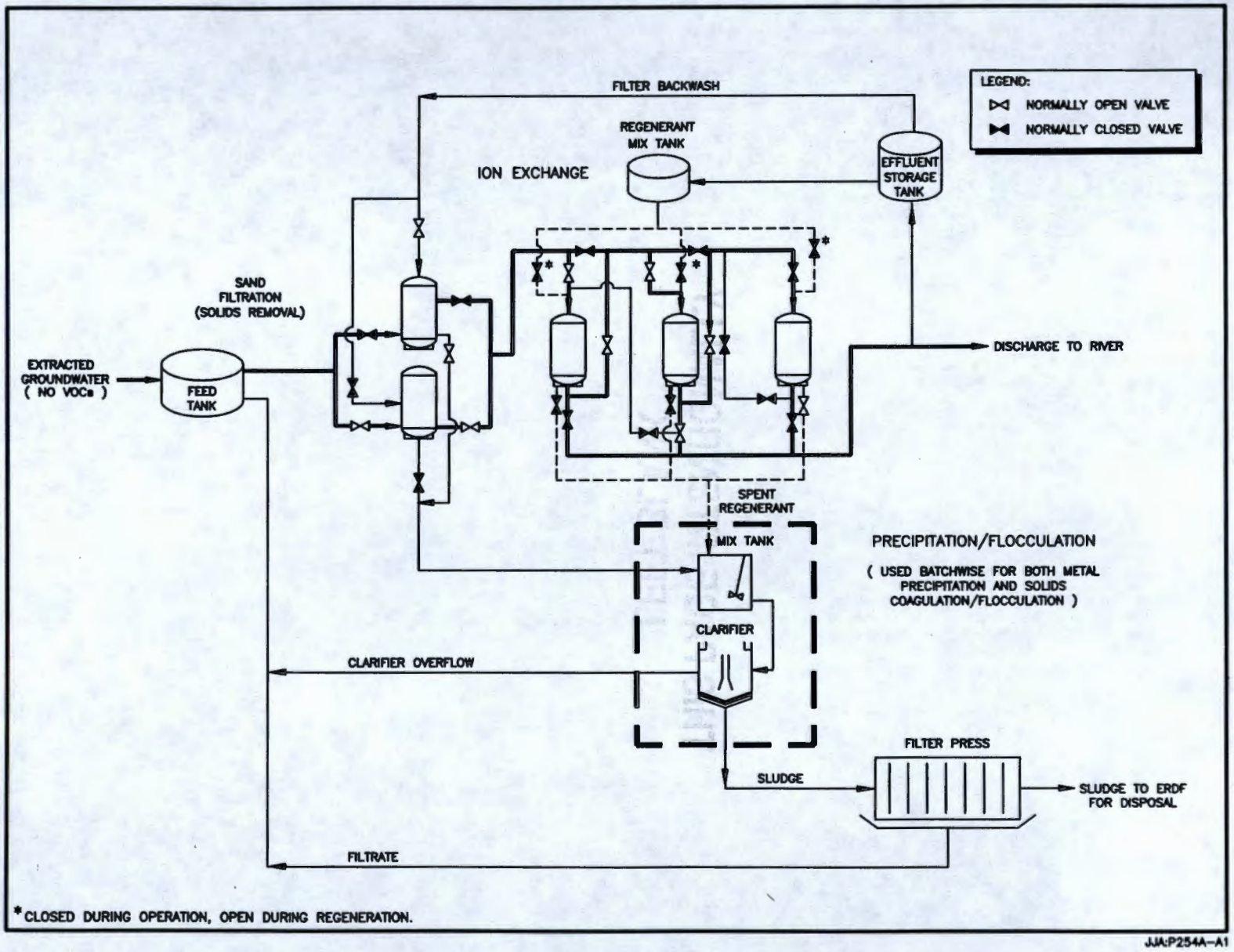

Figure 6-9. Wastewater Treatment System for Selective Hydraulic Containment.

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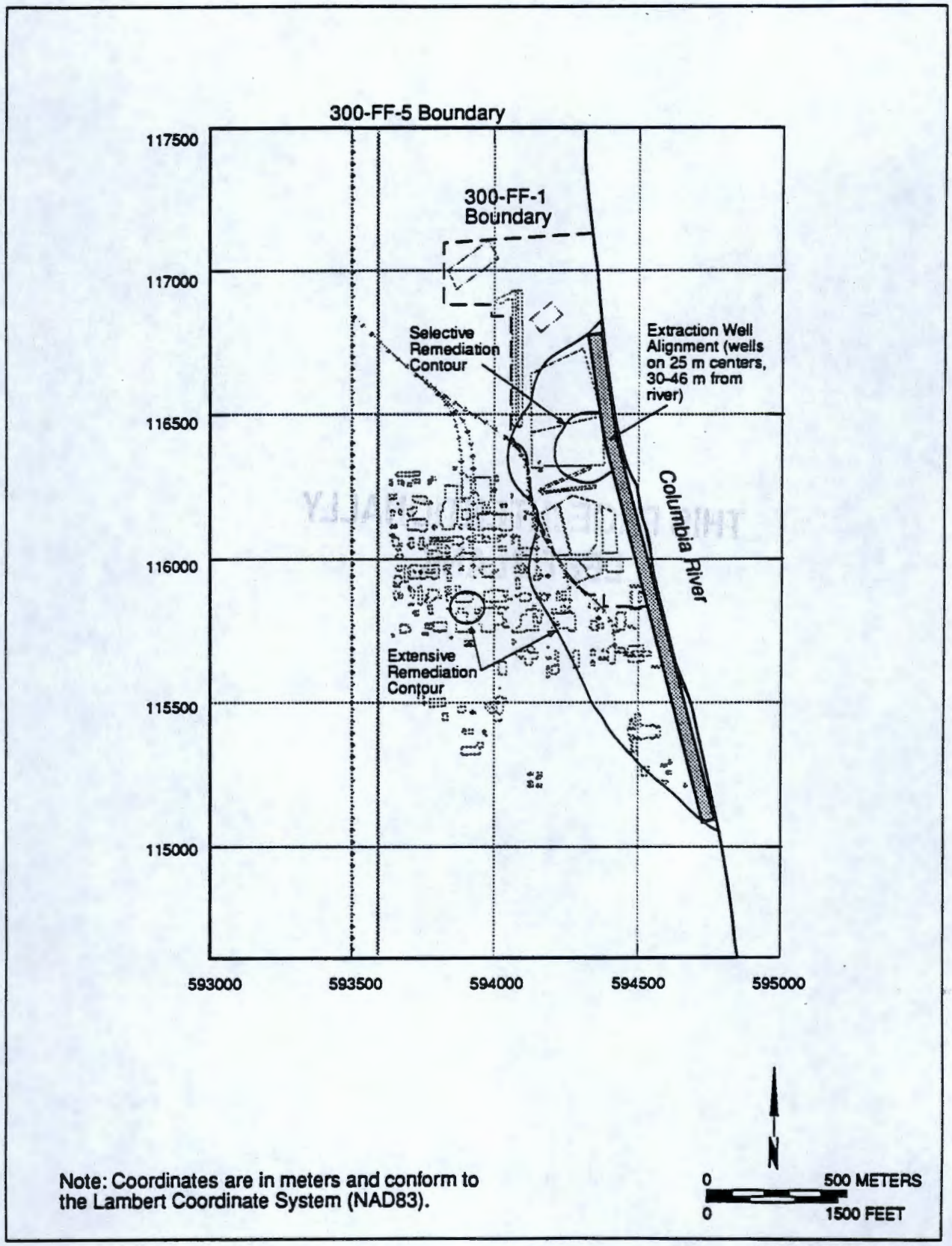

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Figure 6-10. Layout for Extensive Hydraulic Containment.

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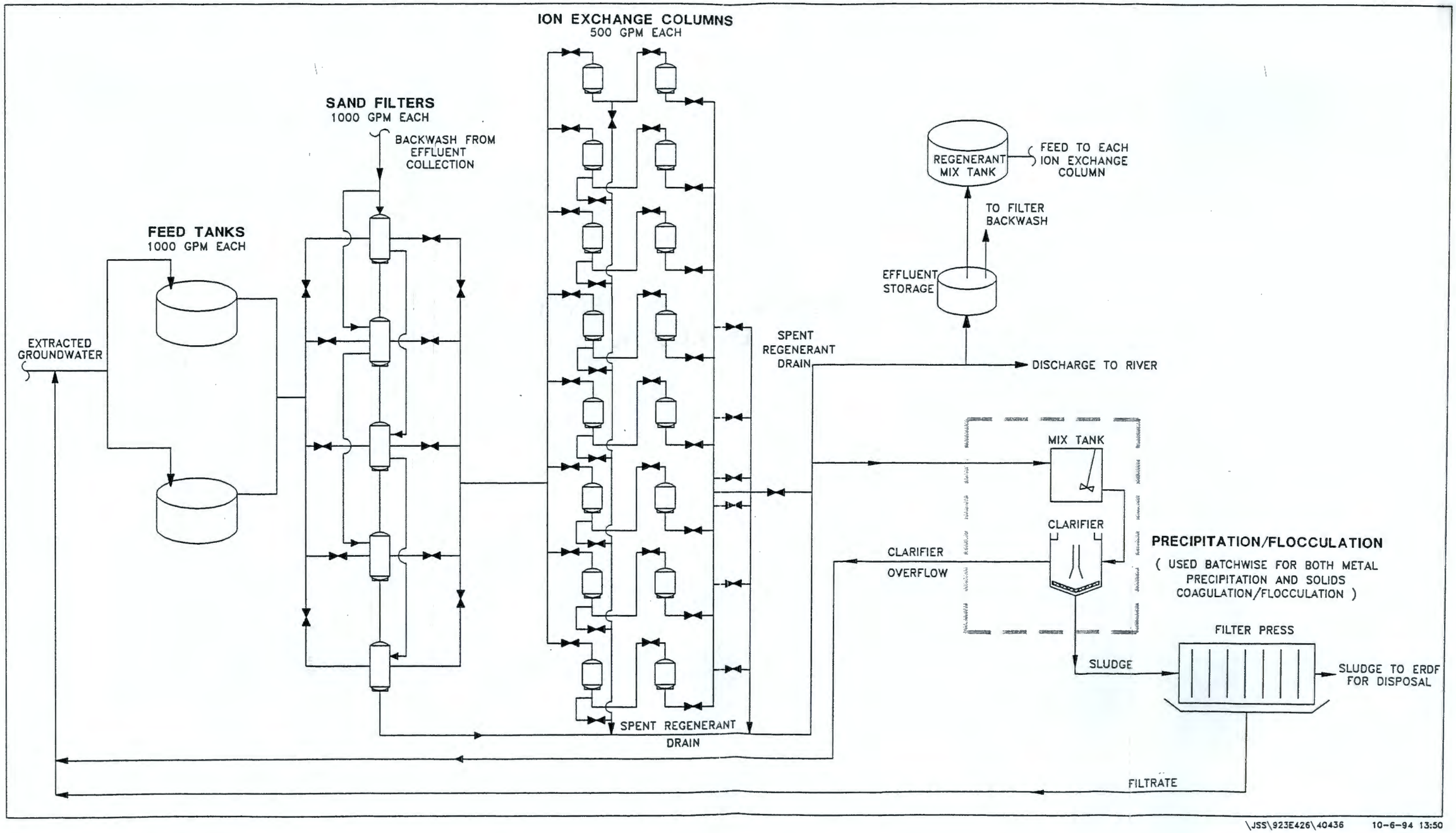

Figure 6-11. Wastewater Treatment System for Extensive Hydraulic Containment.

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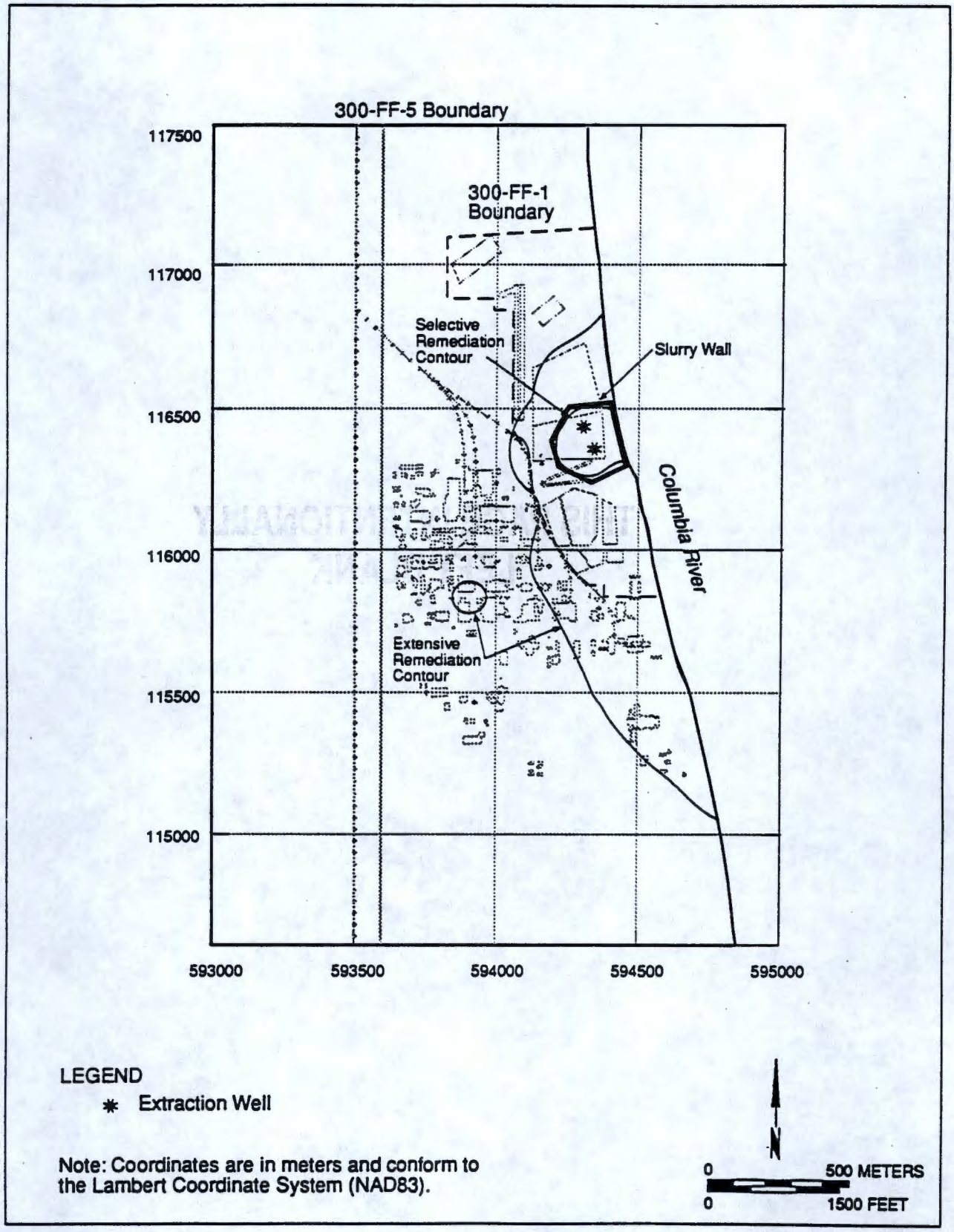

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Figure 6-12. Layout for Selective Slurry Wall Containment.

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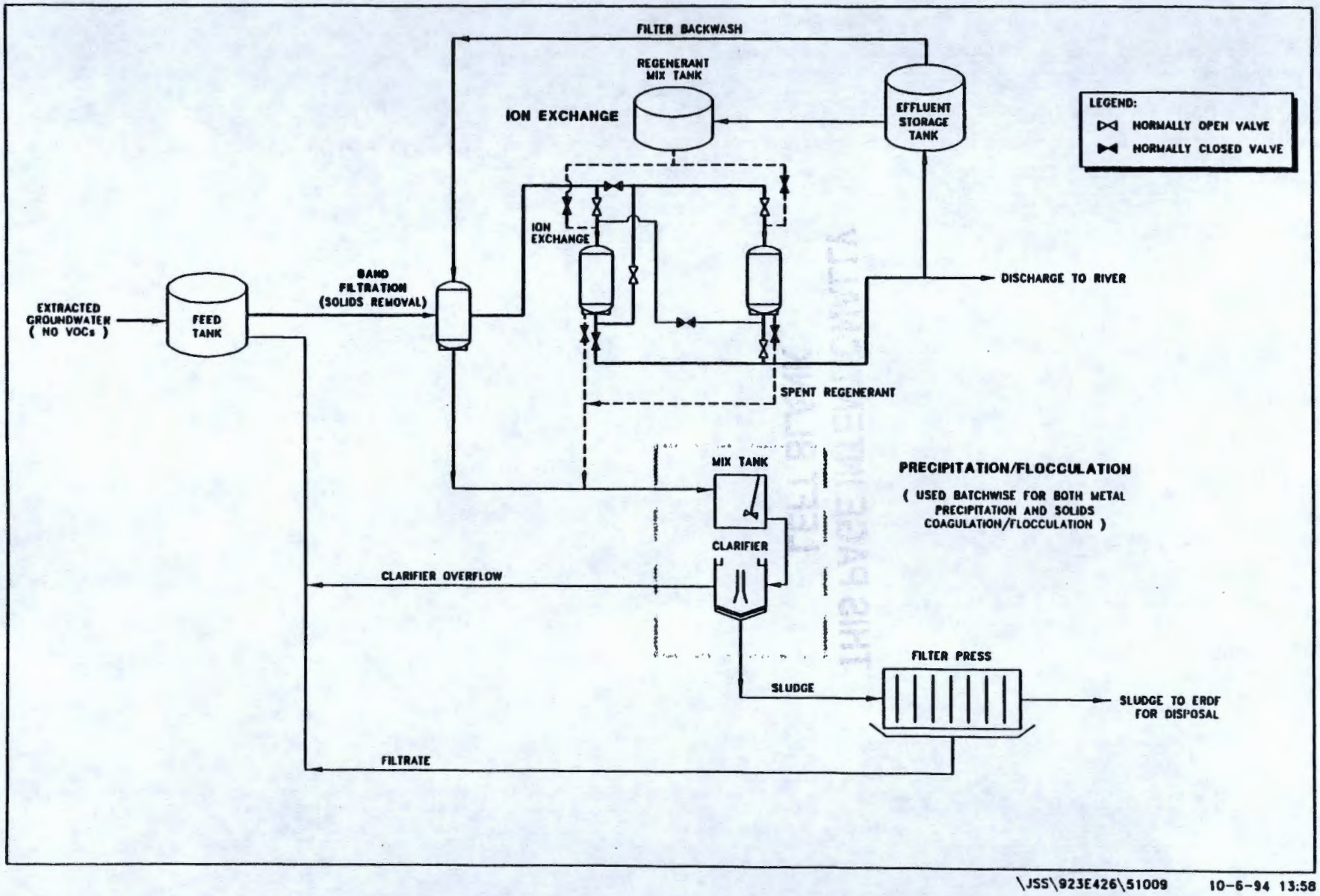

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Figure 6-13. Wastewater Treatment System for Slurry Wall Containment (Selective or Extensive).

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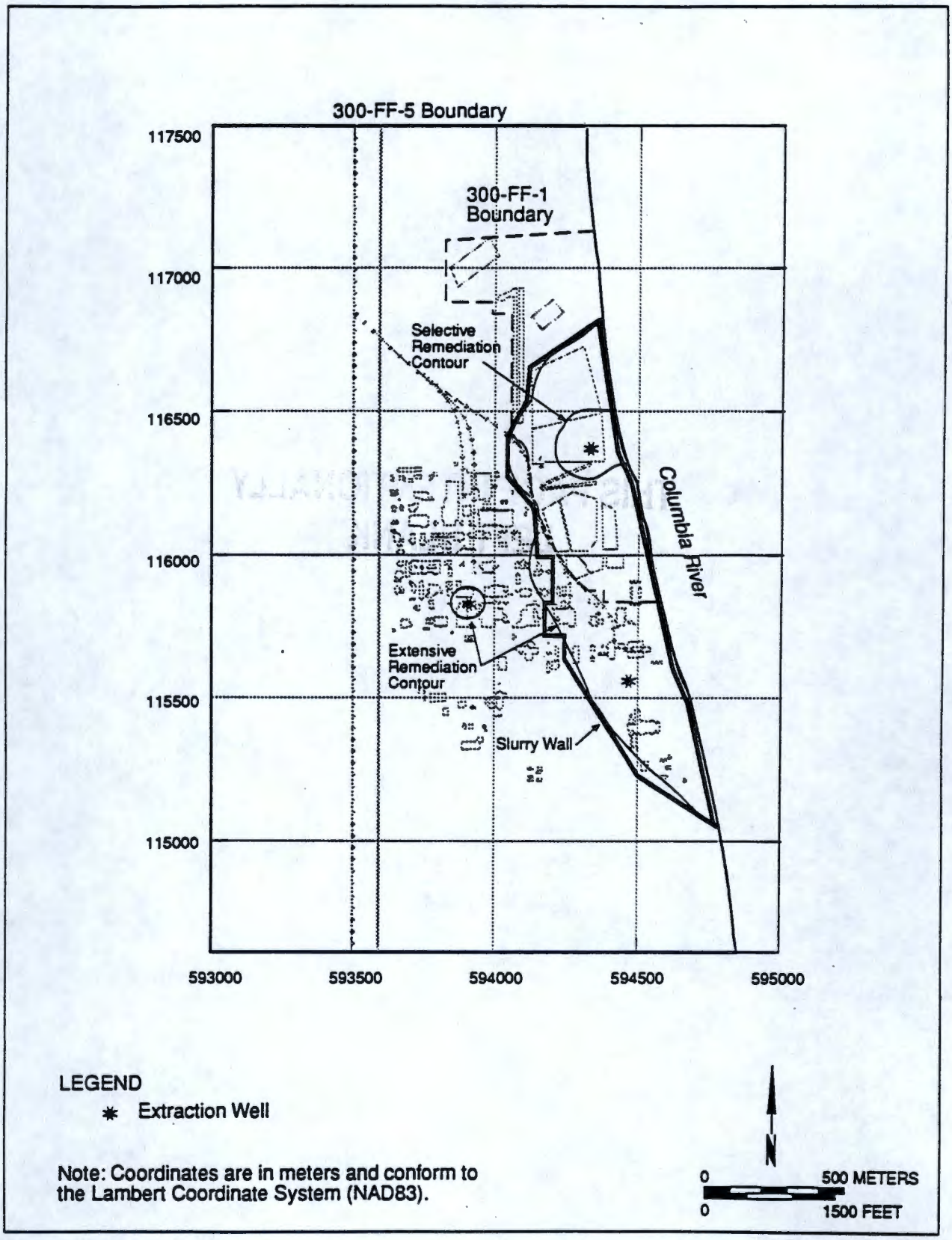

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Figure 6-14. Layout for Extensive Slurry Wall Containment.

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Table 6-1. Worker Risk Estimates for 300-FF-5 Remediation Alternatives.

Remediation Alternative	Remediation Technology	Relative Potential for Radiation Exposure[a]	Person-Years per Technology	Annual Accident Rate for Industrial Category[b]	Annual Fatality Rate for Industrial Category[b]	Estimated Number of Accidents for Technology	Estimates Number of Fatalities for Technology	Estimated Total Accidents for Alternative	Estimated Total Fatalities for Alternative
A No Action	No Action	0	0			0	0	0	0
B Institutional Controls	Institutional Controls	0	0.2	0.142	1.37 E-4	0.03	2.75 E-5	0.03	2.7 E-5
C Selective Hydraulic Containment	Well Installation	1	0.9	0.213	2.06 E-4	0.19	1.85 E-4	3	2.4 E-3
	Treatment System Construction		15	0.142	1.37 E-4	2.1	2.06 E-3		
	Treatment System Operation		6	0.132	2.63 E-5	0.8	1.58 E-4		
D Extensive Hydraulic Containment	Well Installation		7	0.213	2.06 E-4	1.5	1.44 E-3	11	9.8 E-3
	Treatment System Construction	2	60	0.142	1.37 E-4	8.5	8.24 E-3		
	Treatment System Operation		6	0.132	2.63 E-5	0.8	1.58 E-4		
E Selective Slurry Wall	Slurry Wall Construction	3	5	0.142	1.37 E-4	0.71	6.86 E-4	15	4.1 E-3
	Well Installation		0.3	0.213	2.06 E-4	0.06	6.18 E-5		
	Treatment System Construction		5	0.142	1.37 E-4	0.71	6.86 E-4		
	Treatment System Operation		100	0.132	2.63 E-5	13	2.63 E-3		
F Extensive Slurry Wall	Slurry Wall Construction	4	20	0.142	1.37 E-4	2.8	2.75 E-3	31	1.0 E-2
	Well Installation		0.5	0.213	2.06 E-4	0.11	1.03 E-4		
	Treatment System Construction		15	0.142	1.37 E-4	2.13	2.06 E-3		
	Treatment System Operation		200	0.132	2.63 E-5	26	5.26 E-3		

[a] Relative quantitative evaluation of the potential for radiation exposure based on best professional judgment.

[b] Taken from U.S. Department of Labor 1992. Categories include construction and manufacturing. Well drilling rate assumed 1.5 times rate for general construction.

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Table 6-2. Summary of Estimated Costs for 300-FF-5 Remedial Alternative

Alternative	Table Number[a]	Estimated Costs (million)[b]		
		Capital	Operating[c]	Total
A No Action	G-1	$0.0	$0.9	$0.9
B Institutional Controls	G-2	$0.1	$1.3	$1.4
C Selective Hydraulic Containment	G-3	$7.9	$5.3	$13
D Extensive Hydraulic Containment	G-3	$41	$19	$60
E Selective Slurry Wall Containment	G-4	$17	$17	$34
F Extensive Slurry Wall Containment	G-4	$77	$23	$100

[a] See Appendix G
[b] Costs are for mid-1994
[c] Net present value of operating and monitoring costs; assumes 5% interest (net of inflation). Estimated time periods for operation and monitoring are 6 years for Alternatives A through D and 100 years for Alternatives E and F.

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Table 6-3. Summary of Probabilistic Cost Estimates for 300-FF-5 Remediation Alternatives.[a]

Alternative		Deterministic Cost Estimate (millions)	Probabilistic Cost Estimate Values (millions)				
			5th Percentile	25th Percentile	Mean (Average)	75th Percentile	95th Percentile
A	No Action	$ 0.9	$ 0.3	$ 0.6	$0.9	$ 1.1	$1.7
B	Institutional Controls	$ 1.4	$ 0.6	$ 0.9	$ 1.3	$ 1.6	$ 2.4
C	Selective Hydraulic Containment	$ 13	$ 6	$ 10	$ 18	$ 22	$ 39
D	Extensive Hydraulic Containment	$ 60	$ 25	$ 49	$ 108	$ 138	$ 287
E	Selective Slurry Wall Containment	$ 34	$ 24	$ 30	$ 35	$ 39	$ 46
F	Extensive Slurry Wall Containment	$ 100	$ 74	$ 93	$ 109	$ 124	$ 149

[a] See Table 6-2 and Appendix G.

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Table 6-4. Comparison of Alternatives for Long-Term Effectiveness and Permanence.

Alternative		Rank[a]	Basis
A	No Action	2 (tie)	Does not achieve remedial action objectives for limiting exposure to humans. Does achieve remedial action objective of acceptable concentrations by 2018. Differences between alternatives are primarily due to short-term effectiveness (see Table 6-5). Ecological and cultural impacts related to discharge of contaminants to the river are minimal.
B	Institutional Controls	1	Achieves remedial action objectives via natural flushing. Differences between alternatives are primarily due to short-term effectiveness (see Table 6-5). Ecological cultural impacts related to discharge of contaminants to the river are minimal.
C	Selective Hydraulic Containment	2 (tie)	Achieves remedial action objectives via groundwater extraction and treatment (hydraulic containment), institutional controls and natural flushing. Differences between alternatives are primarily due to short-term effectiveness (see Table 6-5). Ecological and cultural impacts related to well and treatment system construction; impacts are more significant that Alternatives A and B.
D	Extensive Hydraulic Containment	2 (tie)	Achieves remedial action objectives via groundwater extraction and treatment (hydraulic containment) and institutional controls. Differences between alternatives are primarily due to short-term effectiveness (see Table 6-5). Ecological and cultural impacts are more significant because of the extent of the alternative.
E	Selective Slurry Wall Containment	3 (tie)	Achieves remedial action objective to limit human exposure via slurry wall containment and institutional controls for the most contaminated groundwater, combined with natural flushing of less-contaminated groundwater. The time to decrease groundwater uranium concentrations to below remediation goals is longer than the hydraulic containment alternatives, but reliable containment is provided during this period. However, this alternative does not achieve the remedial action objective of acceptable groundwater concentrations by 2018. Ecological and cultural impacts are increased due to wall construction activities.
F	Extensive Slurry Wall Containment	3 (tie)	Achieves remedial action objectives via slurry wall containment and institutional controls for all groundwater with contaminant concentrations above remediation goals. The time to decrease uranium contaminant concentrations to below cleanup levels (preliminary remediation goals) is longer than the hydraulic containment alternatives, but reliable containment is provided during this period. However, this alternative does not meet the remedial action objective of acceptable groundwater concentrations by 2018. This alternative represents the most significant ecological and cultural impacts.

[a] Ranking is a relative, qualitative evaluation from 1 (most effective) to 3 (least effective). "Tie" indicates two or more alternatives have the same ranking.

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Table 6-5. Comparison of Alternatives for Reduction in Toxicity, Mobility or Volume through Treatment.

Alternative		Rank[a]	Basis
A	No Action	3 (tie)	Does not provide treatment.
B	Institutional Controls	3 (tie)	Does not provide treatment.
C	Selective Hydraulic Containment	2 (tie)	Provides selective containment and treatment to reduce the volume of contaminated groundwater discharged to the Columbia River.
D	Extensive Hydraulic Containment	1 (tie)	Contains and treats all groundwater with uranium concentrations exceeding MCLs. Provides the maximum reduction in the volume of contaminated groundwater discharged to the Columbia River.
E	Selective Slurry Wall Containment	2 (tie)	Provides selective containment and treatment to reduce the volume of contaminated groundwater discharged to the Columbia River.
F	Extensive Slurry Wall Containment	1 (tie)	Contains and treats all groundwater with contaminant concentrations exceeding MCLs. Provides the maximum reduction in the volume of contaminated groundwater discharged to the Columbia River.

[a] Ranking is a relative, qualitative evaluation from 1 (most treatment) to 3 (least treatment). "Tie" indicates two or more alternatives have the same ranking.

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Table 6-6. Comparison of Alternatives for Short-Term Effectiveness.

Alternative		Rank[a]	Basis
A	No Action	1 (tie)	Remediation goals estimated to be achieved in 3 to 10 years (from later 1993). However, potential exposure to groundwater contamination not prevented during this time. No remediation worker risk.
B	Institutional Controls	1 (tie)	Remediation goals estimated to be achieved in 3 to 10 years (from later 1993). Low current site risk, and exposure to groundwater contamination prevented by institutional controls until concentration meet remediation goals. Very low remediation worker risk.
C	Selective Hydraulic Containment	2	Remediation goals estimated to be achieved in 3 to 10 years (from later 1993). Groundwater extraction and treatment decreases contaminant discharge to the Columbia River, but the potential risks are below acceptable limits (with institutional controls) and exceeded by risks to remediation workers in constructing and operating a moderate-size groundwater extraction and treatment system. Ecological and cultural impacts related to well construction and treatment system.
D	Extensive Hydraulic Containment	3	Remediation goals estimated to be achieved in 3 to 10 years (from later 1993). All contaminated groundwater not meeting remediation goals is collected and treated, but the potential risks are below acceptable limits (with institutional controls). More worker risk than Alternative C due to construction of a very large groundwater extraction and treatment system. Ecological and cultural impacts more significant because of extent of remedial action.
E	Selective Slurry Wall Containment	4	Remedial action objectives achieved upon completion of the slurry wall, but groundwater contaminant concentrations remain above remediation goals for a long time (potentially longer than 100 years) thereby not meeting the remedial action objective to achieve acceptable groundwater concentrations by 2018. Significant remediation worker risk due to construction of the slurry wall and construction and long-term operation of a small groundwater extraction and treatment system. Significant ecological and cultural impacts due to extent of remedial action.
F	Extensive Slurry Wall Containment	5	Remedial action objective to prevent exposure achieved upon completion of the slurry wall, but groundwater contaminant concentrations remain above remediation goals for a long time (potentially longer than 100 years) thereby not meeting the remedial action objective of acceptable groundwater concentrations by 2018. More remediation worker risk than Alternative E due to construction of a very long slurry wall and construction and long-term operation of a small groundwater extraction and treatment system. Greatest ecological and cultural impacts significant because of extent of construction activities.

[a] Ranking is a relative, qualitative evaluation from 1 (most effective) to 5 (least effective).

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Table 6-7. Comparison of Alternatives for Implementability.

Alternative		Rank[a]	Basis
A	No Action	1	Nothing to implement.
B	Institutional Controls	2	Requires implementation of minor administrative activities and monitoring.
C	Selective Hydraulic Containment	3	Requires installation and operation of a moderate-size groundwater extraction and treatment system.
D	Extensive Hydraulic Containment	5	Requires installation and operation of a very large groundwater extraction and treatment system covering an extensive area.
E	Selective Slurry Wall Containment	4	Requires installation of a slurry wall over 100 ft deep in gravelly soils for a relatively short distance. No buildings or utilities expected to impede wall installation. Cultural resources could be encountered during excavation for the wall. Requires installation and operation of a small groundwater extraction and treatment system over an extended period.
F	Extensive Slurry Wall Containment	6	Requires installation of a slurry wall over 100 ft deep in gravelly soils. Portions of the wall would be constructed around buildings, and utilities in developed areas, increasing the difficulty. Cultural resources could be encountered during excavation for the wall. Requires installation and operation of a small groundwater extraction and treatment system over an extended period.

[a] Ranking is a relative, qualitative evaluation from 1 (easiest) to 6 (hardest).

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7.0 CONCLUSIONS

7.1 REMEDIAL INVESTIGATION

7.1.1 ERA Evaluation

In accordance with 40 CFR 300.410, the need for an ERA at the 300-FF-5 Operable Unit was evaluated as part of the Phase I RI. The Phase I RI report (DOE-RL 1994d) recommended that no ERAs be implemented at that time at the operable unit; however, the evaluation was to be repeated once representative data had been obtained regarding average shoreline river water concentrations and at other appropriate points in the remedial response process. This section reports the re-evaluation of the conclusions reached in the Phase I RI regarding the need for ERAs taking into account factors specified in 40 CFR 300.415(b) (2). This section also recommends appropriate removal actions consistent with guidelines provided in 40 CFR 300.415 (d).

Based on an evaluation of the NCP guidelines, and upon consideration of the Supplemental RI data available for this draft, ERAs are not required at the operable unit. There is no evidence of imminent and substantial danger to human or ecological health from exposures to 300-FF-5 Operable Unit contaminants. Supplemental RI data gathered have generally been consistent with data gathered during Phase I and do not result in any significant changes to the evaluations of human or ecological risk made in the baseline risk assessment that would necessitate consideration of ERAs at the operable unit.

7.1.2 Conclusions

Based on the evaluations presented in Chapter 4.0 of the groundwater sampling rounds 5, 6, and 7 and Columbia River data, the following primary conclusions result from this Supplemental RI report.

Uranium and DCE/TCE Trends in the Unconfined Aquifer (Section 4.2.3.4). Uranium concentrations have declined significantly over the seven rounds of RI sampling (December 1991 to June 1994) from concentrations of approximately 100 to 300 μg/L to levels below 100 μg/L in several wells located along the upgradient edge of the uranium plume. This trend is anticipated to continue and will eventually include other downgradient wells. Until then, levels are expected to remain near the current concentrations or possibly increase before reductions occur.

TCE levels have declined at a number of wells in the operable unit such that the MCL (5 μg/l) was exceeded by only a very small margin during the last round (maximum value of 7 μg/L). The MCL was exceeded only at wells 399-1-16B and 399-2-2 during round 7. These wells are both located relatively close together. Based on this trend, TCE may be expected to fall below the MCL in the near future. Levels of DCE have increased from about 60 to 150 μg/L over the period 1986 to 1993 at well 399-1-16B, where the highest concentrations are observed. Because DCE is a common byproduct of TCE degradation, the fluctuations in DCE are probably related to the reductions in TCE concentration observed. On this basis, the levels of DCE may be expected to

fluctuate at well 399-1-16B. The MCL for DCE is exceeded only at well 399-1-16B. Based on these observations, levels of DCE may remain above the MCL at well 399-1-16B for an undetermined period of time.

Filtered Vs Unfiltered Uranium Analyses (Section 4.3.1). The results of uranium analyses on filtered and unfiltered split samples have indicated that there is no significant difference that results from filtering. Filtered and unfiltered samples yielded nearly identical total uranium concentrations. This results from either low suspended solids levels in the collected samples, or from low sorption of uranium to any solids present. The conclusion is that uranium analytical results of unfiltered samples (from which the baseline risk assessment are based) are representative of groundwater conditions in the operable unit.

Evaluation of Sorption-Controlled Release Mechanism (Section 4.3.2). Significant reductions in uranium concentrations have been observed at several wells located along the upgradient perimeter of the uranium plume area (wells 399-1-5, -1-6, -1-10A, -1-11, -1-12, -1-16A, and -1-21A). These wells are located near a possible location of solid-phase uranium in the unconfined aquifer (i.e., in and around the process trenches), if it is present. If a solid-phase source of uranium was present in this portion of the operable unit, the uranium concentrations would be expected to remain relatively constant, because the source would continue to provide uranium to groundwater. However, the levels at these wells have declined from concentrations in the 100 to 300 μg/L range to levels below 100 μg/L during the seven rounds of RI monitoring. The reductions are however, more probably related to the removal and isolation of contaminated sediments at the process trenches during the ERA which eliminated a primary source of uranium within the vadose zone to the groundwater (DOE/RL 1992b) and to the fact that the uranium plume is associated with the highly transmissive Hanford formation and is rapidly flushed from the unconfined aquifer. These rapid declines in concentration provide evidence that a significant source is not present; however, round 7 data show slight increases in uranium concentrations in some wells which may indicate the presence of uranium in the soils immediately above the average water table level in the area. Fluctuating concentrations in these wells appear related to variations in river stage and tend to support this hypothesis. Uranium migration appears to be controlled instead by a sorption-controlled release mechanism, as was assumed in uranium migration calculations presented herein and in the Phase I RI report (DOE-RL 1994d).

Refinement of the Estimates Regarding Time Required for Uranium to Reach Acceptable Levels (Section 4.3.4). Estimates made in the Phase I RI of the time required for uranium to reach acceptable levels in the unconfined aquifer were uncertain resulting from primarily three factors: (1) uncertainty as to the release mechanism controlling uranium migration in groundwater, (2) uncertainty as to the best estimate of the uranium sorption coefficient (K_d), and (3) uncertainty as to the average linear velocity of groundwater in the unconfined aquifer. Information presented in this RI has reduced the uncertainty associated with these items, and it is therefore possible to refine the time estimates of uranium flushing originally made in the Phase I RI. Evaluations are included in this report that narrow the range of best estimated values for the average hydraulic conductivity of the upper portion of the unconfined aquifer, and for uranium K_d. In addition, the solubility-controlled release mechanism probably is not significant to uranium migration in the groundwater. Using a best estimate of hydraulic conductivity of about 1,830 m/day (6,000 ft/day) and a K_d of 1 to 2 mL/g, the best estimate of time required for uranium levels to reach acceptable values in the unconfined aquifer

(MCL of 20 μg/L) is approximately 3 to 10 years from late-1993. This contrasts to estimates in the Phase I RI that suggested uranium levels may still exceed the 20 μg/L level in year 2018, the first year the DOE might relax the current institutional controls on groundwater use in the operable unit.

Baseline Risk Assessment (Section 4.4). Based on the Supplemental RI data and the data screening reported herein, no significant changes occurred to the results of the human health risk assessment, and the conclusions of the baseline risk assessment presented in the Phase I RI remain valid. This conclusion was essentially that by assuming average Columbia River concentrations and excluding chloroform in groundwater (which is attributable to chlorination) the maximum ICR calculated for the current condition is 1×10^{-6} (industrial receptors in the 300 Area). This risk is primarily due to TCE in groundwater. The risks associated with the river are well below 1×10^{-6}.

With respect to the ecological risk assessment, further evaluation of the groundwater data collected during the seven rounds of RI sampling have indicated that the three metals (manganese, nickel, and copper) identified in the Phase I RI as potentially posing an unacceptable ecological health risk can be eliminated from the risk assessment. The metals are eliminated because they either are not present above background or do not exceed chronic LOEL levels in the river. Therefore, there are no compounds associated with the operable unit that will pose potentially unacceptable risks to ecologic health.

7.2 FEASIBILITY STUDY

Contaminated groundwater from the 300 Area groundwater does not currently pose unacceptable risk to human health or the environment. The only current use of groundwater in the 300 Area is one industrial production well. There is no current or planned use of 300 Area groundwater for drinking. The estimated risk in this well primarily results from chloroform at concentrations below the MCL typical of municipal water supplies.

The preliminary remediation goals are driven by ARAR limits, which are MCLs for this operable unit. Contaminants for the 300-FF-5 Operable Unit are present in groundwater above MCLs. However, average concentrations of 300-FF-5 contaminants in near-shore water from the Columbia River do not present unacceptable risk to human health or the environment. These concentrations are below MCLs, except for uranium under some conditions. Under worst-case conditions (extreme low Columbia River stages) near-shore river water along the 300 Area can contain concentrations of uranium above its proposed MCL of 20 μg/L. However, other than near the river edge, the concentrations of uranium and other 300 Area contaminants are indistinguishable from background levels (including at the 300 Area and city of Richland water intakes). Therefore, there is no significant impact on the Columbia River by contaminated groundwater from the 300 Area.

There is no unacceptable risk to human health or the environment, provided direct exposure to contaminated groundwater is prevented. In addition, groundwater contamination resulting from 300 Area operations is expected to decrease below MCLs by the year 2018, except possibly in the vicinity of well cluster 399-1-16 for nickel, TCE, and DCE.

Human health and the environment can be protected, and remediation goals (cleanup levels) met at the 300-FF-5 Operable Unit using one or more of the following methods: (1) natural flushing

of the aquifer, (2) hydraulic containment, and/or (3) slurry wall containment. The extent of containment (via either hydraulic containment or slurry wall containment) could vary between all groundwater with contaminant concentrations above MCLs and no natural flushing, and no containment with all remediation via natural flushing. Selective remediation alternatives were developed to illustrate the feasibility and cost effectiveness of remediation by combining containment of the most highly contaminated groundwater with natural flushing of remaining contamination.

Table 7-1 summarizes the comparative analysis of the alternatives. All of the alternatives, including the no-action alternative, are nearly indistinguishable in terms of long-term effectiveness. Some differentiation can be made based on the time necessary to achieve remediation goals and containment of isolated regions of TCE, DCE, and nickel contamination at levels slightly above the MCL. Risk differences between the alternatives are predominantly in the short-term.

Active remediation of groundwater could not begin until after completion of (1) the alternative selection process (i.e., publishing the ROD), (2) necessary treatability studies, (3) final remedial design of the selected alternative, (4) selection of remediation contractors, and (5) construction of groundwater extraction and treatment systems. Because of the time required to complete all of these activities, it would take 2 to 4 years before remedial action (other than institutional controls) could begin. Given that natural flushing is expected to achieve remediation goals for uranium in 3 to 10 years, the period of operation for a groundwater extraction and treatment system could be very short.

The negative aspects of the active remedial systems include worker safety and environmental effects during implementation and high costs for the realized benefit. The institutional controls alternative provides adequate protection of human health and the environment, limits short-term effects to the workers and the environment, and achieves the same results in an acceptable time period at a fraction of the cost of active remediation.

Except for the No-Action Alternative, each alternative would disturb natural and cultural resources present within the operable unit. Those alternatives requiring construction of slurry walls, wells and treatment systems, and other related actions, such as access roads (Alternatives C, D, E, and F) will cause substantially more disturbance to natural and cultural resources than the alternatives that require minimal surface disturbance (Alternatives A and B).

The primary determinant in the cost of the remediation alternatives is the degree of remedial action: natural flushing, selective active remediation, or extensive active remediation. Of secondary importance are the differences between costs for hydraulic and slurry wall containment technologies. The estimated costs for both Alternative A (No Action) and B (Institutional Controls) are much lower than for the other alternatives. The cost of these alternatives is dominated by the cost of monitoring, which is included in all of the alternatives. The next most expensive alternatives are the selective remediation alternatives (C and E). The most expensive alternatives are the extensive remediation alternatives (D and F). These last two alternatives would also be significantly more difficult to implement than the other alternatives.

Based on the deterministic cost estimates for these alternatives, the hydraulic containment alternatives are the most cost-effective alternatives for active remediation. With natural flushing of the system continuing, the effectiveness of active remediation in a few years is questionable, and therefore, the impacts on remedial costs estimates are uncertain. If it appears that the preferred

alternative will include hydraulic groundwater containment, additional investigations may be necessary to reduce the uncertainty in the feasibility and relative costs of hydraulic and slurry wall containment alternatives.

If groundwater extraction and treatment is included in the selected remedy, treatability studies during final design will be needed to determine parameters needed for final design of the system. These studies could include:

- Pump testing or additional evaluation of the flux of groundwater in the unconfined aquifer to determine key aquifer properties relevant to groundwater extraction.

- Detailed treatability testing of ion exchange on 300 Area groundwater from the area(s) to be captured, to select the appropriate resin, determine column life (before regeneration), and other design parameters. Treatability testing would consist of initial laboratory batch tests, followed by bench-scale column tests, followed by field pilot testing.

- Treatability testing for precipitation of uranium and other metals from spent ion-exchange regenerant.

- Treatability testing for sand filtration and flocculation.

Institutional controls and monitoring, allowing natural flushing of the aquifer to achieve remediation goals would (1) be protective of human health and the environment, (2) meet ARARs by controlling exposure to contaminated groundwater until MCLs are achieved via natural flushing, (3) not provide treatment, (4) have high short-term effectiveness, (5) be very easy to implement, and (6) be inexpensive to accomplish.

Considering their poor implementability and high cost, the extensive remedial alternatives (D and F) are not considered practicable. Based on the FS evaluation and other factors discussed in Section 5.1.1, natural flushing for 3 to 10 years would provide groundwater restoration in a reasonable time frame.

Institutional Controls Alternative B deserves strong consideration. Unlike many sites, where institutional controls would be required indefinitely, the 300-FF-5 Operable Unit would only require them for a relatively short time. Institutional controls can be considered highly reliable as long as the Hanford Site remains under DOE jurisdiction (presumably until at least the year 2018). Natural flushing of the aquifer is expected to achieve remediation goals (for uranium) within this time frame.

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Table 7-1. Comparative Analysis Summary

Evaluation Criteria	Alternatives[1]					
	A	B	C	D	E	F
Long-Term Effectiveness and Permanence	Best	Best	Better	Better	Good	Good
Reduction of Toxicity, Mobility, and Volume	Good	Good	Better	Best	Better	Best
Short-Term Effectiveness	Best	Best	Better	Good	Fair	Poor
Implementability	Best	Best	Better	Good	Fair	Poor
Present Worth ($ millions)	0.9	1.4	13	60	34	100

Notes:

1. Alternatives are summarized as follows:
   - A No Action
   - B Institutional Controls
   - C Selective Hydraulic Containment
   - D Extensive Hydraulic Containment
   - E Selective Slurry Wall Containment
   - F Extensive Slurry Wall Containment

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APPENDIX A

SURFACE WATER ANALYTICAL DATA

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GLOSSARY OF DATA REPORTING QUALIFIERS

DATA QUALIFIERS (WHC, 1992a and 1992b)

B - Indicates the constituent was analyzed for and detected. The concentration reported is less than the contract required detection limit (CRDL) but greater than the instrument detection limit (IDL). The associated data should be considered usable for decision making purposes. (Applies to metals only in this instance.)

U - Indicates the constituent was analyzed for and not detected. The concentration reported is the same detection limit corrected for sample aliquot size, dilution factors and percent solids (in the case of solid matrices) by the laboratory. The associated data should be considered usable for decision making purposes.

UJ - Indicates the constituent was analyzed for and was not detected. Due to a minor quality control deficiency identified during data validation, the concentration reported may not accurately reflect the sample detection limit. The associated data have been qualified as estimated but should be considered usable for decision making purposes.

BJ - Indicates the constituent was analyzed for and detected at a concentration less than the CRDL but greater than the IDL. Due to a minor quality control deficiency identified during data validation, the associated data have been qualified as estimated, but should be considered usable for decision making purposes.

J - Indicates the constituent was analyzed for and detected. Due to a minor quality control deficiency identified during data validation the associated data have been qualified as estimated, but should be considered usable for decision making purposes.

UR - Indicates the constituent was analyzed for and not detected. Due to a major quality control deficiency identified during data validation, the associated data have been qualified as unusable for decision making purposes.

R - Indicates the constituent was analyzed for and detected. Due to a major quality control deficiency identified during data validation, the associated data have been qualified as unusable for decision making purposes.

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RIVER WATER
QA METALS Analysis Results

Program		CERCLA		CERCLA		CERCLA		CERCLA		CERCLA	
Well ID		SPRING 6,3		SPRING 6,3		SPRING 9,3		SPRING 9,3		SPRING 9,10	
Date		6-23-94		6-23-94		6-23-94		6-23-94		6-23-94	
Sample Type		SPLIT		SPLIT		DUPLICATE		DUPLICATE		DUPLICATE	
Lab ID		TMA		TMA		IT		IT		IT	
Filtered		NO		YES		NO		YES		NO	
SAMPLE DEPTH (in feet)		3.17000		3.17000		2.25000		2.25000		3.75000	
Sample ID		B0C2V7		B0C2V8		B0C2S4		B0C2S6		B0C2S9	
Parameter	Units	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q
Aluminum	UG/L	93.600	U	31.400	BJ	70.400	U	19.000	U	45.400	B
Antimony	UG/L	16.100	U	16.100	U	19.500	U	19.500	U	19.500	U
Barium	UG/L	34.000	U	31.900	U	27.800	B	27.000	B	27.800	B
Beryllium	UG/L	0.600	U	0.600	U	0.300	U	0.300	U	0.300	U
Cadmium	UG/L	0.800	U	0.800	U	1.800	U	1.800	U	1.800	U
Calcium	UG/L	16600.000		16500.000		19300.000		18700.000		19400.000	
Chromium	UG/L	3.700	U	3.700	UJ	2.800	U	2.800	U	2.800	U
Cobalt	UG/L	2.300	U	2.300	U	29.000	U	29.000	U	29.000	U
Copper	UG/L	2.500	U	2.500	U	4.500	U	4.500	U	4.500	U
Iron	UG/L	96.000	BJ	15.000	UJ	95.000	U	13.600	U	55.300	U
Magnesium	UG/L	3870.000	B	3860.000	BJ	4470.000	B	4330.000	B	4460.000	B
Manganese	UG/L	7.200	BJ	0.700	U	8.700	B	3.100	U	8.300	B
Nickel	UG/L	7.900	U	7.900	U	4.900	UJ	4.900	UJ	4.900	UJ
Potassium	UG/L	769.000	B	617.000	B	1010.000	U	1020.000	U	955.000	U
Silver	UG/L	3.700	U	3.700	U	4.200	UJ	4.200	UJ	4.200	UJ
Sodium	UG/L	2150.000	B	2100.000	BJ	2520.000	B	2370.000	B	2380.000	B
Vanadium	UG/L	2.500	U	2.500	U	9.800	U	10.400	B	9.800	U
Zinc	UG/L	5.600	U	3.200	U	6.900	U	6.700	U	10.400	U

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RIVER WATER
QA METALS Analysis Results

Program		CERCLA		CERCLA		CERCLA		CERCLA		CERCLA	
Well ID		SPRING 9,10		SPRING 11,1		SPRING 11,1		SPRING 11,3		SPRING 11,3	
Date		6-23-94		6-23-94		6-23-94		6-23-94		6-23-94	
Sample Type		DUPLICATE		SPLIT		SPLIT		DUPLICATE		DUPLICATE	
Lab ID		IT		TMA		TMA		IT		IT	
Filtered		YES		NO		YES		NO		YES	
SAMPLE DEPTH (in feet)		3.75000		5.00000		5.00000		2.00000		2.00000	
Sample ID		B0C2T1		B0C2W0		B0C2W1		B0C2T7		B0C2T9	
Parameter	Units	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q
Aluminum	UG/L	19.000	U	91.600	U	23.800	U	19.000	U	,19.000	U
Antimony	UG/L	19.500	U	16.100	U	16.100	U	19.500	UJ	19.500	UJ
Barium	UG/L	27.000	B	34.000	U	31.900	U	27.900	B	33.000	B
Beryllium	UG/L	0.300	U	0.600	U	0.600	U	0.300	U	0.300	U
Cadmium	UG/L	1.800	U	0.800	U	0.800	U	1.800	U	1.800	U
Calcium	UG/L	18200.000		17000.000		16200.000		18400.000		18400.000	
Chromium	UG/L	2.800	U	3.700	U	3.700	UJ	2.800	UJ	2.800	UJ
Cobalt	UG/L	29.000	U	2.300	U	2.300	U	2.900	U	2.900	U
Copper	UG/L	4.500	U	2.500	U	2.500	U	4.500	U	4.500	U
Iron	UG/L	15.200	U	105.000	J	15.000	UJ	61.000	U	20.900	U
Magnesium	UG/L	4210.000	B	3860.000	B	3830.000	BJ	4210.000	B	4240.000	B
Manganese	UG/L	2.700	U	6.200	BJ	0.700	U	7.200	U	2.400	U
Nickel	UG/L	4.900	UJ	7.900	U	7.900	U	12.500	B	4.900	U
Potassium	UG/L	869.000	U	700.000	B	711.000	B	963.000	U	934.000	U
Silver	UG/L	4.200	UJ	3.700	U	3.700	U	4.200	UJ	4.200	UJ
Sodium	UG/L	2400.000	B	2210.000	B	2110.000	BJ	2360.000	B	2440.000	B
Vanadium	UG/L	9.800	U	2.500	U	2.500	U	9.800	U	9.800	U
Zinc	UG/L	8.300	U	4.300	U	3.200	U	9.000	U	11.000	U

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RIVER WATER
QA METALS Analysis Results

Program		CERCLA		CERCLA		CERCLA		CERCLA	
Well ID		SPRING 11		SPRING 11		SPRING 11		SPRING 11	
Date		6-23-94		6-23-94		6-23-94		6-23-94	
Sample Type		EQUIP BLANK		EQUIP BLANK		EQUIP BLANK		EQUIP BLANK	
Lab ID		IT		IT		IT		IT	
Filtered		NO		NO		YES		YES	
SAMPLE DEPTH (in feet)									
Sample ID		B0C2V6		B0C2W2		B0C2V9		B0C2W3	
Parameter	Units	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q
Aluminum	UG/L	19.000	U	19.000	U	19.000	U	19.000	U
Antimony	UG/L	19.500	UJ	19.500	UJ	19.500	UJ	19.500	UJ
Barium	UG/L	1.300	U	1.300	U	1.300	U	1.300	U
Beryllium	UG/L	0.300	U	0.300	U	0.300	U	0.300	U
Cadmium	UG/L	1.800	U	1.800	U	1.800	U	1.800	U
Calcium	UG/L	86.400	U	51.000	U	82.100	U	53.100	U
Chromium	UG/L	2.800	U	2.800	U	2.800	U	2.800	U
Cobalt	UG/L	2.900	U	2.900	U	2.900	U	2.900	U
Copper	UG/L	4.500	U	4.500	U	7.300	U	4.500	U
Iron	UG/L	8.600	U	8.000	U	13.200	U	10.400	U
Magnesium	UG/L	24.700	U	24.700	U	41.400	U	24.700	U
Manganese	UG/L	1.300	U	1.400	U	1.400	U	1.100	U
Nickel	UG/L	4.900	U	4.900	U	4.900	U	4.900	U
Potassium	UG/L	347.000	U	311.000	U	297.000	U	297.000	U
Silver	UG/L	4.200	UJ	4.200	UJ	4.200	UJ	4.200	UJ
Sodium	UG/L	66.100	U	50.300	U	84.800	U	53.700	U
Vanadium	UG/L	9.800	U	9.800	U	9.800	U	9.800	U
Zinc	UG/L	6.000	U	8.000	U	31.900		3.800	U

RIVER WATER
QA URANIUM Analysis Results

Program		CERCLA		CERCLA		CERCLA		CERCLA		CERCLA	
Well ID		SPRING 6,3		SPRING 9,3		SPRING 9,10		SPRING 11,1		SPRING 11,3	
Date		6-23-94		6-23-94		6-23-94		6-23-94		6-23-94	
Sample Type		SPLIT		DUPLICATE		DUPLICATE		SPLIT		DUPLICATE	
Lab ID		TMA		IT		IT		TMA		IT	
Filtered		NO		NO		NO		NO		NO	
SAMPLE DEPTH (in feet)		3.17000		2.25000		3.75000		5.00000		2.00000	
Sample ID		B0C2V7		B0C2S4		B0C2S9		B0C2W0		B0C2T7	
Parameter	Units	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q
Uranium	UG/L	0.480		0.512		0.481		0.440		0.459	

RIVER WATER
QA URANIUM Analysis Results

Program		CERCLA		CERCLA	
Well ID		SPRING 11		SPRING 11	
Date		6-23-94		6-23-94	
Sample Type		EQUIP BLANK		EQUIP BLANK	
Lab ID		IT		IT	
Filtered		NO		NO	
SAMPLE DEPTH (in feet)					
Sample ID		BOC2V6		BOC2W2	
Parameter	Units	Conc.	Q	Conc.	Q
Uranium	UG/L	0.004	UJ	0.004	UJ

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RIVER WATER
METALS Analysis Results

Program		CERCLA		CERCLA		CERCLA		CERCLA		CERCLA	
Well ID		SPRING 6,3		SPRING 6,3		SPRING 6,10		SPRING 6,10		SPRING 6,20	
Date		6-23-94		6-23-94		6-23-94		6-23-94		6-23-94	
Sample Type		WATER		WATER		WATER		WATER		WATER	
Lab ID		IT		IT		IT		IT		IT	
Filtered		NO		YES		NO		YES		NO	
SAMPLE DEPTH (in feet)		3.17000		3.17000		4.75000		4.75000		6.33000	
Sample ID		B0C2R4		B0C2R5		B0C2R7		B0C2R8		B0C2S0	
Parameter	Units	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q
Aluminum	UG/L	46.600	U	19.000	U	29.000	U	19.000	U	1120.000	
Antimony	UG/L	19.500	UJ	19.500	U	19.500	U	19.500	U	19.500	U
Barium	UG/L	29.400	B	26.600	B	33.400	B	26.000	B	47.400	B
Beryllium	UG/L	0.300	U	0.520	U	0.300	U	0.300	U	0.300	U
Cadmium	UG/L	1.800	U	1.800	U	1.800	U	1.800	U	1.800	U
Calcium	UG/L	19800.000		18500.000		19500.000		18300.000		21000.000	
Chromium	UG/L	2.800	U	2.800	U	2.800	U	2.800	U	2.800	U
Cobalt	UG/L	2.900	U	2.900	U	2.900	U	2.900	U	2.900	U
Copper	UG/L	4.500	U	4.500	U	4.500	U	4.500	U	4.500	U
Iron	UG/L	106.000		18.200	U	103.000	U	12.400	U	1860.000	
Magnesium	UG/L	4460.000	B	4160.000	B	4360.000	B	4160.000	B	4940.000	B
Manganese	UG/L	9.400	U	3.800	U	9.100	B	3.000	U	77.800	
Nickel	UG/L	4.900	U	4.900	U	4.900	U	4.900	U	4.900	U
Potassium	UG/L	1010.000	U	999.000	U	1010.000	U	948.000	U	1320.000	U
Silver	UG/L	4.200	UJ	4.200	UJ	4.200	UJ	4.200	UJ	4.200	UJ
Sodium	UG/L	2530.000	B	2240.000	B	2510.000	B	2190.000	B	2600.000	B
Vanadium	UG/L	9.800	U	9.800	U	9.800	U	9.800	U	9.800	U
Zinc	UG/L	14.400	U	6.100	U	10.800	U	3.500	U	75.000	

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RIVER WATER
METALS Analysis Results

Program		CERCLA		CERCLA		CERCLA		CERCLA		CERCLA	
Well ID		SPRING 6,20		SPRING 9,3		SPRING 9,3		SPRING 9,10		SPRING 9,10	
Date		6-23-94		6-23-94		6-23-94		6-23-94		6-23-94	
Sample Type		WATER		WATER		WATER		WATER		WATER	
Lab ID		IT		IT		IT		IT		IT	
Filtered		YES		NO		YES		NO		YES	
SAMPLE DEPTH (in feet)		6.33000		2.25000		2.25000		3.75000		3.75000	
Sample ID		B0C2S1		B0C2S3		B0C2S5		B0C2S8		B0C2T0	
Parameter	Units	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q
Aluminum	UG/L	19.000	U	67.700	U	19.000	U	68.000	B	19.000	U
Antimony	UG/L	19.500	U	19.500	U	19.500	U	32.700	U	19.500	U
Barium	UG/L	26.800	B	28.400	B	28.400	B	29.900	B	27.800	B
Beryllium	UG/L	0.300	U	0.300	U	0.300	U	0.300	U	0.300	U
Cadmium	UG/L	1.800	U	1.800	U	1.800	U	2.000	B	1.800	U
Calcium	UG/L	18500.000		19200.000		20700.000		20100.000		19000.000	
Chromium	UG/L	2.800	U	2.800	U	2.800	U	2.800	U	2.800	U
Cobalt	UG/L	2.900	U	29.000	U	29.000	U	29.000	U	29.000	U
Copper	UG/L	4.500	U	4.500	U	4.500	U	7.200	B	4.500	U
Iron	UG/L	21.100	U	86.000	U	10.200	U	78.200	U	14.200	U
Magnesium	UG/L	4210.000	B	4460.000	B	4740.000	B	4580.000	B	4370.000	B
Manganese	UG/L	3.800	U	8.700	B	3.700	U	9.500	B	3.000	U
Nickel	UG/L	4.900	U	4.900	UJ	4.900	UJ	4.900	UJ	4.900	UJ
Potassium	UG/L	1090.000	U	1060.000	U	1340.000	B	1120.000	U	1050.000	U
Silver	UG/L	4.200	UJ	4.200	UJ	4.200	UJ	4.200	UJ	4.200	UJ
Sodium	UG/L	2190.000	B	2490.000	B	2630.000	B	2430.000	B	2430.000	B
Vanadium	UG/L	9.800	U	9.800	U	9.800	U	12.500	B	9.800	U
Zinc	UG/L	3.000	U	21.200	U	11.200	U	7.200	U	5.300	U

RIVER WATER
METALS Analysis Results

Program		CERCLA		CERCLA		CERCLA		CERCLA		CERCLA	
Well ID		SPRING 9,20		SPRING 9,20		SPRING 11,1		SPRING 11,1		SPRING 11,2	
Date		6-23-94		6-23-94		6-23-94		6-23-94		6-23-94	
Sample Type		WATER		WATER		WATER		WATER		WATER	
Lab ID		IT		IT		IT		IT		IT	
Filtered		NO		YES		NO		YES		NO	
SAMPLE DEPTH (in feet)		4.67000		4.67000		5.00000		5.00000		5.50000	
Sample ID		B0C2T3		B0C2T4		B0C2V1		B0C2V2		B0C2V4	
Parameter	Units	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q
Aluminum	UG/L	19.000	U	19.000	U	99.000	U	19.000	U	37.800	U
Antimony	UG/L	19.500	UJ	19.500	UJ	19.500	UJ	19.500	UJ	19.500	UJ
Barium	UG/L	28.300	B	26.200	B	28.100	B	27.900	B	28.500	B
Beryllium	UG/L	0.300	U	0.300	U	0.300	U	0.520	U	0.300	U
Cadmium	UG/L	1.800	U	1.800	U	1.800	U	1.800	U	1.800	U
Calcium	UG/L	19200.000		18100.000		18200.000		18300.000		19800.000	
Chromium	UG/L	2.800	U	2.800	U	2.800	UJ	2.800	U	2.800	U
Cobalt	UG/L	2.900	U	2.900	U	2.900	U	2.900	U	2.900	U
Copper	UG/L	4.500	U	4.500	U	4.500	U	4.500	U	4.500	U
Iron	UG/L	84.700	B	11.100	U	122.000		15.800	U	83.600	B
Magnesium	UG/L	4280.000	B	4160.000	B	4320.000	B	4160.000	B	4470.000	B
Manganese	UG/L	8.600	U	2.400	U	8.100	U	2.700	U	8.800	U
Nickel	UG/L	4.900	U	4.900	U	4.900	U	4.900	U	4.900	U
Potassium	UG/L	934.000	U	941.000	U	1010.000	U	984.000	U	1050.000	U
Silver	UG/L	4.200	UJ	4.200	UJ	4.200	UJ	4.200	UJ	4.200	UJ
Sodium	UG/L	2410.000	B	2270.000	B	2290.000	B	2210.000	B	2620.000	B
Vanadium	UG/L	9.800	U	9.800	U	9.800	U	9.800	U	9.800	U
Zinc	UG/L	17.400	B	3.600	U	12.400	U	6.900	U	17.800	B

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RIVER WATER
METALS Analysis Results

Program		CERCLA		CERCLA		CERCLA	
Well ID		SPRING 11,2		SPRING 11,3		SPRING 11,3	
Date		6-23-94		6-23-94		6-23-94	
Sample Type		WATER		WATER		WATER	
Lab ID		IT		IT		IT	
Filtered		YES		NO		YES	
SAMPLE DEPTH (in feet)		5.50000		2.00000		2.00000	
Sample ID		B0C2V5		B0C2T6		B0C2T8	
Parameter	Units	Conc.	Q	Conc.	Q	Conc.	Q
Aluminum	UG/L	19.000	U	49.300	U	19.000	U
Antimony	UG/L	19.500	UJ	19.500	UJ	19.500	UJ
Barium	UG/L	26.600	B	27.700	B	29.600	B
Beryllium	UG/L	0.300	U	0.300	U	0.300	U
Cadmium	UG/L	1.800	U	1.800	U	1.800	U
Calcium	UG/L	17900.000		18400.000		18800.000	
Chromium	UG/L	2.800	U	2.800	UJ	2.800	UJ
Cobalt	UG/L	2.900	U	2.900	U	2.900	U
Copper	UG/L	4.500	U	4.500	U	4.500	U
Iron	UG/L	22.400	U	67.800	U	18.800	U
Magnesium	UG/L	4110.000	B	4190.000	B	4340.000	B
Manganese	UG/L	2.700	U	7.600	U	2.500	U
Nickel	UG/L	4.900	U	4.900	U	4.900	U
Potassium	UG/L	963.000	U	919.000	U	919.000	U
Silver	UG/L	4.200	UJ	4.200	UJ	4.200	UJ
Sodium	UG/L	2350.000	B	2220.000	B	2320.000	B
Vanadium	UG/L	9.800	U	9.800	U	9.800	U
Zinc	UG/L	8.000	U	11.500	U	8.200	U

RIVER WATER
URANIUM Analysis Results

Program		CERCLA		CERCLA		CERCLA		CERCLA		CERCLA	
Well ID		SPRING 6,3		SPRING 6,3		SPRING 6,10		SPRING 6,10		SPRING 6,20	
Date		6-23-94		6-23-94		6-23-94		6-23-94		6-23-94	
Sample Type		WATER		WATER		WATER		WATER		WATER	
Lab ID		IT		IT		IT		IT		IT	
Filtered		NO		NO		NO		NO		NO	
SAMPLE DEPTH (in feet)		1.58000		3.17000		2.33000		4.75000		3.17000	
Sample ID		B0C2R3		B0C2R4		B0C2R6		B0C2R7		B0C2R9	
Parameter	Units	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q
Uranium	UG/L	0.487	J	0.469	J	0.434	J	0.468	J	0.469	J

RIVER WATER
URANIUM Analysis Results

Program		CERCLA		CERCLA		CERCLA		CERCLA		CERCLA	
Well ID		SPRING 6,20		SPRING 9,3		SPRING 9,3		SPRING 9,10		SPRING 9,10	
Date		6-23-94		6-23-94		6-23-94		6-23-94		6-23-94	
Sample Type		WATER		WATER		WATER		WATER		WATER	
Lab ID		IT		IT		IT		IT		IT	
Filtered		NO		NO		NO		NO		NO	
SAMPLE DEPTH (in feet)		6.33000		1.25000		2.25000		1.92000		3.75000	
Sample ID		B0C2S0		B0C2S2		B0C2S3		B0C2S7		B0C2S8	
Parameter	Units	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q
Uranium	UG/L	0.478	J	0.488		0.501		0.446		0.494	

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RIVER WATER
URANIUM Analysis Results

Program		CERCLA		CERCLA		CERCLA		CERCLA		CERCLA	
Well ID		SPRING 9,20		SPRING 9,20		SPRING 11,1		SPRING 11,1		SPRING 11,2	
Date		6-23-94		6-23-94		6-23-94		6-23-94		6-23-94	
Sample Type		WATER		WATER		WATER		WATER		WATER	
Lab ID		IT		IT		IT		IT		IT	
Filtered		NO		NO		NO		NO		NO	
SAMPLE DEPTH (in feet)		2.33000		4.67000		2.50000		5.00000		2.67000	
Sample ID		B0C2T2		B0C2T3		B0C2V0		B0C2V1		B0C2V3	
Parameter	Units	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q
Uranium	UG/L	0.368	J	0.465	J	0.421	J	0.381	J	0.403	J

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RIVER WATER
URANIUM Analysis Results

Program		CERCLA		CERCLA		CERCLA	
Well ID		SPRING 11,2		SPRING 11,3		SPRING 11,3	
Date		6-23-94		6-23-94		6-23-94	
Sample Type		WATER		WATER		WATER	
Lab ID		IT		IT		IT	
Filtered		NO		NO		NO	
SAMPLE DEPTH (in feet)		5.50000		1.00000		2.00000	
Sample ID		B0C2V4		B0C2T5		B0C2T6	
Parameter	Units	Conc.	Q	Conc.	Q	Conc.	Q
Uranium	UG/L	0.438	J	0.467	J	0.442	J

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APPENDIX B

GROUNDWATER ANALYTICAL DATA

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GLOSSARY OF DATA REPORTING QUALIFIERS

DATA QUALIFIERS AND FLAGS FOR RCRA PROGRAM DATA (DOE/RL, 1994h)

B - This flag is used when the analyte is found in the associated blank as well as in the sample. It indicates possible/probable blank contamination and warns the data user to take appropriate action. This flag must be used for a TIC as well as for a TCL compound.

D - Identifies compounds identified in an analysis at a secondary dilution factor.

L - This flag is used when an analytical result below a CRQL and or above an MDL is reported.

Q - This flag means that the field QC data associated with the sample data were outside limits established in the *QAPP for the RCRA Groundwater Monitoring Activities (WHC 1992c)*. The Q-flagged data can be used qualitatively, but no regulatory decisions should be made based on a single-flagged data point.

J - Indicates an estimated value. This flag is used when the mass spectral data indicate the presence of a compound that meets the identification criteria but the result is less than the sample quantitation limit and greater than zero. The sample quantitation limit is corrected for dilution and for percent moisture.

U - Indicates compound was analyzed for but not detected. The sample quantitation limit is corrected for dilution and percent moisture.

F - This flag indicates that a request has been made for data evaluation. The value is not to be used for decision-making purposes.

UQ - Indicates the constituent was analyzed for and not detected. In addition, the field QC data associated with the sample data were outside established limits. The Q-flagged data can be used qualitatively, but no regulatory decisions should be made based on a single-flagged data point.

DATA QUALIFIERS FOR CERCLA DATA (WHC 1992a and 1992b)

B - Indicates the constituent was analyzed for and detected. The concentration reported is less than the contract required detection limit (CRDL) but greater than the instrument detection limit (IDL). The associated data should be considered usable for decision making purposes. (Applies to metals only in this instance.)

U - Indicates the constituent was analyzed for and not detected. The concentration reported is the same detection limit corrected for sample aliquot size, dilution factors and percent solids (in the case of solid matrices) by the laboratory. The associated data should be considered usable for decision making purposes.

UJ - Indicates the constituent was analyzed for and was not detected. Due to a minor quality control deficiency identified during data validation, the concentration reported may not accurately reflect the sample detection limit. The associated data have been qualified as estimated but should be considered usable for decision making purposes.

BJ - Indicates the constituent was analyzed for and detected at a concentration less than the CRDL but greater than the IDL. Due to a minor quality control deficiency identified during data validation, the associated data have been qualified as estimated, but should be considered usable for decision making purposes.

J - Indicates the constituent was analyzed for and detected. Due to a minor quality control deficiency identified during data validation the associated data have been qualified as estimated, but should be considered usable for decision making purposes.

UR - Indicates the constituent was analyzed for and not detected. Due to a major quality control deficiency identified during data validation, the associated data have been qualified as unusable for decision making purposes.

R - Indicates the constituent was analyzed for and detected. Due to a major quality control deficiency identified during data validation, the associated data have been qualified as unusable for decision making purposes.

QA FIELD Analysis Results

Program		RCRA		CERCLA		RCRA		CERCLA		CERCLA	
Well ID		FTR94		399-1-5		399-1-17A		399-3-11		399-4-7	
Round		5		5		5		5		5	
Date		1-14-93		3-10-93		5-14-93		3-3-93		2-25-93	
Sample Type		FIELD BL		SPLIT		DUPLICATE		DUPLICATE		SPLIT	
Filtered				NO		NO		NO		NO	
Filter Size (in microns)											
Sample ID		B07TY4		B086S1		B07BM6		B086S3		B086S2	
Parameter	Units	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q
Specific conductance	UMHO/CM			433.000		206.000		378.000		380.000	
Turbidity	NTU	0.100	U								
Temperature	DEG C			15.800		20.000		16.200		17.600	
PH	STD.UNIT			7.410		7.480		7.610		7.350	

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QA FIELD Analysis Results

Program		CERCLA		RCRA	
Well ID		399-4-10		FTR193	
Round		5		7	
Date		3-3-93		4-18-94	
Sample Type		DUPLICATE		FIELD BL	
Filtered		NO			
Filter Size (in microns)					
Sample ID		B086S4		B0BRJ5	
Parameter	Units	Conc.	Q	Conc.	Q
Specific conductance	UMHO/CM	360.000			
Turbidity	NTU			0.290	
Temperature	DEG C	17.300			
PH	STD.UNIT	7.260		5.800	

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QA GENERAL CHEMISTRY Analysis Results

Program		RCRA		RCRA		RCRA		RCRA		RCRA	
Well ID		FTR94		FTR94		FTR94		FTR94		FTR99	
Round		5		5		5		5		5	
Date		1-14-93		1-14-93		1-14-93		1-14-93		2-12-93	
Sample Type		FIELD BL		FIELD BL		FIELD BL		FIELD BL		FIELD BL	
Lab ID		DATA CHEM		DATA CHEM		DATA CHEM		DATA CHEM		DATA CHEM	
Filtered											
Filter Size (in microns)											
Sample ID		B07TY4		B07TY5		B07TY6		B07TY7		B085F8	
Parameter	Units	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q
Alkalinity	MG/L									50.000	U
Bromide	UG/L	500.000	U								
Chloride	UG/L	200.000	U								
Fluoride	UG/L	100.000	U								
Nitrate	UG/L	200.000	U								
Nitrite	UG/L	200.000	U								
Phosphate	UG/L	400.000	U								
Sulfate	UG/L	500.000	U								
Coliform Bacteria	C/DL	1.000	U							1.000	U
Total Dissolved Solids											
Total Organic Carbon	UG/L	1000.000	U	1000.000	U	1000.000	U	1000.000	U	1000.000	U
Total organic halides	UG/L	10.000	U	10.000	U	10.000	U	10.000	U	10.000	U
Specific conductance											
Ammonium ion	UG/L	100.000	U								
PH											

QA GENERAL CHEMISTRY Analysis Results

Program		RCRA		RCRA		RCRA		RCRA		RCRA	
Well ID		FTR99		399-1-17A		399-1-17B		399-3-10		FTR193	
Round		5		5		5		6		7	
Date		2-12-93		5-14-93		2-18-93		9-3-93		4-18-94	
Sample Type		FIELD BL		DUPLICATE		DUPLICATE		DUPLICATE		FIELD BL	
Lab ID		DATA CHEM		DATA CHEM		DATA CHEM		DATA CHEM		DATA CHEM	
Filtered				NO		NO		NO			
Filter Size (in microns)											
Sample ID		B085F8		B07BM6		B085G3		B09660		B0BRJ5	
Parameter	Units	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q
Alkalinity	MG/L	50.000	U			170.000		70.000	B		
Bromide	UG/L									110.000	U
Chloride	UG/L									71.000	U
Fluoride	UG/L									51.000	U
Nitrate	UG/L									96.000	U
Nitrite	UG/L									110.000	U
Phosphate	UG/L									470.000	U
Sulfate	UG/L									89.000	U
Coliform Bacteria	C/DL	1.000	U			1.000	U	1.000	U	1.000	U
Total Dissolved Solids	MG/L									10.000	U
Total Organic Carbon	UG/L	1000.000	U	800.000	L	1000.000	U	500.000	L	320.000	U
Total organic halides	UG/L	10.000	U			20.000		9.000	L		
Specific conductance	UMHO/CM			206.000							
Ammonium ion											
PH	STD.UNIT			7.480						5.800	

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QA GENERAL CHEMISTRY Analysis Results

Program		RCRA		RCRA		RCRA	
Well ID		FTR193		FTR193		FTR193	
Round		7		7		7	
Date		4-18-94		4-18-94		4-18-94	
Sample Type		FIELD BL		FIELD BL		FIELD BL	
Lab ID		DATA CHEM		DATA CHEM		DATA CHEM	
Filtered							
Filter Size (in microns)							
Sample ID		B0BRJ6		B0BRJ7		B0BRJ8	
Parameter	Units	Conc.	Q	Conc.	Q	Conc.	Q
Alkalinity							
Bromide							
Chloride							
Fluoride							
Nitrate							
Nitrite							
Phosphate							
Sulfate							
Coliform Bacteria							
Total Dissolved Solids							
Total Organic Carbon	UG/L	320.000	U	320.000	U	320.000	U
Total organic halides							
Specific conductance							
Ammonium ion							
PH							

QA HERBICIDES ORGANIC Analysis Results

Program		RCRA		RCRA		RCRA		RCRA		RCRA	
Well ID		FTR94		FTR99		FTR99		399-1-17B		399-3-10	
Round		5		5		5		5		6	
Date		1-14-93		2-12-93		2-12-93		2-18-93		9-3-93	
Sample Type		FIELD BL		FIELD BL		FIELD BL		DUPLICATE		DUPLICATE	
Lab ID		DATA CHEM		DATA CHEM		DATA CHEM		DATA CHEM		DATA CHEM	
Filtered								NO		NO	
Filter Size (in microns)											
Sample ID		B07TY4		B085F8		B085F8		B085G3		B09660	
Parameter	Units	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q
2,4,5-T	UG/L	2.000	U	2.000	U	2.000	U	2.000	U	0.384	U
2,4,5-TP	UG/L	2.000	U	2.000	U	2.000	U	2.000	U	0.408	U
2,4-Dichlorophenoxyacetic acid	UG/L	10.000	U	10.000	U	10.000	U	10.000	U	0.186	U
2-secButyl-4,6-dinitrophenol(DNBP)	UG/L	5.000	U	5.000	U	5.000	U	5.000	U	1.350	U

QA HERBICIDES ORGANIC Analysis Results

Program		RCRA	
Well ID		FTR193	
Round		7	
Date		4-18-94	
Sample Type		FIELD BL	
Lab ID		DATA CHEM	
Filtered			
Filter Size (in microns)			
Sample ID		B0BRJ5	
Parameter	Units	Conc.	Q
2,4,5-T	UG/L	0.018	U
2,4,5-TP	UG/L	0.015	U
2,4-Dichlorophenoxyacetic acid	UG/L	0.052	U
2-secButyl-4,6-dinitrophenol(DNBP)	UG/L	1.700	U

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QA METALS Analysis Results

Program		RCRA		RCRA		RCRA		RCRA		RCRA	
Well ID		FTR94		FTR94		FTR99		FTR99		FTR99	
Round		5		5		5		5		5	
Date		1-14-93		1-14-93		2-12-93		2-12-93		2-12-93	
Sample Type		FIELD BL		FIELD BL		FIELD BL		FIELD BL		FIELD BL	
Lab ID		DATA CHEM		DATA CHEM		DATA CHEM		DATA CHEM		DATA CHEM	
Filtered				YES							
Filter Size (in microns)											
Sample ID		B07TY4		B07TY9		B085F8		B085F8		B085F9	
Parameter	Units	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q
Aluminum											
Antimony	UG/L	200.000	U	200.000	U	200.000	U	200.000	U	200.000	U
Arsenic	UG/L	5.000	U	5.000	U	5.000	U	5.000	U	5.000	U
Barium	UG/L	20.000	U	20.000	U	20.000	U	20.000	U	20.000	U
Beryllium	UG/L	3.000	U	3.000	U	3.000	U	3.000	U	3.000	U
Cadmium	UG/L	10.000	U	10.000	U	10.000	U	10.000	U	10.000	U
Calcium	UG/L	100.000	U	100.000	U	200.000		200.000		200.000	
Chromium	UG/L	20.000	U	20.000	U	20.000	U	20.000	U	20.000	U
Cobalt	UG/L	20.000	U	20.000	U	20.000	U	20.000	U	20.000	U
Copper	UG/L	20.000	U	20.000	U	20.000	U	20.000	U	20.000	U
Iron	UG/L	20.000	U	20.000	U	20.000		20.000		20.000	U
Lead	UG/L	5.000	U	5.000	U	5.000	U	5.000	U	5.000	U
Magnesium	UG/L	100.000	U	100.000	U	100.000	U	100.000	U	100.000	U
Manganese	UG/L	10.000	U	10.000	U	10.000	U	10.000	U	10.000	U
Mercury	UG/L					0.200	U	0.200	U	0.200	U
Nickel	UG/L	30.000	U	30.000	U	30.000	U	30.000	U	30.000	U
Potassium	UG/L	300.000	U	300.000	U	300.000	U	300.000	U	500.000	
Selenium	UG/L	10.000	U	10.000	U	10.000	U	10.000	U	10.000	U
Silver	UG/L	20.000	U	20.000	U	20.000	U	20.000	U	20.000	U
Sodium	UG/L	300.000	U	300.000	U	300.000	U	300.000	U	300.000	U
Tin	UG/L	100.000	U	100.000	U	100.000	U	100.000	U	100.000	U
Vanadium	UG/L	30.000	U	30.000	U	30.000	U	30.000	U	30.000	U
Zinc	UG/L	10.000	U	10.000	U	10.000	U	10.000	U	10.000	U

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QA METALS Analysis Results

Program		RCRA		RCRA		RCRA		RCRA		RCRA	
Well ID		FTR99		399-1-17B		399-1-17B		399-3-10		399-3-10	
Round		5		5		5		6		6	
Date		2-12-93		2-18-93		2-18-93		9-3-93		9-3-93	
Sample Type		FIELD BL		DUPLICATE		DUPLICATE		DUPLICATE		DUPLICATE	
Lab ID		DATA CHEM		DATA CHEM		DATA CHEM		DATA CHEM		DATA CHEM	
Filtered		YES		NO		YES		NO		YES	
Filter Size (in microns)											
Sample ID		B085F9		B085G3		B085G5		B09660		B09662	
Parameter	Units	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q
Aluminum	UG/L							38.000	L	40.000	L
Antimony	UG/L	200.000	U	200.000	U	200.000	U	69.400	U	69.400	U
Arsenic	UG/L	5.000	U	5.000	U	5.000	U	1.380	U	1.380	U
Barium	UG/L	20.000	U	70.000		70.000		53.000		51.000	
Beryllium	UG/L	3.000	U	3.000	U	3.000	U	0.814	U	0.814	U
Cadmium	UG/L	10.000	U	10.000	U	10.000	U	4.700	U	4.700	U
Calcium	UG/L	200.000		19000.000		19000.000		40000.000		38000.000	
Chromium	UG/L	20.000	U	20.000		20.000	U	9.400	L	5.420	U
Cobalt	UG/L	20.000	U	20.000	U	20.000	U	4.050	U	4.050	U
Copper	UG/L	20.000	U	20.000	U	20.000	U	5.000	L	4.600	L
Iron	UG/L	20.000	U	490.000		330.000		290.000		70.000	
Lead	UG/L	5.000	U	5.000	U	5.000	U	0.680	L	0.730	L
Magnesium	UG/L	100.000	U	6900.000		7000.000		7500.000		7100.000	
Manganese	UG/L	10.000	U	80.000		80.000		11.000		6.400	L
Mercury	UG/L	0.200	U	0.200	U	0.200	U	0.158	U	0.158	U
Nickel	UG/L	30.000	U	30.000	U	30.000	U	17.900	U	17.900	U
Potassium	UG/L	500.000		7100.000		5900.000		3900.000		3600.000	
Selenium	UG/L	10.000	U	10.000	U	10.000	U	1.210	U	1.210	U
Silver	UG/L	20.000	U	20.000	U	20.000	U	4.900	L	3.500	L
Sodium	UG/L	300.000	U	50000.000		51000.000		14000.000		14000.000	
Tin	UG/L	100.000	U	100.000	U	100.000	U	51.100	U	51.100	U
Vanadium	UG/L	30.000	U	30.000	U	30.000	U	3.900	L	3.840	U
Zinc	UG/L	10.000	U	10.000	U	10.000	U	3.700	L	3.440	U

QA METALS Analysis Results

Program		RCRA		RCRA		CERCLA		CERCLA		CERCLA	
Well ID		FTR193		FTR193		399-1-5		399-1-5		399-1-5	
Round		7		7		7		7		7	
Date		4-18-94		4-18-94		6-24-94		6-24-94		6-24-94	
Sample Type		FIELD BL		FIELD BL		DUPLICATE		DUPLICATE		SPLIT	
Lab ID		DATA CHEM		DATA CHEM		IT		IT		TMA	
Filtered				YES		NO		YES		NO	
Filter Size (in microns)											
Sample ID		B0BRJ5		B0BRJ9		B0BZJ6		B0BZJ7		B0BZJ4	
Parameter	Units	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q
Aluminum	UG/L	46.000	BL	22.000	BL	19.000	UJ	19.000	UJ	38.400	U
Antimony	UG/L	26.000	U	30.000	L	19.500	UJ	19.500	UJ	16.100	U
Arsenic											
Barium	UG/L	1.300	U	1.300	U	37.700	B	38.000	B	42.100	U
Beryllium	UG/L	1.500	U	1.500	U	0.800	U	0.600	U	0.600	U
Cadmium	UG/L	3.000	U	3.000	U	1.800	UJ	1.800	UJ	0.800	U
Calcium	UG/L	86.000	L	49.000	L	54700.000		55000.000		49000.000	
Chromium	UG/L	11.000	U	11.000	U	4.500	BJ	2.800	UJ	8.400	U
Cobalt	UG/L	6.500	U	6.500	U	2.900	UJ	2.900	UJ	2.300	U
Copper	UG/L	3.200	BL	3.200	BL	4.500	UJ	4.500	UJ	2.500	U
Iron	UG/L	23.000		18.000	U	48.200	U	42.800	U	49.600	U
Lead											
Magnesium	UG/L	25.000	U	25.000	U	10900.000		10900.000		10100.000	
Manganese	UG/L	1.000	U	1.000	U	1.400	BJ	1.400	BJ	1.600	U
Mercury											
Nickel	UG/L	16.000	U	16.000	U	4.900	UJ	4.900	UJ	7.900	U
Potassium	UG/L	890.000	U	890.000	U	3060.000	B	3110.000	B	2650.000	B
Selenium											
Silver	UG/L	3.400	U	3.400	U	4.200	UJ	5.800	UJ	3.700	U
Sodium	UG/L	340.000	B	230.000	BL	23300.000		23600.000		21600.000	
Tin	UG/L	24.000	U	24.000	U						
Vanadium	UG/L	6.400	U	6.400	U	9.800	UJ	9.800	UJ	3.500	B
Zinc	UG/L	4.400	U	4.400	U	18.600	B	8.700	B	3.200	U

QA METALS Analysis Results

Program		CERCLA		CERCLA		CERCLA		CERCLA		CERCLA	
Well ID		399-1-5		399-2-2		399-2-2		399-3-11		399-3-11	
Round		7		7		7		7		7	
Date		6-24-94		6-23-94		6-23-94		6-22-94		6-22-94	
Sample Type		SPLIT		DUPLICATE		DUPLICATE		DUPLICATE		DUPLICATE	
Lab ID		TMA		IT		IT		IT		IT	
Filtered		YES		NO		YES		NO		YES	
Filter Size (in microns)											
Sample ID		B0BZJ5		B0BZK6		B0BZK7		B0BZL2		B0BZL3	
Parameter	Units	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q
Aluminum	UG/L	23.800	U	34.500	U	34.500	U	34.500	U	34.500	U
Antimony	UG/L	16.100	U	30.500	U	30.500	U	30.500	U	30.500	U
Arsenic											
Barium	UG/L	42.100	B	45.800	B	45.100	B	44.200	B	45.100	B
Beryllium	UG/L	0.600	U	0.800	U	0.600	U	0.470	U	0.300	U
Cadmium	UG/L	1.000	U	2.200	U	2.200	U	2.200	U	2.200	U
Calcium	UG/L	49200.000		44900.000		44300.000		47900.000		48400.000	
Chromium	UG/L	3.700	U	5.000	BJ	3.000	UJ	7.100	B	3.000	U
Cobalt	UG/L	2.300	U	3.200	UJ	3.200	UJ	3.200	U	3.200	U
Copper	UG/L	2.500	U	2.100	UJ	2.100	UJ	8.000	U	7.300	U
Iron	UG/L	74.300	U	111.000	U	32.400	U	52.800	U	31.300	U
Lead											
Magnesium	UG/L	10200.000		8330.000		8260.000		9980.000		10100.000	
Manganese	UG/L	0.700	U	2.100	B	0.770	BJ	2.700	U	2.000	U
Mercury											
Nickel	UG/L	7.900	U	11.400	U	11.400	U	11.400	U	11.400	U
Potassium	UG/L	2590.000	B	3660.000	B	3500.000	B	3870.000	B	5780.000	
Selenium											
Silver	UG/L	3.700	U	3.000	UJ	3.000	UJ	3.000	U	3.000	U
Sodium	UG/L	21700.000		26400.000		26600.000		20200.000		20500.000	
Tin											
Vanadium	UG/L	2.500	U	1.900	UJ	1.900	UJ	15.400	U	14.000	U
Zinc	UG/L	12.000	U	14.700	B	6.500	B	9.300	B	4.800	B

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QA METALS Analysis Results

Program		CERCLA		CERCLA		CERCLA		CERCLA		CERCLA	
Well ID		399-3-11		399-3-11		399-3-12		399-3-12		399-4-7	
Round		7		7		7		7		7	
Date		6-22-94		6-22-94		6-22-94		6-22-94		6-23-94	
Sample Type		EQUIP.BL		EQUIP.BL		EQUIP.BL		EQUIP.BL		SPLIT	
Lab ID		IT		IT		IT		IT		TMA	
Filtered		NO		YES		NO		YES		NO	
Filter Size (in microns)											
Sample ID		B0BZM6		B0BZM7		B0BZM8		B0BZM9		B0BZL8	
Parameter	Units	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q
Aluminum	UG/L	34.500	U	34.500	U	34.500	U	34.500	U	23.800	U
Antimony	UG/L	30.500	U	30.500	U	30.500	U	30.500	U	16.100	U
Arsenic											
Barium	UG/L	0.700	U	0.700	U	0.700	U	0.700	U	48.700	B
Beryllium	UG/L	0.310	U	0.310	U	0.310	U	0.200	U	0.600	U
Cadmium	UG/L	2.200	U	2.200	U	2.200	U	2.200	U	0.850	U
Calcium	UG/L	36.600	U	82.300	U	56.300	U	42.100	U	44000.000	
Chromium	UG/L	3.000	U	3.000	U	3.000	B	3.000	U	3.700	U
Cobalt	UG/L	3.200	U	3.200	U	3.200	U	3.200	U	2.300	U
Copper	UG/L	6.100	U	6.800	U	5.600	U	4.700	U	2.500	U
Iron	UG/L	17.600	U	29.000	U	12.900	U	10.600	U	1190.000	
Lead											
Magnesium	UG/L	59.200	U	125.000	U	112.000	U	36.000	U	8450.000	
Manganese	UG/L	0.660	U	0.650	U	0.650	U	0.600	U	42.500	
Mercury											
Nickel	UG/L	11.400	U	11.400	U	11.400	U	11.400	U	7.900	U
Potassium	UG/L	2710.000	U	2710.000	U	2710.000	U	2710.000	U	4530.000	B
Selenium											
Silver	UG/L	3.000	U	3.000	U	3.000	U	3.000	U	3.700	U
Sodium	UG/L	54.300	U	110.000	U	80.500	U	40.200	U	17600.000	
Tin											
Vanadium	UG/L	2.200	U	5.300	U	4.400	U	1.900	U	7.000	B
Zinc	UG/L	7.400	B	6.600	B	11.200	B	6.200	B	15.700	U

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QA METALS Analysis Results

Program		CERCLA		CERCLA		CERCLA	
Well ID		399-4-7		399-4-10		399-4-10	
Round		7		7		7	
Date		6-23-94		6-23-94		6-23-94	
Sample Type		SPLIT		DUPLICATE		DUPLICATE	
Lab ID		TMA		IT		IT	
Filtered		YES		NO		YES	
Filter Size (in microns)							
Sample ID		B0BZL9		B0BZM2		B0BZM3	
Parameter	Units	Conc.	Q	Conc.	Q	Conc.	Q
Aluminum	UG/L	42.400	B	19.000	UJ	19.000	UJ
Antimony	UG/L	16.100	U	19.500	UJ	19.500	UJ
Arsenic							
Barium	UG/L	49.800	U	53.400	B	53.700	B
Beryllium	UG/L	0.600	U	0.800	U	0.800	U
Cadmium	UG/L	0.830	U	1.800	UJ	1.800	UJ
Calcium	UG/L	44800.000		45300.000		46300.000	
Chromium	UG/L	3.700	UJ	2.800	UJ	2.800	UJ
Cobalt	UG/L	2.300	U	2.900	UJ	2.900	UJ
Copper	UG/L	2.700	B	4.500	UJ	4.500	UJ
Iron	UG/L	25.300	U	30.900	U	29.300	U
Lead							
Magnesium	UG/L	8590.000		8320.000		8430.000	
Manganese	UG/L	1.600	U	1.500	B	2.100	B
Mercury							
Nickel	UG/L	7.900	U	4.900	UJ	4.900	UJ
Potassium	UG/L	4580.000	B	4890.000	B	4940.000	B
Selenium							
Silver	UG/L	3.700	U	4.200	UJ	4.200	UJ
Sodium	UG/L	17900.000		18500.000		18800.000	
Tin							
Vanadium	UG/L	3.900	B	9.800	UJ	9.800	UJ
Zinc	UG/L	11.300	U	3.100	U	1.600	UJ

QA PESTICIDES/PCBs ORGANIC Analysis Results

Program		RCRA		RCRA		RCRA		RCRA		RCRA	
Well ID		FTR94		FTR99		FTR99		399-1-17B		399-3-10	
Round		5		5		5		5		6	
Date		1-14-93		2-12-93		2-12-93		2-18-93		9-3-93	
Sample Type		FIELD BL		FIELD BL		FIELD BL		DUPLICATE		DUPLICATE	
Lab ID		DATA CHEM		DATA CHEM		DATA CHEM		DATA CHEM		DATA CHEM	
Filtered								NO		NO	
Filter Size (in microns)											
Sample ID		B07TY4		B085F8		B085F8		B085G3		B09660	
Parameter	Units	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q
Aldrin	UG/L	0.050	U	0.050	U	0.050	U	0.050	U	0.050	U
Alpha-BHC	UG/L	0.050	U	0.050	U	0.050	U	0.050	U	0.012	U
Beta-BHC	UG/L	0.050	U	0.050	U	0.050	U	0.050	U	0.003	U
Chlordane	UG/L	0.100	U	0.100	U	0.100	U	0.100	U	0.006	U
Delta-BHC	UG/L	0.100	U	0.100	U	0.100	U	0.100	U	0.001	U
Dieldrin	UG/L	0.050	U	0.050	U	0.050	U	0.050	U	0.019	U
4,4'-DDD	UG/L	0.100	U	0.100	U	0.100	U	0.100	U	0.001	U
4,4'-DDE	UG/L	0.050	U	0.050	U	0.050	U	0.050	U	0.001	U
4,4'-DDT	UG/L	0.100	U	0.100	U	0.100	U	0.100	U	0.011	U
Endosulfan I	UG/L	0.100	U	0.100	U	0.100	U	0.100	U	0.003	U
Endosulfan II	UG/L	0.050	U	0.050	U	0.050	U	0.050	U	0.004	U
Endosulfan sulfate	UG/L	0.500	U	0.500	U	0.500	U	0.500	U	0.007	U
Endrin	UG/L	0.100	U	0.100	U	0.100	U	0.100	U	0.008	U
Endrin aldehyde	UG/L	0.200	U	0.200	U	0.200	U	0.200	U	0.011	U
Gamma-BHC (Lindane)	UG/L	0.050	U	0.050	U	0.050	U	0.050	U	0.002	U
Heptachlor	UG/L	0.050	U	0.050	U	0.050	U	0.050	U	0.002	U
Heptachlor epoxide	UG/L	1.000	U	1.000	U	1.000	U	1.000	U	0.001	U
Methoxychlor	UG/L	2.000	U	2.000	U	2.000	U	2.000	U	0.100	U
Toxaphene	UG/L	2.000	U	2.000	U	2.000	U	2.000	U	0.890	U
Aroclor-1260											
Aroclor-1254											
Aroclor-1221											
Aroclor-1232											
Aroclor-1248											
Aroclor-1016											
Aroclor-1242											

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QA PESTICIDES/PCBs ORGANIC Analysis Results

Program		RCRA	
Well ID		FTR193	
Round		7	
Date		4-18-94	
Sample Type		FIELD BL	
Lab ID		DATA CHEM	
Filtered			
Filter Size (in microns)			
Sample ID		BOBRJ5	
Parameter	Units	Conc.	Q
Aldrin	UG/L	0.002	U
Alpha-BHC	UG/L	0.003	U
Beta-BHC	UG/L	0.001	U
Chlordane	UG/L	0.042	U
Delta-BHC	UG/L	0.002	U
Dieldrin	UG/L	0.002	U
4,4'-DDD	UG/L	0.004	U
4,4'-DDE	UG/L	0.002	U
4,4'-DDT	UG/L	0.001	U
Endosulfan I	UG/L	0.002	U
Endosulfan II	UG/L	0.001	U
Endosulfan sulfate	UG/L	0.002	U
Endrin	UG/L	0.004	U
Endrin aldehyde	UG/L	0.004	U
Gamma-BHC (Lindane)	UG/L	0.002	U
Heptachlor	UG/L	0.002	U
Heptachlor epoxide	UG/L	0.001	U
Methoxychlor	UG/L	0.022	U
Toxaphene	UG/L	0.700	U
Aroclor-1260	UG/L	0.079	U
Aroclor-1254	UG/L	0.092	U
Aroclor-1221	UG/L	0.060	U
Aroclor-1232	UG/L	0.094	U
Aroclor-1248	UG/L	0.047	U
Aroclor-1016	UG/L	0.059	U
Aroclor-1242	UG/L	0.170	U

QA RADIONUCLIDE Analysis Results

Program		CERCLA		CERCLA		RCRA		RCRA		CERCLA	
Well ID						FTR99		FTR99		399-1-5	
Round		5		5		5		5		5	
Date		3-3-93		3-3-93		2-12-93		2-12-93		3-10-93	
Sample Type		EQUIP.BL		EQUIP.BL		FIELD BL		FIELD BL		SPLIT	
Lab ID		TMA		TMA		DATA CHEM		DATA CHEM		WESTON	
Filtered		NO		NO						NO	
Filter Size (in microns)											
Sample ID		B086R9		B086S0		B085F8		B085F8		B086S1	
Parameter	Units	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q
Antimony-125											
Cesium-137											
Cobalt-60											
Gross Alpha	PCI/L	2.000	UJ	2.000	UJ	0.146	U	0.146	U	120.000	R
Gross Beta	PCI/L	2.000	U	2.000	U	-0.238	U	-0.238	U	85.000	R
Radium	PCI/L					-0.065	U	-0.065	U		
Ruthenium-106											
Strontium-90											
Technetium-99											
Tritium	PCI/L					63.800	U	63.800	U		
Uranium	UG/L	0.080	U	0.080	U	0.106	U	0.106	U		
Uranium-233/234											
Uranium-234											
Uranium-235											
Uranium-238											

QA RADIONUCLIDE Analysis Results

Program		RCRA		CERCLA		CERCLA		CERCLA		CERCLA	
Well ID		399-1-17B		399-3-11		399-4-7		399-4-10			
Round		5		5		5		5		6	
Date		2-18-93		3-3-93		2-25-93		3-3-93		9-23-93	
Sample Type		DUPLICATE		DUPLICATE		SPLIT		DUPLICATE		EQUIP.BL	
Lab ID		DATA CHEM		TMA		WESTON		TMA		TMA	
Filtered		NO		NO		NO		NO		NO	
Filter Size (in microns)											
Sample ID		B085G3		B086S3		B086S2		B086S4		B095M3	
Parameter	Units	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q
Antimony-125											
Cesium-137											
Cobalt-60											
Gross Alpha	PCI/L	0.787	U	14.000	J	28.000	R	19.000	J		
Gross Beta	PCI/L	5.460	U	20.000		19.000	R	15.000			
Radium	PCI/L	-0.012	U								
Ruthenium-106											
Strontium-90											
Technetium-99											
Tritium	PCI/L	-60.100	U								
Uranium	UG/L	-0.007	U	38.000				43.000		0.040	U
Uranium-233/234	PCI/L									0.095	U
Uranium-234											
Uranium-235	PCI/L									0.096	U
Uranium-238	PCI/L									0.079	U

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QA RADIONUCLIDE Analysis Results

Program		CERCLA		CERCLA		RCRA		CERCLA		CERCLA	
Well ID				399-1-5		399-3-10		399-3-11		399-4-7	
Round		6		6		6		6		6	
Date		9-23-93		9-24-93		9-3-93		9-22-93		9-17-93	
Sample Type		EQUIP.BL		SPLIT		DUPLICATE		DUPLICATE		SPLIT	
Lab ID		TMA		WESTON		DATA CHEM		TMA		WESTON	
Filtered		NO		NO		NO		NO		NO	
Filter Size (in microns)											
Sample ID		B095M4		B095M5		B09660		B095K8		B095J1	
Parameter	Units	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q
Antimony-125										/	
Cesium-137											
Cobalt-60											
Gross Alpha	PCI/L					13.600					
Gross Beta	PCI/L					7.900					
Radium	PCI/L					-0.041	U				
Ruthenium-106											
Strontium-90											
Technetium-99											
Tritium	PCI/L					2650.000					
Uranium	UG/L	0.037	U	59.000		23.200		27.000		36.000	
Uranium-233/234	PCI/L	0.018	U					3.500			
Uranium-234	PCI/L			33.000						15.000	
Uranium-235	PCI/L	-0.016	U	1.200				0.280		0.440	
Uranium-238	PCI/L	0.013	U	25.000				3.600		15.000	

QA RADIONUCLIDE Analysis Results

Program		CERCLA		RCRA		CERCLA		CERCLA		CERCLA	
Well ID		399-4-10		FTR193		399-1-5		399-3-11		399-3-11	
Round		6		7		7		7		7	
Date		9-22-93		4-18-94		6-24-94		6-22-94		6-22-94	
Sample Type		DUPLICATE		FIELD BL		SPLIT		DUPLICATE		EQUIP.BL	
Lab ID		TMA		DATA CHEM		TMA		IT		IT	
Filtered		NO				NO		NO		NO	
Filter Size (in microns)											
Sample ID		B095L5		B0BRJ5		B0BZJ4		B0BZL2		B0BZM6	
Parameter	Units	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q
Antimony-125											
Cesium-137											
Cobalt-60											
Gross Alpha	PCI/L			0.047	U						
Gross Beta	PCI/L			-0.103	U						
Radium											
Ruthenium-106											
Strontium-90											
Technetium-99											
Tritium	PCI/L			131.000	U						
Uranium	UG/L	70.000				120.000		95.700		0.013	
Uranium-233/234	PCI/L	27.000									
Uranium-234											
Uranium-235	PCI/L	0.860	U								
Uranium-238	PCI/L	25.000									

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QA RADIONUCLIDE Analysis Results

Program		CERCLA		CERCLA		CERCLA	
Well ID		399-3-12		399-4-7		399-4-10	
Round		7		7		7	
Date		6-22-94		6-23-94		6-23-94	
Sample Type		EQUIP.BL		SPLIT		DUPLICATE	
Lab ID		IT		TMA		IT	
Filtered		NO		NO		NO	
Filter Size (in microns)							
Sample ID		B0BZM8		B0BZL8		B0BZM2	
Parameter	Units	Conc.	Q	Conc.	Q	Conc.	Q
Antimony-125							
Cesium-137							
Cobalt-60							
Gross Alpha							
Gross Beta							
Radium							
Ruthenium-106							
Strontium-90							
Technetium-99							
Tritium							
Uranium	UG/L	0.020		53.000		41.500	
Uranium-233/234							
Uranium-234							
Uranium-235							
Uranium-238							

QA SEMI-VOLATILE ORGANIC Analysis Results

Program		RCRA		RCRA		RCRA		RCRA		RCRA	
Well ID		FER116		FER118		FER121		FER127		FTR94	
Round		5		5		5		5		5	
Date		1-8-93		1-14-93		1-27-93		2-16-93		1-14-93	
Sample Type		FIELD BL		FIELD BL		FIELD BL		FIELD BL		FIELD BL	
Lab ID		DATA CHEM		DATA CHEM		DATA CHEM		DATA CHEM		DATA CHEM	
Filtered											
Filter Size (in microns)											
Sample ID		B01NM0		B01NM2		B01NM5		B01NN1		B07TY4	
Parameter	Units	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q
1,4-Dichlorobenzene	UG/L	5.000	U	5.000	U	5.000	U	5.000	U		
2,4,6-Trichlorophenol	UG/L									5.000	U
2,4-Dichlorophenol	UG/L									5.000	U
2,4-Dimethylphenol	UG/L									5.000	U
2,4-Dinitrophenol	UG/L									150.000	U
2,6-Dichlorophenol	UG/L									5.000	U
2-Chlorophenol	UG/L									5.000	U
2-Nitrophenol	UG/L									5.000	U
4,6-Dinitro-o-cresol	UG/L									200.000	U
4-Chloro-3-methylphenol	UG/L									5.000	U
4-Nitrophenol	UG/L									30.000	U
Pentachlorophenol	UG/L									100.000	U
Phenol	UG/L									1.000	U
Tetrachlorophenol	UG/L									10.000	U
Tetrahydrofuran	UG/L	10.000	U	10.000	U	10.000	U	10.000	U		
Total cresols	UG/L									10.000	U
Trichlorophenol	UG/L									5.000	U

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QA SEMI-VOLATILE ORGANIC Analysis Results

Program		RCRA		RCRA		RCRA		RCRA		RCRA	
Well ID		FTR99		FTR99		TRP301		TRP303		TRP306	
Round		5		5		5		5		5	
Date		2-12-93		2-12-93		1-8-93		1-14-93		1-21-93	
Sample Type		FIELD BL		FIELD BL		FIELD BL		FIELD BL		FIELD BL	
Lab ID		DATA CHEM		DATA CHEM		DATA CHEM		DATA CHEM		DATA CHEM	
Filtered											
Filter Size (in microns)											
Sample ID		B085F8		B085F8		B01NH7		B01NH9		B01NJ2	
Parameter	Units	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q
1,4-Dichlorobenzene	UG/L	5.000	U	5.000	U	5.000	U	5.000	U	5.000	U
2,4,6-Trichlorophenol	UG/L	5.000	U	5.000	U						
2,4-Dichlorophenol	UG/L	5.000	U	5.000	U						
2,4-Dimethylphenol	UG/L	5.000	U	5.000	U						
2,4-Dinitrophenol	UG/L	150.000	U	150.000	U						
2,6-Dichlorophenol	UG/L	5.000	U	5.000	U						
2-Chlorophenol	UG/L	5.000	U	5.000	U						
2-Nitrophenol	UG/L	5.000	U	5.000	U						
4,6-Dinitro-o-cresol	UG/L	200.000	U	200.000	U						
4-Chloro-3-methylphenol	UG/L	5.000	U	5.000	U						
4-Nitrophenol	UG/L	30.000	U	30.000	U						
Pentachlorophenol	UG/L	100.000	U	100.000	U						
Phenol	UG/L	1.000	U	1.000	U						
Tetrachlorophenol	UG/L	10.000	U	10.000	U						
Tetrahydrofuran	UG/L	10.000	U	10.000	U	10.000	U	10.000	U	10.000	U
Total cresols	UG/L	10.000	U	10.000	U						
Trichlorophenol	UG/L	5.000	U	5.000	U						

QA SEMI-VOLATILE ORGANIC Analysis Results

Program		RCRA		RCRA		RCRA		RCRA		RCRA	
Well ID		TRP310		TRP321		TRP322		TRP324		TRP373	
Round		5		5		5		5		5	
Date		1-27-93		2-12-93		2-16-93		2-18-93		5-14-93	
Sample Type		FIELD BL		FIELD BL		FIELD BL		FIELD BL		FIELD BL	
Lab ID		DATA CHEM		DATA CHEM		DATA CHEM		DATA CHEM		DATA CHEM	
Filtered											
Filter Size (in microns)											
Sample ID		B01NJ6		B01P07		B01P08		B01P10		B07BH9	
Parameter	Units	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q
1,4-Dichlorobenzene	UG/L	5.000	U	5.000	U	5.000	U	5.000	U	0.630	U
2,4,6-Trichlorophenol											
2,4-Dichlorophenol											
2,4-Dimethylphenol											
2,4-Dinitrophenol											
2,6-Dichlorophenol											
2-Chlorophenol											
2-Nitrophenol											
4,6-Dinitro-o-cresol											
4-Chloro-3-methylphenol											
4-Nitrophenol											
Pentachlorophenol											
Phenol											
Tetrachlorophenol											
Tetrahydrofuran	UG/L	10.000	U	10.000	U	10.000	U	10.000	U	3.670	U
Total cresols											
Trichlorophenol											

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QA SEMI-VOLATILE ORGANIC Analysis Results

Program		RCRA		RCRA		RCRA		RCRA		RCRA	
Well ID		TRP374		TRP378		399-1-17B		FER174		FER176	
Round		5		5		5		6		6	
Date		5-14-93		5-20-93		2-18-93		9-7-93		9-14-93	
Sample Type		FIELD BL		FIELD BL		DUPLICATE		FIELD BL		FIELD BL	
Lab ID		DATA CHEM		DATA CHEM		DATA CHEM		DATA CHEM		DATA CHEM	
Filtered						NO					
Filter Size (in microns)											
Sample ID		B07BJ0		B07BJ4		B085G3		B07CT0		B07CT2	
Parameter	Units	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q
1,4-Dichlorobenzene	UG/L	0.630	U	0.630	U	5.000	U	0.630	U	0.630	U
2,4,6-Trichlorophenol	UG/L					5.000	U				
2,4-Dichlorophenol	UG/L					5.000	U				
2,4-Dimethylphenol	UG/L					5.000	U				
2,4-Dinitrophenol	UG/L					150.000	U				
2,6-Dichlorophenol	UG/L					5.000	U				
2-Chlorophenol	UG/L					5.000	U				
2-Nitrophenol	UG/L					5.000	U				
4,6-Dinitro-o-cresol	UG/L					200.000	U				
4-Chloro-3-methylphenol	UG/L					5.000	U				
4-Nitrophenol	UG/L					30.000	U				
Pentachlorophenol	UG/L					100.000	U				
Phenol	UG/L					1.000	U				
Tetrachlorophenol	UG/L					10.000	U				
Tetrahydrofuran	UG/L	3.670	U	3.670	U	10.000	U	3.670	U	3.670	U
Total cresols	UG/L					10.000	U				
Trichlorophenol	UG/L					5.000	U				

QA SEMI-VOLATILE ORGANIC Analysis Results

Program		RCRA		RCRA		RCRA		RCRA		RCRA	
Well ID		FER194		TRP438		TRP439		TRP443		TRP448	
Round		6		6		6		6		6	
Date		12-9-93		9-3-93		9-7-93		9-14-93		9-27-93	
Sample Type		FIELD BL		FIELD BL		FIELD BL		FIELD BL		FIELD BL	
Lab ID		DATA CHEM		DATA CHEM		DATA CHEM		DATA CHEM		DATA CHEM	
Filtered											
Filter Size (in microns)											
Sample ID		B07CW0		B07CP4		B07CP5		B07CP9		B07CQ4	
Parameter	Units	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q
1,4-Dichlorobenzene	UG/L	0.630	U	0.630	U	0.630	U	0.630	U	0.630	U
2,4,6-Trichlorophenol											
2,4-Dichlorophenol											
2,4-Dimethylphenol											
2,4-Dinitrophenol											
2,6-Dichlorophenol											
2-Chlorophenol											
2-Nitrophenol											
4,6-Dinitro-o-cresol											
4-Chloro-3-methylphenol											
4-Nitrophenol											
Pentachlorophenol											
Phenol											
Tetrachlorophenol											
Tetrahydrofuran	UG/L	3.670	U	3.670	U	3.670	U	3.670	U	3.670	U
Total cresols											
Trichlorophenol											

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QA SEMI-VOLATILE ORGANIC Analysis Results

Program		RCRA		RCRA		RCRA		RCRA		RCRA	
Well ID		TRP450		TRP456		TRP491		399-3-10		FER239	
Round		6		6		6		6		7	
Date		9-29-93		10-7-93		12-9-93		9-3-93		6-23-94	
Sample Type		FIELD BL		FIELD BL		FIELD BL		DUPLICATE		FIELD BL	
Lab ID		DATA CHEM		DATA CHEM		DATA CHEM		DATA CHEM		DATA CHEM	
Filtered								NO			
Filter Size (in microns)											
Sample ID		B07CQ6		B07CR2		B07F91		B09660		B09GT7	
Parameter	Units	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q
1,4-Dichlorobenzene	UG/L	0.630	U	0.630	U	0.630	U	1.000	U	0.370	U
2,4,6-Trichlorophenol	UG/L							1.450	U		
2,4-Dichlorophenol	UG/L							1.500	U		
2,4-Dimethylphenol	UG/L							1.010	U		
2,4-Dinitrophenol	UG/L							0.960	U		
2,6-Dichlorophenol	UG/L							1.590	U		
2-Chlorophenol	UG/L							1.420	U		
2-Nitrophenol	UG/L							1.560	U		
4,6-Dinitro-o-cresol	UG/L							1.180	U		
4-Chloro-3-methylphenol	UG/L							1.120	U		
4-Nitrophenol	UG/L							0.650	U		
Pentachlorophenol	UG/L							0.870	U		
Phenol	UG/L							0.310	U		
Tetrachlorophenol	UG/L							1.050	U		
Tetrahydrofuran	UG/L	7.100	L	6.800	L	3.670	U	0.600	U	2.800	U
Total cresols	UG/L							4.660	U		
Trichlorophenol	UG/L							1.110	U		

QA SEMI-VOLATILE ORGANIC Analysis Results

Program		RCRA		RCRA		RCRA		RCRA	
Well ID		FTR193		TRP561		TRP600		TRP601	
Round		7		7		7		7	
Date		4-18-94		4-18-94		6-22-94		6-23-94	
Sample Type		FIELD BL		FIELD BL		FIELD BL		FIELD BL	
Lab ID		DATA CHEM		DATA CHEM		DATA CHEM		DATA CHEM	
Filtered									
Filter Size (in microns)									
Sample ID		B0BRJ5		B09G29		B09GP8		B09GP9	
Parameter	Units	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q
1,4-Dichlorobenzene	UG/L			0.370	U	0.370	U	0.370	U
2,4,6-Trichlorophenol	UG/L	1.600	U						
2,4-Dichlorophenol	UG/L	1.500	U						
2,4-Dimethylphenol	UG/L	1.500	U						
2,4-Dinitrophenol	UG/L	1.800	U						
2,6-Dichlorophenol	UG/L	2.200	U						
2-Chlorophenol	UG/L	1.500	U						
2-Nitrophenol	UG/L	1.700	U						
4,6-Dinitro-o-cresol	UG/L	1.600	U						
4-Chloro-3-methylphenol	UG/L	1.500	U						
4-Nitrophenol	UG/L	1.400	U						
Pentachlorophenol	UG/L	1.700	U						
Phenol	UG/L	0.570	U						
Tetrachlorophenol	UG/L	1.400	U						
Tetrahydrofuran	UG/L			2.800	U	2.800	U	2.800	U
Total cresols	UG/L	4.800	U						
Trichlorophenol	UG/L	2.100	U						

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QA VOLATILE ORGANIC Analysis Results

Program		CERCLA		CERCLA		RCRA	
Well ID						FER116	
Round		5		5		5	
Date		3-3-93		3-3-93		1-8-93	
Sample Type		EQUIP.BL		EQUIP.BL		FIELD BL	
Lab ID		TMA		TMA		DATA CHEM	
Filtered		NO		NO			
Filter Size (in microns)		NAN		NAN		NAN	
Sample ID		B086R9		B086S0		B01NM0	
Parameter	Units	Conc.	Q	Conc.	Q	Conc.	Q
Chloromethane	UG/L	10.000	U	10.000	U		
Bromomethane	UG/L	10.000	U	10.000	U		
Vinyl Chloride	UG/L	10.000	U	10.000	U	10.000	U
Chloroethane	UG/L	10.000	U	10.000	U		
Methylene Chloride	UG/L	10.000	U	10.000	U	5.000	U
Acetone	UG/L	16.000		14.000		65.000	UB
Carbon Disulfide	UG/L	10.000	U	10.000	U		
1,1-Dichloroethene	UG/L	10.000	U	10.000	U		
1,1-Dichloroethane	UG/L	10.000	U	10.000	U	5.000	U
1,2-Dichloroethene (total)	UG/L	10.000	U	10.000	U		
cis-1,2-Dichloroethylene							
1,2-Dichloroethane	UG/L	10.000	U	10.000	U	5.000	U
trans-1,2-Dichloroethylene	UG/L					5.000	U
Chloroform	UG/L	10.000	U	1.000	J	5.000	U
2-Butanone	UG/L	10.000	U	10.000	U	100.000	U
1-Butanol	UG/L					1000.000	U
1,1,1-Trichloroethane	UG/L	10.000	U	10.000	U	5.000	U
Carbon Tetrachloride	UG/L	10.000	U	10.000	U	5.000	U
Bromodichloromethane	UG/L	10.000	U	10.000	U		
1,2-Dichloropropane	UG/L	10.000	U	10.000	U		
cis-1,3-Dichloropropene	UG/L	10.000	U	10.000	U		
Trichloroethene	UG/L	10.000	U	10.000	U	5.000	U
Dibromochloromethane	UG/L	10.000	U	10.000	U		
1,1,2-Trichloroethane	UG/L	10.000	U	10.000	U	5.000	U
Benzene	UG/L	10.000	U	10.000	U	5.000	U
trans-1,3-Dichloropropene	UG/L	10.000	U	10.000	U		
Bromoform	UG/L	10.000	U	10.000	U		
4-Methyl-2-Pentanone	UG/L	10.000	U	10.000	U	50.000	U
2-Hexanone	UG/L	10.000	U	10.000	U		
Tetrachloroethene	UG/L	10.000	U	10.000	U	5.000	U
Toluene	UG/L	1.000	J	1.000	J	5.000	U
1,1,2,2-Tetrachloroethane	UG/L	10.000	U	10.000	U		
Chlorobenzene	UG/L	10.000	U	10.000	U		
Ethyl Benzene	UG/L	10.000	U	10.000	U		
Ethyl Cyanide							
Styrene	UG/L	10.000	U	10.000	U		
Xylenes (total)	UG/L	10.000	U	10.000	U	5.000	U
Hydrazine							

QA VOLATILE ORGANIC Analysis Results

Program		RCRA		RCRA		RCRA	
Well ID		FER118		FER121		FER127	
Round		5		5		5	
Date		1-14-93		1-27-93		2-16-93	
Sample Type		FIELD BL		FIELD BL		FIELD BL	
Lab ID		DATA CHEM		DATA CHEM		DATA CHEM	
Filtered							
Filter Size (in microns)		NAN		NAN		NAN	
Sample ID		B01NM2		B01NM5		B01NN1	
Parameter	Units	Conc.	Q	Conc.	Q	Conc.	Q
Chloromethane							
Bromomethane							
Vinyl Chloride	UG/L	10.000	U	10.000	U	10.000	U
Chloroethane							
Methylene Chloride	UG/L	5.000	U	1.900	BU	3.900	BU
Acetone	UG/L	100.000	U	100.000	U	6.000	U
Carbon Disulfide							
1,1-Dichloroethene							
1,1-Dichloroethane	UG/L	5.000	U	5.000	U	5.000	U
1,2-Dichloroethene (total)							
cis-1,2-Dichloroethylene							
1,2-Dichloroethane	UG/L	5.000	U	5.000	U	5.000	U
trans-1,2-Dichloroethylene	UG/L	5.000	U	5.000	U	5.000	U
Chloroform	UG/L	5.000	U	5.000	U	5.000	U
2-Butanone	UG/L	100.000	U	100.000	U	100.000	U
1-Butanol	UG/L	1000.000	U	1000.000	U	1000.000	U
1,1,1-Trichloroethane	UG/L	5.000	U	5.000	U	5.000	U
Carbon Tetrachloride	UG/L	5.000	U	5.000	U	0.600	U
Bromodichloromethane							
1,2-Dichloropropane							
cis-1,3-Dichloropropene							
Trichloroethene	UG/L	5.000	U	5.000	U	5.000	U
Dibromochloromethane							
1,1,2-Trichloroethane	UG/L	5.000	U	5.000	U	5.000	U
Benzene	UG/L	5.000	U	5.000	U	5.000	U
trans-1,3-Dichloropropene							
Bromoform							
4-Methyl-2-Pentanone	UG/L	50.000	U	50.000	U	50.000	U
2-Hexanone							
Tetrachloroethene	UG/L	5.000	U	5.000	U	5.000	U
Toluene	UG/L	5.000	U	5.000	U	5.000	U
1,1,2,2-Tetrachloroethane							
Chlorobenzene							
Ethyl Benzene							
Ethyl Cyanide							
Styrene							
Xylenes (total)	UG/L	5.000	U	5.000	U	5.000	U
Hydrazine							

QA VOLATILE ORGANIC Analysis Results

Program		RCRA		RCRA		RCRA	
Well ID		FTR94		FTR99		FTR99	
Round		5		5		5	
Date		1-14-93		2-12-93		2-12-93	
Sample Type		FIELD BL		FIELD BL		FIELD BL	
Lab ID		DATA CHEM		DATA CHEM		DATA CHEM	
Filtered							
Filter Size (in microns)		NAN		NAN		NAN	
Sample ID		B07TY4		B085F8		B085F8	
Parameter	Units	Conc.	Q	Conc.	Q	Conc.	Q
Chloromethane							
Bromomethane							
Vinyl Chloride	UG/L			10.000	U	10.000	U
Chloroethane							
Methylene Chloride	UG/L			2.800	BU	2.800	BU
Acetone	UG/L			100.000	U	100.000	U
Carbon Disulfide							
1,1-Dichloroethene							
1,1-Dichloroethane	UG/L			5.000	U	5.000	U
1,2-Dichloroethene (total)							
cis-1,2-Dichloroethylene							
1,2-Dichloroethane	UG/L			5.000	U	5.000	U
trans-1,2-Dichloroethylene	UG/L			5.000	U	5.000	U
Chloroform	UG/L			5.000	U	5.000	U
2-Butanone	UG/L			100.000	U	100.000	U
1-Butanol	UG/L			1000.000	U	1000.000	U
1,1,1-Trichloroethane	UG/L			5.000	U	5.000	U
Carbon Tetrachloride	UG/L			5.000	U	5.000	U
Bromodichloromethane							
1,2-Dichloropropane							
cis-1,3-Dichloropropene							
Trichloroethene	UG/L			5.000	U	5.000	U
Dibromochloromethane							
1,1,2-Trichloroethane	UG/L			5.000	U	5.000	U
Benzene	UG/L			5.000	U	5.000	U
trans-1,3-Dichloropropene							
Bromoform							
4-Methyl-2-Pentanone	UG/L			50.000	U	50.000	U
2-Hexanone							
Tetrachloroethene	UG/L			5.000	U	5.000	U
Toluene	UG/L			5.000	U	5.000	U
1,1,2,2-Tetrachloroethane							
Chlorobenzene							
Ethyl Benzene							
Ethyl Cyanide							
Styrene							
Xylenes (total)	UG/L			5.000	U	5.000	U
Hydrazine	UG/L	30.000	U				

QA VOLATILE ORGANIC Analysis Results

Program		RCRA		RCRA		RCRA	
Well ID		TRP301		TRP303		TRP306	
Round		5		5		5	
Date		1-8-93		1-14-93		1-21-93	
Sample Type		FIELD BL		FIELD BL		FIELD BL	
Lab ID		DATA CHEM		DATA CHEM		DATA CHEM	
Filtered							
Filter Size (in microns)		NAN		NAN		NAN	
Sample ID		B01NH7		B01NH9		B01NJ2	
Parameter	Units	Conc.	Q	Conc.	Q	Conc.	Q
Chloromethane							
Bromomethane							
Vinyl Chloride	UG/L	10.000	U	10.000	U	10.000	U
Chloroethane							
Methylene Chloride	UG/L	5.000	U	5.000	U	5.000	U
Acetone	UG/L	51.000	UB	100.000	U	10.000	U
Carbon Disulfide							
1,1-Dichloroethene							
1,1-Dichloroethane	UG/L	5.000	U	5.000	U	5.000	U
1,2-Dichloroethene (total)							
cis-1,2-Dichloroethylene							
1,2-Dichloroethane	UG/L	5.000	U	5.000	U	5.000	U
trans-1,2-Dichloroethylene	UG/L	5.000	U	5.000	U	5.000	U
Chloroform	UG/L	5.000	U	5.000	U	5.000	U
2-Butanone	UG/L	100.000	U	100.000	U	100.000	U
1-Butanol	UG/L	1000.000	U	1000.000	U	1000.000	U
1,1,1-Trichloroethane	UG/L	5.000	U	5.000	U	5.000	U
Carbon Tetrachloride	UG/L	5.000	U	5.000	U	5.000	U
Bromodichloromethane							
1,2-Dichloropropane							
cis-1,3-Dichloropropene							
Trichloroethene	UG/L	5.000	U	5.000	U	5.000	U
Dibromochloromethane							
1,1,2-Trichloroethane	UG/L	5.000	U	5.000	U	5.000	U
Benzene	UG/L	5.000	U	5.000	U	5.000	U
trans-1,3-Dichloropropene							
Bromoform							
4-Methyl-2-Pentanone	UG/L	50.000	U	50.000	U	50.000	U
2-Hexanone							
Tetrachloroethene	UG/L	5.000	U	5.000	U	5.000	U
Toluene	UG/L	5.000	U	5.000	U	5.000	U
1,1,2,2-Tetrachloroethane							
Chlorobenzene							
Ethyl Benzene							
Ethyl Cyanide							
Styrene							
Xylenes (total)	UG/L	5.000	U	5.000	U	5.000	U
Hydrazine							

QA VOLATILE ORGANIC Analysis Results

Program		RCRA		RCRA		RCRA	
Well ID		TRP310		TRP321		TRP322	
Round		5		5		5	
Date		1-27-93		2-12-93		2-16-93	
Sample Type		FIELD BL		FIELD BL		FIELD BL	
Lab ID		DATA CHEM		DATA CHEM		DATA CHEM	
Filtered							
Filter Size (in microns)		NAN		NAN		NAN	
Sample ID		B01NJ6		B01P07		B01P08	
Parameter	Units	Conc.	Q	Conc.	Q	Conc.	Q
Chloromethane							
Bromomethane							
Vinyl Chloride	UG/L	10.000	U	10.000	U	10.000	U
Chloroethane							
Methylene Chloride	UG/L	1.800	BU	2.300	BU	3.300	BU
Acetone	UG/L	100.000	U	100.000	U	100.000	U
Carbon Disulfide							
1,1-Dichloroethene							
1,1-Dichloroethane	UG/L	5.000	U	5.000	U	5.000	U
1,2-Dichloroethene (total)							
cis-1,2-Dichloroethylene							
1,2-Dichloroethane	UG/L	5.000	U	5.000	U	5.000	U
trans-1,2-Dichloroethylene	UG/L	5.000	U	5.000	U	5.000	U
Chloroform	UG/L	5.000	U	5.000	U	5.000	U
2-Butanone	UG/L	100.000	U	100.000	U	100.000	U
1-Butanol	UG/L	1000.000	U	1000.000	U	1000.000	U
1,1,1-Trichloroethane	UG/L	5.000	U	5.000	U	5.000	U
Carbon Tetrachloride	UG/L	5.000	U	5.000	U	5.000	U
Bromodichloromethane							
1,2-Dichloropropane							
cis-1,3-Dichloropropene							
Trichloroethene	UG/L	5.000	U	5.000	U	5.000	U
Dibromochloromethane							
1,1,2-Trichloroethane	UG/L	5.000	U	5.000	U	5.000	U
Benzene	UG/L	5.000	U	5.000	U	5.000	U
trans-1,3-Dichloropropene							
Bromoform							
4-Methyl-2-Pentanone	UG/L	50.000	U	50.000	U	50.000	U
2-Hexanone							
Tetrachloroethene	UG/L	5.000	U	5.000	U	5.000	U
Toluene	UG/L	5.000	U	0.740	JU	5.000	U
1,1,2,2-Tetrachloroethane							
Chlorobenzene							
Ethyl Benzene							
Ethyl Cyanide							
Styrene							
Xylenes (total)	UG/L	5.000	U	5.000	U	5.000	U
Hydrazine							

QA VOLATILE ORGANIC Analysis Results

Program		RCRA		RCRA		RCRA	
Well ID		TRP324		TRP373		TRP374	
Round		5		5		5	
Date		2-18-93		5-14-93		5-14-93	
Sample Type		FIELD BL		FIELD BL		FIELD BL	
Lab ID		DATA CHEM		DATA CHEM		DATA CHEM	
Filtered							
Filter Size (in microns)		NAN		NAN		NAN	
Sample ID		B01P10		B07BH9		B07BJ0	
Parameter	Units	Conc.	Q	Conc.	Q	Conc.	Q
Chloromethane							
Bromomethane							
Vinyl Chloride	UG/L	10.000	U	0.780	U	0.780	U
Chloroethane							
Methylene Chloride	UG/L	2.900	BU	2.800	BL	2.000	BL
Acetone	UG/L	100.000	U	18.000	BL	13.400	U
Carbon Disulfide	UG/L			0.950	U	0.950	U
1,1-Dichloroethene							
1,1-Dichloroethane	UG/L	5.000	U	0.610	U	0.610	U
1,2-Dichloroethene (total)	UG/L			1.200	U	1.200	U
cis-1,2-Dichloroethylene							
1,2-Dichloroethane	UG/L	5.000	U	0.450	U	0.450	U
trans-1,2-Dichloroethylene	UG/L	5.000	U				
Chloroform	UG/L	5.000	U	0.400	U	0.400	U
2-Butanone	UG/L	100.000	U	4.250	U	4.250	U
1-Butanol	UG/L	1000.000	U	13.100	U	13.100	U
1,1,1-Trichloroethane	UG/L	5.000	U	0.640	U	0.640	U
Carbon Tetrachloride	UG/L	5.000	U	0.870	U	0.870	U
Bromodichloromethane							
1,2-Dichloropropane							
cis-1,3-Dichloropropene							
Trichloroethene	UG/L	5.000	U	0.770	U	0.770	U
Dibromochloromethane							
1,1,2-Trichloroethane	UG/L	5.000	U	0.250	U	0.250	U
Benzene	UG/L	5.000	U	0.650	U	0.650	U
trans-1,3-Dichloropropene							
Bromoform							
4-Methyl-2-Pentanone	UG/L	50.000	U	0.850	U	0.850	U
2-Hexanone							
Tetrachloroethene	UG/L	5.000	U	1.100	U	1.100	U
Toluene	UG/L	5.000	U	0.730	U	0.730	U
1,1,2,2-Tetrachloroethane							
Chlorobenzene							
Ethyl Benzene							
Ethyl Cyanide	UG/L			4.340	U	4.340	U
Styrene							
Xylenes (total)	UG/L	5.000	U	1.700	U	1.700	U
Hydrazine							

QA VOLATILE ORGANIC Analysis Results

Program		RCRA		CERCLA		CERCLA	
Well ID		TRP378		399-1-5		399-1-16C	
Round		5		5		5	
Date		5-20-93		3-10-93		2-26-93	
Sample Type		FIELD BL		SPLIT		METHOD BL	
Lab ID		DATA CHEM		WESTON		TMA	
Filtered				NO		NO	
Filter Size (in microns)		NAN		NAN		NAN	
Sample ID		B07BJ4		B086S1		B086T3	
Parameter	Units	Conc.	Q	Conc.	Q	Conc.	Q
Chloromethane	UG/L			10.000	U	10.000	U
Bromomethane	UG/L			10.000	U	10.000	U
Vinyl Chloride	UG/L	0.780	U	10.000	U	10.000	U
Chloroethane	UG/L			10.000	U	10.000	U
Methylene Chloride	UG/L	0.610	U	10.000	U	4.000	J
Acetone	UG/L	13.400	U	10.000	U	10.000	U
Carbon Disulfide	UG/L	0.950	U	10.000	U	10.000	U
1,1-Dichloroethene	UG/L			10.000	U	10.000	U
1,1-Dichloroethane	UG/L	0.610	U	10.000	U	10.000	U
1,2-Dichloroethene (total)	UG/L	1.200	U	10.000	U	10.000	U
cis-1,2-Dichloroethylene							
1,2-Dichloroethane	UG/L	0.450	U	10.000	U	10.000	U
trans-1,2-Dichloroethylene							
Chloroform	UG/L	0.400	U	10.000	U	10.000	U
2-Butanone	UG/L	4.250	U	10.000	U	10.000	U
1-Butanol	UG/L	13.100	U				
1,1,1-Trichloroethane	UG/L	0.640	U	10.000	U	10.000	U
Carbon Tetrachloride	UG/L	0.870	U	10.000	U	10.000	U
Bromodichloromethane	UG/L			10.000	U	10.000	U
1,2-Dichloropropane	UG/L			10.000	U	10.000	U
cis-1,3-Dichloropropene	UG/L			10.000	U	10.000	U
Trichloroethene	UG/L	0.770	U	10.000	U	10.000	U
Dibromochloromethane	UG/L			10.000	U	10.000	U
1,1,2-Trichloroethane	UG/L	0.250	U	10.000	U	10.000	U
Benzene	UG/L	0.650	U	10.000	U	10.000	U
trans-1,3-Dichloropropene	UG/L			10.000	U	10.000	U
Bromoform	UG/L			10.000	U	10.000	U
4-Methyl-2-Pentanone	UG/L	0.850	U	10.000	U	10.000	U
2-Hexanone	UG/L			10.000	U	10.000	U
Tetrachloroethene	UG/L	1.100	U	10.000	U	10.000	U
Toluene	UG/L	0.730	U	10.000	U	10.000	U
1,1,2,2-Tetrachloroethane	UG/L			10.000	U	10.000	U
Chlorobenzene	UG/L			10.000	U	10.000	U
Ethyl Benzene	UG/L			10.000	U	10.000	U
Ethyl Cyanide	UG/L	4.340	U				
Styrene	UG/L			10.000	U	10.000	U
Xylenes (total)	UG/L	1.700	U	10.000	U	10.000	U
Hydrazine							

QA VOLATILE ORGANIC Analysis Results

Program		CERCLA		RCRA		CERCLA	
Well ID		399-1-16C		399-1-17B		399-1-21A	
Round		5		5		5	
Date		2-26-93		2-18-93		3-9-93	
Sample Type		TRIP BL		DUPLICATE		TRIP BL	
Lab ID		TMA		DATA CHEM		TMA	
Filtered		NO		NO		NO	
Filter Size (in microns)		NAN		NAN		NAN	
Sample ID		B086T2		B085G3		B089B5	
Parameter	Units	Conc.	Q	Conc.	Q	Conc.	Q
Chloromethane	UG/L	10.000	U			10.000	U
Bromomethane	UG/L	10.000	U			10.000	U
Vinyl Chloride	UG/L	10.000	U	10.000	U	10.000	U
Chloroethane	UG/L	10.000	U			10.000	U
Methylene Chloride	UG/L	2.000	J	2.200	BU	10.000	U
Acetone	UG/L	10.000	U	100.000	U	10.000	U
Carbon Disulfide	UG/L	10.000	U			10.000	U
1,1-Dichloroethene	UG/L	10.000	U			10.000	U
1,1-Dichloroethane	UG/L	10.000	U	5.000	U	10.000	U
1,2-Dichloroethene (total)	UG/L	10.000	U			10.000	U
cis-1,2-Dichloroethylene							
1,2-Dichloroethane	UG/L	10.000	U	5.000	U	10.000	U
trans-1,2-Dichloroethylene	UG/L			4.500	U		
Chloroform	UG/L	10.000	U	5.000	U	10.000	U
2-Butanone	UG/L	10.000	U	100.000	U	10.000	U
1-Butanol	UG/L			1000.000	U		
1,1,1-Trichloroethane	UG/L	10.000	U	5.000	U	10.000	U
Carbon Tetrachloride	UG/L	10.000	U	5.000	U	10.000	U
Bromodichloromethane	UG/L	10.000	U			10.000	U
1,2-Dichloropropane	UG/L	10.000	U			10.000	U
cis-1,3-Dichloropropene	UG/L	10.000	U			10.000	U
Trichloroethene	UG/L	10.000	U	5.000	U	10.000	U
Dibromochloromethane	UG/L	10.000	U			10.000	U
1,1,2-Trichloroethane	UG/L	10.000	U	5.000	U	10.000	U
Benzene	UG/L	10.000	U	5.000	U	10.000	U
trans-1,3-Dichloropropene	UG/L	10.000	U			10.000	U
Bromoform	UG/L	10.000	U			10.000	U
4-Methyl-2-Pentanone	UG/L	10.000	U	50.000	U	10.000	U
2-Hexanone	UG/L	10.000	U			10.000	U
Tetrachloroethene	UG/L	10.000	U	5.000	U	10.000	U
Toluene	UG/L	10.000	U	1.500	U	10.000	U
1,1,2,2-Tetrachloroethane	UG/L	10.000	U			10.000	U
Chlorobenzene	UG/L	10.000	U			10.000	U
Ethyl Benzene	UG/L	10.000	U			10.000	U
Ethyl Cyanide							
Styrene	UG/L	10.000	U			10.000	U
Xylenes (total)	UG/L	10.000	U	5.000	U	10.000	U
Hydrazine							

QA VOLATILE ORGANIC Analysis Results

Program		CERCLA		CERCLA		CERCLA	
Well ID		399-2-2		399-3-11		399-3-11	
Round		5		5		5	
Date		3-17-93		3-3-93		3-3-93	
Sample Type		TRIP BL		METHOD BL		TRIP BL	
Lab ID		TMA		TMA		TMA	
Filtered		NO		NO		NO	
Filter Size (in microns)		NAN		NAN		NAN	
Sample ID		B08BF3		B086T0		B086T1	
Parameter	Units	Conc.	Q	Conc.	Q	Conc.	Q
Chloromethane	UG/L	10.000	U	10.000	U	10.000	U
Bromomethane	UG/L	10.000	U	10.000	U	10.000	U
Vinyl Chloride	UG/L	10.000	U	10.000	U	10.000	U
Chloroethane	UG/L	10.000	U	10.000	U	10.000	U
Methylene Chloride	UG/L	10.000	U	3.000	J	2.000	J
Acetone	UG/L	10.000	U	10.000		10.000	U
Carbon Disulfide	UG/L	10.000	U	10.000	U	10.000	U
1,1-Dichloroethene	UG/L	10.000	U	10.000	U	10.000	U
1,1-Dichloroethane	UG/L	10.000	U	10.000	U	10.000	U
1,2-Dichloroethene (total)	UG/L	10.000	U	10.000	U	10.000	U
cis-1,2-Dichloroethylene							
1,2-Dichloroethane	UG/L	10.000	U	10.000	U	10.000	U
trans-1,2-Dichloroethylene							
Chloroform	UG/L	10.000	U	10.000	U	10.000	U
2-Butanone	UG/L	10.000	U	10.000	U	10.000	U
1-Butanol							
1,1,1-Trichloroethane	UG/L	10.000	U	10.000	U	10.000	U
Carbon Tetrachloride	UG/L	10.000	U	10.000	U	10.000	U
Bromodichloromethane	UG/L	10.000	U	10.000	U	10.000	U
1,2-Dichloropropane	UG/L	10.000	U	10.000	U	10.000	U
cis-1,3-Dichloropropene	UG/L	10.000	U	10.000	U	10.000	U
Trichloroethene	UG/L	10.000	U	10.000	U	10.000	U
Dibromochloromethane	UG/L	10.000	U	10.000	U	10.000	U
1,1,2-Trichloroethane	UG/L	10.000	U	10.000	U	10.000	U
Benzene	UG/L	10.000	U	10.000	U	10.000	U
trans-1,3-Dichloropropene	UG/L	10.000	U	10.000	U	10.000	U
Bromoform	UG/L	10.000	U	10.000	U	10.000	U
4-Methyl-2-Pentanone	UG/L	10.000	U	10.000	U	10.000	U
2-Hexanone	UG/L	10.000	U	10.000	U	10.000	U
Tetrachloroethene	UG/L	10.000	U	10.000	U	10.000	U
Toluene	UG/L	10.000	U	10.000	U	10.000	U
1,1,2,2-Tetrachloroethane	UG/L	10.000	U	10.000	U	10.000	U
Chlorobenzene	UG/L	10.000	U	10.000	U	10.000	U
Ethyl Benzene	UG/L	10.000	U	10.000	U	10.000	U
Ethyl Cyanide							
Styrene	UG/L	10.000	U	10.000	U	10.000	U
Xylenes (total)	UG/L	10.000	U	10.000	U	10.000	U
Hydrazine							

QA VOLATILE ORGANIC Analysis Results

Program		CERCLA		CERCLA		CERCLA	
Well ID		399-3-11		399-4-1		399-4-7	
Round		5		5		5	
Date		3-3-93		3-12-93		2-25-93	
Sample Type		DUPLICATE		TRIP BL		SPLIT	
Lab ID		TMA		TMA		WESTON	
Filtered		NO		NO		NO	
Filter Size (in microns)		NAN		NAN		NAN	
Sample ID		B086S3		B089B2		B086S2	
Parameter	Units	Conc.	Q	Conc.	Q	Conc.	Q
Chloromethane	UG/L	10.000	U	10.000	U	10.000	U
Bromomethane	UG/L	10.000	U	10.000	U	10.000	U
Vinyl Chloride	UG/L	10.000	U	10.000	U	10.000	U
Chloroethane	UG/L	10.000	U	10.000	U	10.000	U
Methylene Chloride	UG/L	10.000	U	1.000	J	1.000	J
Acetone	UG/L	11.000		10.000	U	10.000	U
Carbon Disulfide	UG/L	10.000	U	10.000	U	10.000	U
1,1-Dichloroethene	UG/L	10.000	U	10.000	U	10.000	U
1,1-Dichloroethane	UG/L	10.000	U	10.000	U	10.000	U
1,2-Dichloroethene (total)	UG/L	10.000	U	10.000	U	10.000	U
cis-1,2-Dichloroethylene							
1,2-Dichloroethane	UG/L	10.000	U	10.000	U	10.000	U
trans-1,2-Dichloroethylene							
Chloroform	UG/L	6.000	J	10.000	U	3.000	J
2-Butanone	UG/L	10.000	U	10.000	U	10.000	U
1-Butanol							
1,1,1-Trichloroethane	UG/L	10.000	U	10.000	U	10.000	U
Carbon Tetrachloride	UG/L	10.000	U	10.000	U	10.000	U
Bromodichloromethane	UG/L	10.000	U	10.000	U	10.000	U
1,2-Dichloropropane	UG/L	10.000	U	10.000	U	10.000	U
cis-1,3-Dichloropropene	UG/L	10.000	U	10.000	U	10.000	U
Trichloroethene	UG/L	3.000	J	10.000	U	3.000	J
Dibromochloromethane	UG/L	10.000	U	10.000	U	10.000	U
1,1,2-Trichloroethane	UG/L	10.000	U	10.000	U	10.000	U
Benzene	UG/L	10.000	U	10.000	U	10.000	U
trans-1,3-Dichloropropene	UG/L	10.000	U	10.000	U	10.000	U
Bromoform	UG/L	10.000	U	10.000	U	10.000	U
4-Methyl-2-Pentanone	UG/L	10.000	U	10.000	U	10.000	U
2-Hexanone	UG/L	10.000	U	10.000	U	10.000	U
Tetrachloroethene	UG/L	10.000	U	10.000	U	10.000	U
Toluene	UG/L	10.000	U	10.000	U	10.000	U
1,1,2,2-Tetrachloroethane	UG/L	10.000	U	10.000	U	10.000	U
Chlorobenzene	UG/L	10.000	U	10.000	U	10.000	U
Ethyl Benzene	UG/L	10.000	U	10.000	U	10.000	U
Ethyl Cyanide							
Styrene	UG/L	10.000	U	10.000	U	10.000	U
Xylenes (total)	UG/L	10.000	U	10.000	U	10.000	U
Hydrazine							

QA VOLATILE ORGANIC Analysis Results

Program		CERCLA		CERCLA		CERCLA	
Well ID		399-4-10		399-4-12		399-8-5A	
Round		5		5		5	
Date		3-3-93		2-25-93		2-25-93	
Sample Type		DUPLICATE		TRIP BL		TRIP BL	
Lab ID		TMA		TMA		TMA	
Filtered		NO		NO		NO	
Filter Size (in microns)		NAN		NAN		NAN	
Sample ID		B086S4		B086T6		B086T5	
Parameter	Units	Conc.	Q	Conc.	Q	Conc.	Q
Chloromethane	UG/L	10.000	U	10.000	U	10.000	U
Bromomethane	UG/L	10.000	U	10.000	U	10.000	U
Vinyl Chloride	UG/L	10.000	U	10.000	U	10.000	U
Chloroethane	UG/L	10.000	U	10.000	U	10.000	U
Methylene Chloride	UG/L	10.000	U	2.000	J	3.000	J
Acetone	UG/L	10.000		10.000	U	10.000	U
Carbon Disulfide	UG/L	10.000	U	10.000	U	10.000	U
1,1-Dichloroethene	UG/L	10.000	U	10.000	U	10.000	U
1,1-Dichloroethane	UG/L	10.000	U	10.000	U	10.000	U
1,2-Dichloroethene (total)	UG/L	10.000	U	10.000	U	10.000	U
cis-1,2-Dichloroethylene							
1,2-Dichloroethane	UG/L	10.000	U	10.000	U	10.000	U
trans-1,2-Dichloroethylene							
Chloroform	UG/L	3.000	J	10.000	U	10.000	U
2-Butanone	UG/L	10.000	U	10.000	U	10.000	U
1-Butanol							
1,1,1-Trichloroethane	UG/L	10.000	U	10.000	U	10.000	U
Carbon Tetrachloride	UG/L	10.000	U	10.000	U	10.000	U
Bromodichloromethane	UG/L	10.000	U	10.000	U	10.000	U
1,2-Dichloropropane	UG/L	10.000	U	10.000	U	10.000	U
cis-1,3-Dichloropropene	UG/L	10.000	U	10.000	U	10.000	U
Trichloroethene	UG/L	2.000	J	10.000	U	10.000	U
Dibromochloromethane	UG/L	10.000	U	10.000	U	10.000	U
1,1,2-Trichloroethane	UG/L	10.000	U	10.000	U	10.000	U
Benzene	UG/L	10.000	U	10.000	U	10.000	U
trans-1,3-Dichloropropene	UG/L	10.000	U	10.000	U	10.000	U
Bromoform	UG/L	10.000	U	10.000	U	10.000	U
4-Methyl-2-Pentanone	UG/L	10.000	U	10.000	U	10.000	U
2-Hexanone	UG/L	10.000	U	10.000	U	10.000	U
Tetrachloroethene	UG/L	10.000	U	10.000	U	10.000	U
Toluene	UG/L	10.000	U	10.000	U	10.000	U
1,1,2,2-Tetrachloroethane	UG/L	10.000	U	10.000	U	10.000	U
Chlorobenzene	UG/L	10.000	U	10.000	U	10.000	U
Ethyl Benzene	UG/L	10.000	U	10.000	U	10.000	U
Ethyl Cyanide							
Styrene	UG/L	10.000	U	10.000	U	10.000	U
Xylenes (total)	UG/L	10.000	U	10.000	U	10.000	U
Hydrazine							

QA VOLATILE ORGANIC Analysis Results

Program		CERCLA		CERCLA		CERCLA	
Well ID		699-S27-E14					
Round		5		6		6	
Date		2-26-93		9-23-93		9-23-93	
Sample Type		TRIP BL		EQUIP.BL		EQUIP.BL	
Lab ID		TMA		TMA		TMA	
Filtered		NO		NO		NO	
Filter Size (in microns)		NAN		NAN		NAN	
Sample ID		B086T4		B095M3		B095M4	
Parameter	Units	Conc.	Q	Conc.	Q	Conc.	Q
Chloromethane	UG/L	10.000	U	10.000	U	10.000	U
Bromomethane	UG/L	10.000	U	10.000	U	10.000	U
Vinyl Chloride	UG/L	10.000	U	10.000	U	10.000	U
Chloroethane	UG/L	10.000	U	10.000	U	10.000	U
Methylene Chloride	UG/L	4.000	J	10.000	U	1.000	J
Acetone	UG/L	10.000	U	10.000	U	10.000	U
Carbon Disulfide	UG/L	10.000	U	10.000	U	10.000	U
1,1-Dichloroethene	UG/L	10.000	U	10.000	U	10.000	U
1,1-Dichloroethane	UG/L	10.000	U	10.000	U	10.000	U
1,2-Dichloroethene (total)	UG/L	10.000	U	10.000	U	10.000	U
cis-1,2-Dichloroethylene							
1,2-Dichloroethane	UG/L	10.000	U	10.000	U	10.000	U
trans-1,2-Dichloroethylene							
Chloroform	UG/L	10.000	U	10.000	U	10.000	U
2-Butanone	UG/L	10.000	U	10.000	U	10.000	U
1-Butanol							
1,1,1-Trichloroethane	UG/L	10.000	U	10.000	U	10.000	U
Carbon Tetrachloride	UG/L	10.000	U	10.000	U	10.000	U
Bromodichloromethane	UG/L	10.000	U	10.000	U	10.000	U
1,2-Dichloropropane	UG/L	10.000	U	10.000	U	10.000	U
cis-1,3-Dichloropropene	UG/L	10.000	U	10.000	U	10.000	U
Trichloroethene	UG/L	10.000	U	10.000	U	10.000	U
Dibromochloromethane	UG/L	10.000	U	10.000	U	10.000	U
1,1,2-Trichloroethane	UG/L	10.000	U	10.000	U	10.000	U
Benzene	UG/L	10.000	U	10.000	U	10.000	U
trans-1,3-Dichloropropene	UG/L	10.000	U	10.000	U	10.000	U
Bromoform	UG/L	10.000	U	10.000	U	10.000	U
4-Methyl-2-Pentanone	UG/L	10.000	U	10.000	U	10.000	U
2-Hexanone	UG/L	10.000	U	10.000	U	10.000	U
Tetrachloroethene	UG/L	10.000	U	10.000	U	10.000	U
Toluene	UG/L	10.000	U	10.000	U	10.000	U
1,1,2,2-Tetrachloroethane	UG/L	10.000	U	10.000	U	10.000	U
Chlorobenzene	UG/L	10.000	U	10.000	U	10.000	U
Ethyl Benzene	UG/L	10.000	U	10.000	U	10.000	U
Ethyl Cyanide							
Styrene	UG/L	10.000	U	10.000	U	10.000	U
Xylenes (total)	UG/L	10.000	U	10.000	U	10.000	U
Hydrazine							

QA VOLATILE ORGANIC Analysis Results

Program		RCRA		RCRA		RCRA	
Well ID		FER174		FER176		FER194	
Round		6		6		6	
Date		9-7-93		9-14-93		12-9-93	
Sample Type		FIELD BL		FIELD BL		FIELD BL	
Lab ID		DATA CHEM		DATA CHEM		DATA CHEM	
Filtered							
Filter Size (in microns)		NAN		NAN		NAN	
Sample ID		B07CT0		B07CT2		B07CW0	
Parameter	Units	Conc.	Q	Conc.	Q	Conc.	Q
Chloromethane							
Bromomethane							
Vinyl Chloride	UG/L	0.780	U	0.780	U	0.780	U
Chloroethane							
Methylene Chloride	UG/L	0.610	U	7.100	B	0.610	U
Acetone	UG/L	13.400	U	13.400	U	27.000	L
Carbon Disulfide	UG/L	0.950	U	0.950	U	0.950	U
1,1-Dichloroethene							
1,1-Dichloroethane	UG/L	0.610	U	0.610	U	0.610	U
1,2-Dichloroethene (total)	UG/L	1.200	U	1.200	U	1.200	U
cis-1,2-Dichloroethylene							
1,2-Dichloroethane	UG/L	0.450	U	0.450	U	0.450	U
trans-1,2-Dichloroethylene							
Chloroform	UG/L	0.400	U	0.400	U	0.400	U
2-Butanone	UG/L	4.250	U	4.250	U	4.250	U
1-Butanol	UG/L	13.100	U	13.100	U	13.100	U
1,1,1-Trichloroethane	UG/L	0.640	U	0.640	U	9.500	
Carbon Tetrachloride	UG/L	0.870	U	0.870	U	0.870	U
Bromodichloromethane							
1,2-Dichloropropane							
cis-1,3-Dichloropropene							
Trichloroethene	UG/L	0.770	U	0.770	U	0.770	U
Dibromochloromethane							
1,1,2-Trichloroethane	UG/L	0.250	U	0.250	U	0.250	U
Benzene	UG/L	0.650	U	0.650	U	0.650	U
trans-1,3-Dichloropropene							
Bromoform							
4-Methyl-2-Pentanone	UG/L	0.850	U	0.850	U	0.850	U
2-Hexanone							
Tetrachloroethene	UG/L	1.100	U	1.100	U	1.100	U
Toluene	UG/L	0.730	U	0.730	U	0.730	U
1,1,2,2-Tetrachloroethane							
Chlorobenzene							
Ethyl Benzene							
Ethyl Cyanide	UG/L	4.340	U	4.340	U	4.340	U
Styrene							
Xylenes (total)	UG/L	1.700	U	1.700	U	1.700	U
Hydrazine							

QA VOLATILE ORGANIC Analysis Results

Program		RCRA		RCRA		RCRA	
Well ID		TRP438		TRP439		TRP443	
Round		6		6		6	
Date		9-3-93		9-7-93		9-14-93	
Sample Type		FIELD BL		FIELD BL		FIELD BL	
Lab ID		DATA CHEM		DATA CHEM		DATA CHEM	
Filtered							
Filter Size (in microns)		NAN		NAN		NAN	
Sample ID		B07CP4		B07CP5		B07CP9	
Parameter	Units	Conc.	Q	Conc.	Q	Conc.	Q
Chloromethane							
Bromomethane							
Vinyl Chloride	UG/L	0.780	U	0.780	U	0.780	U
Chloroethane							
Methylene Chloride	UG/L	0.610	U	0.610	U	0.610	U
Acetone	UG/L	13.400	U	13.400	U	13.400	U
Carbon Disulfide	UG/L	0.950	U	0.950	U	0.950	U
1,1-Dichloroethene							
1,1-Dichloroethane	UG/L	0.610	U	0.610	U	0.610	U
1,2-Dichloroethene (total)	UG/L	1.200	U	1.200	U	1.200	U
cis-1,2-Dichloroethylene							
1,2-Dichloroethane	UG/L	0.450	U	0.450	U	0.450	U
trans-1,2-Dichloroethylene							
Chloroform	UG/L	0.400	U	0.400	U	0.400	U
2-Butanone	UG/L	4.250	U	4.250	U	4.250	U
1-Butanol	UG/L	13.100	U	13.100	U	13.100	U
1,1,1-Trichloroethane	UG/L	0.640	U	0.640	U	0.640	U
Carbon Tetrachloride	UG/L	0.870	U	0.870	U	0.870	U
Bromodichloromethane							
1,2-Dichloropropane							
cis-1,3-Dichloropropene							
Trichloroethene	UG/L	0.770	U	0.770	U	0.770	U
Dibromochloromethane							
1,1,2-Trichloroethane	UG/L	0.250	U	0.250	U	0.250	U
Benzene	UG/L	0.650	U	0.650	U	0.650	U
trans-1,3-Dichloropropene							
Bromoform							
4-Methyl-2-Pentanone	UG/L	0.850	U	0.850	U	0.850	U
2-Hexanone							
Tetrachloroethene	UG/L	1.100	U	1.100	U	1.100	U
Toluene	UG/L	0.730	U	0.730	U	0.730	U
1,1,2,2-Tetrachloroethane							
Chlorobenzene							
Ethyl Benzene							
Ethyl Cyanide	UG/L	4.340	U	4.340	U	4.340	U
Styrene							
Xylenes (total)	UG/L	1.700	U	1.700	U	1.700	U
Hydrazine							

QA VOLATILE ORGANIC Analysis Results

Program		RCRA		RCRA		RCRA	
Well ID		TRP448		TRP450		TRP456	
Round		6		6		6	
Date		9-27-93		9-29-93		10-7-93	
Sample Type		FIELD BL		FIELD BL		FIELD BL	
Lab ID		DATA CHEM		DATA CHEM		DATA CHEM	
Filtered							
Filter Size (in microns)		NAN		NAN		NAN	
Sample ID		B07CQ4		B07CQ6		B07CR2	
Parameter	Units	Conc.	Q	Conc.	Q	Conc.	Q
Chloromethane							
Bromomethane							
Vinyl Chloride	UG/L	0.780	U	0.780	U	0.780	U
Chloroethane							
Methylene Chloride	UG/L	0.610	U	0.610	U	0.610	U
Acetone	UG/L	13.400	U	13.400	U	13.400	U
Carbon Disulfide	UG/L	0.950	U	0.950	U	0.950	U
1,1-Dichloroethene							
1,1-Dichloroethane	UG/L	0.610	U	0.610	U	0.610	U
1,2-Dichloroethene (total)	UG/L	1.200	U	1.200	U	1.200	U
cis-1,2-Dichloroethylene							
1,2-Dichloroethane	UG/L	0.450	U	0.450	U	0.450	U
trans-1,2-Dichloroethylene							
Chloroform	UG/L	0.400	U	0.400	U	0.400	U
2-Butanone	UG/L	4.250	U	4.250	U	4.250	U
1-Butanol	UG/L	13.100	U	13.100	U	13.100	U
1,1,1-Trichloroethane	UG/L	0.640	U	0.640	U	0.640	U
Carbon Tetrachloride	UG/L	0.870	U	0.870	U	0.870	U
Bromodichloromethane							
1,2-Dichloropropane							
cis-1,3-Dichloropropene							
Trichloroethene	UG/L	0.770	U	0.770	U	0.770	U
Dibromochloromethane							
1,1,2-Trichloroethane	UG/L	0.250	U	0.250	U	0.250	U
Benzene	UG/L	0.650	U	0.650	U	0.650	U
trans-1,3-Dichloropropene							
Bromoform							
4-Methyl-2-Pentanone	UG/L	0.850	U	0.850	U	0.850	U
2-Hexanone							
Tetrachloroethene	UG/L	1.100	U	1.100	U	1.100	U
Toluene	UG/L	0.730	U	0.730	U	0.730	U
1,1,2,2-Tetrachloroethane							
Chlorobenzene							
Ethyl Benzene							
Ethyl Cyanide	UG/L	4.340	U	4.340	U	4.340	U
Styrene							
Xylenes (total)	UG/L	1.700	U	1.700	U	1.700	U
Hydrazine							

QA VOLATILE ORGANIC Analysis Results

Program		RCRA		CERCLA		CERCLA	
Well ID		TRP491		399-1-5		399-1-5	
Round		6		6		6	
Date		12-9-93		9-24-93		9-24-93	
Sample Type		FIELD BL		TRIP BL		SPLIT	
Lab ID		DATA CHEM		WESTON		WESTON	
Filtered				NO		NO	
Filter Size (in microns)		NAN		NAN		NAN	
Sample ID		B07F91		B095M8		B095M5	
Parameter	Units	Conc.	Q	Conc.	Q	Conc.	Q
Chloromethane	UG/L			10.000	U	10.000	U
Bromomethane	UG/L			10.000	U	10.000	U
Vinyl Chloride	UG/L	0.780	U	10.000	U	10.000	U
Chloroethane	UG/L			10.000	U	10.000	U
Methylene Chloride	UG/L	0.610	U	10.000	U	10.000	U
Acetone	UG/L	13.400	U	10.000	U	10.000	U
Carbon Disulfide	UG/L	0.950	U	10.000	U	10.000	U
1,1-Dichloroethene	UG/L			10.000	U	10.000	U
1,1-Dichloroethane	UG/L	0.610	U	10.000	U	10.000	U
1,2-Dichloroethene (total)	UG/L	1.200	U	10.000	U	10.000	U
cis-1,2-Dichloroethylene							
1,2-Dichloroethane	UG/L	0.450	U	10.000	U	10.000	U
trans-1,2-Dichloroethylene							
Chloroform	UG/L	0.400	U	10.000	U	10.000	U
2-Butanone	UG/L	4.250	U	10.000	U	10.000	U
1-Butanol	UG/L	13.100	U				
1,1,1-Trichloroethane	UG/L	0.640	U	10.000	U	10.000	U
Carbon Tetrachloride	UG/L	0.870	U	10.000	U	10.000	U
Bromodichloromethane	UG/L			10.000	U	10.000	U
1,2-Dichloropropane	UG/L			10.000	U	10.000	U
cis-1,3-Dichloropropene	UG/L			10.000	U	10.000	U
Trichloroethene	UG/L	0.770	U	10.000	U	10.000	U
Dibromochloromethane	UG/L			10.000	U	10.000	U
1,1,2-Trichloroethane	UG/L	0.250	U	10.000	U	10.000	U
Benzene	UG/L	0.650	U	10.000	U	10.000	U
trans-1,3-Dichloropropene	UG/L			10.000	U	10.000	U
Bromoform	UG/L			10.000	U	10.000	U
4-Methyl-2-Pentanone	UG/L	0.850	U	10.000	U	10.000	U
2-Hexanone	UG/L			10.000	U	10.000	U
Tetrachloroethene	UG/L	1.100	U	10.000	U	10.000	U
Toluene	UG/L	0.730	U	10.000	U	10.000	U
1,1,2,2-Tetrachloroethane	UG/L			10.000	U	10.000	U
Chlorobenzene	UG/L			10.000	U	10.000	U
Ethyl Benzene	UG/L			10.000	U	10.000	U
Ethyl Cyanide	UG/L	4.340	U				
Styrene	UG/L			10.000	U	10.000	U
Xylenes (total)	UG/L	1.700	U	10.000	U	10.000	U
Hydrazine							

QA VOLATILE ORGANIC Analysis Results

Program		CERCLA		CERCLA		CERCLA	
Well ID		399-1-7		399-1-21A		399-2-2	
Round		6		6		6	
Date		9-16-93		9-24-93		9-21-93	
Sample Type		TRIP BL		TRIP BL		TRIP BL	
Lab ID		TMA		TMA		TMA	
Filtered		NO		NO		NO	
Filter Size (in microns)		NAN		NAN		NAN	
Sample ID		B095J6		B095M7		B095M6	
Parameter	Units	Conc.	Q	Conc.	Q	Conc.	Q
Chloromethane	UG/L	10.000	U	10.000	U	10.000	U
Bromomethane	UG/L	10.000	U	10.000	U	10.000	U
Vinyl Chloride	UG/L	10.000	U	10.000	U	10.000	U
Chloroethane	UG/L	10.000	U	10.000	U	10.000	U
Methylene Chloride	UG/L	10.000	U	10.000	UJ	10.000	UJ
Acetone	UG/L	9.000	J	10.000	U	10.000	UJ
Carbon Disulfide	UG/L	10.000	U	10.000	U	10.000	U
1,1-Dichloroethene	UG/L	10.000	U	10.000	U	10.000	U
1,1-Dichloroethane	UG/L	10.000	U	10.000	U	10.000	U
1,2-Dichloroethene (total)	UG/L	10.000	U	10.000	UJ	10.000	UJ
cis-1,2-Dichloroethylene							
1,2-Dichloroethane	UG/L	10.000	U	10.000	U	10.000	U
trans-1,2-Dichloroethylene							
Chloroform	UG/L	10.000	U	10.000	U	10.000	UJ
2-Butanone	UG/L	10.000	U	10.000	U	10.000	U
1-Butanol							
1,1,1-Trichloroethane	UG/L	10.000	U	10.000	U	10.000	U
Carbon Tetrachloride	UG/L	10.000	U	10.000	U	10.000	U
Bromodichloromethane	UG/L	10.000	U	10.000	U	10.000	U
1,2-Dichloropropane	UG/L	10.000	U	10.000	U	10.000	U
cis-1,3-Dichloropropene	UG/L	10.000	U	10.000	U	10.000	U
Trichloroethene	UG/L	10.000	U	10.000	UJ	10.000	UJ
Dibromochloromethane	UG/L	10.000	U	10.000	U	10.000	U
1,1,2-Trichloroethane	UG/L	10.000	U	10.000	U	10.000	U
Benzene	UG/L	10.000	U	10.000	U	10.000	U
trans-1,3-Dichloropropene	UG/L	10.000	U	10.000	U	10.000	U
Bromoform	UG/L	10.000	U	10.000	U	10.000	U
4-Methyl-2-Pentanone	UG/L	10.000	U	10.000	U	10.000	U
2-Hexanone	UG/L	10.000	U	10.000	U	10.000	U
Tetrachloroethene	UG/L	10.000	U	10.000	UJ	10.000	UJ
Toluene	UG/L	10.000	U	10.000	U	10.000	U
1,1,2,2-Tetrachloroethane	UG/L	10.000	U	10.000	U	10.000	U
Chlorobenzene	UG/L	10.000	U	10.000	U	10.000	U
Ethyl Benzene	UG/L	10.000	U	10.000	U	10.000	U
Ethyl Cyanide							
Styrene	UG/L	10.000	U	10.000	U	10.000	U
Xylenes (total)	UG/L	10.000	U	10.000	U	10.000	U
Hydrazine							

QA VOLATILE ORGANIC Analysis Results

Program		RCRA		CERCLA		CERCLA	
Well ID		399-3-10		399-3-11		399-4-7	
Round		6		6		6	
Date		9-3-93		9-22-93		9-17-93	
Sample Type		DUPLICATE		DUPLICATE		SPLIT	
Lab ID		DATA CHEM		TMA		WESTON	
Filtered		NO		NO		NO	
Filter Size (in microns)		NAN		NAN		NAN	
Sample ID		B09660		B095K8		B095J1	
Parameter	Units	Conc.	Q	Conc.	Q	Conc.	Q
Chloromethane	UG/L			10.000	U	10.000	U
Bromomethane	UG/L			10.000	U	10.000	U
Vinyl Chloride	UG/L	1.100	U	10.000	U	10.000	U
Chloroethane	UG/L			10.000	U	10.000	U
Methylene Chloride	UG/L	0.300	U	10.000	U	10.000	U
Acetone	UG/L	4.500	U	9.000	J	10.000	U
Carbon Disulfide	UG/L	1.800	U	10.000	U	10.000	U
1,1-Dichloroethene	UG/L			10.000	U	10.000	U
1,1-Dichloroethane	UG/L	0.400	U	10.000	U	10.000	U
1,2-Dichloroethene (total)	UG/L	1.200	U	10.000	U	10.000	U
cis-1,2-Dichloroethylene							
1,2-Dichloroethane	UG/L	0.300	U	10.000	U	10.000	U
trans-1,2-Dichloroethylene							
Chloroform	UG/L	3.100	L	11.000		11.000	
2-Butanone	UG/L	100.000	U	10.000	U	10.000	U
1-Butanol	UG/L	17.000	U				
1,1,1-Trichloroethane	UG/L	0.640	U	10.000	U	10.000	U
Carbon Tetrachloride	UG/L	0.100	U	10.000	U	10.000	U
Bromodichloromethane	UG/L			10.000	U	10.000	U
1,2-Dichloropropane	UG/L			10.000	U	10.000	U
cis-1,3-Dichloropropene	UG/L			10.000	U	10.000	U
Trichloroethene	UG/L	1.200	L	2.000	J	5.000	J
Dibromochloromethane	UG/L			10.000	U	10.000	U
1,1,2-Trichloroethane	UG/L	0.500	U	10.000	U	10.000	U
Benzene	UG/L	0.200	U	10.000	U	10.000	U
trans-1,3-Dichloropropene	UG/L			10.000	U	10.000	U
Bromoform	UG/L			10.000	U	10.000	U
4-Methyl-2-Pentanone	UG/L	0.600	U	10.000	U	10.000	U
2-Hexanone	UG/L			10.000	U	10.000	U
Tetrachloroethene	UG/L	2.600	U	10.000	U	10.000	U
Toluene	UG/L	0.300	U	10.000	U	10.000	U
1,1,2,2-Tetrachloroethane	UG/L			10.000	U	10.000	U
Chlorobenzene	UG/L			10.000	U	10.000	U
Ethyl Benzene	UG/L			10.000	U	10.000	U
Ethyl Cyanide	UG/L	10.000	U				
Styrene	UG/L			10.000	U	10.000	U
Xylenes (total)	UG/L	0.500	U	10.000	U	10.000	U
Hydrazine							

QA VOLATILE ORGANIC Analysis Results

Program		CERCLA		CERCLA		CERCLA	
Well ID		399-4-10		399-4-10		399-4-10	
Round		6		6		6	
Date		9-22-93		9-27-93		9-27-93	
Sample Type		DUPLICATE		METHOD BL		METHOD BL	
Lab ID		TMA		TMA		TMA	
Filtered		NO		NO		NO	
Filter Size (in microns)		NAN		NAN		NAN	
Sample ID		B095L5		B095N1		B095N2	
Parameter	Units	Conc.	Q	Conc.	Q	Conc.	Q
Chloromethane	UG/L	10.000	U	10.000	U	10.000	U
Bromomethane	UG/L	10.000	U	10.000	U	10.000	U
Vinyl Chloride	UG/L	10.000	U	10.000	U	10.000	U
Chloroethane	UG/L	10.000	U	10.000	U	10.000	U
Methylene Chloride	UG/L	10.000	U	10.000	U	10.000	U
Acetone	UG/L	6.000	J	10.000	U	10.000	U
Carbon Disulfide	UG/L	10.000	U	10.000	U	10.000	U
1,1-Dichloroethene	UG/L	10.000	U	10.000	U	10.000	U
1,1-Dichloroethane	UG/L	10.000	U	10.000	U	10.000	U
1,2-Dichloroethene (total)	UG/L	10.000	U	10.000	U	10.000	U
cis-1,2-Dichloroethylene							
1,2-Dichloroethane	UG/L	10.000	U	10.000	U	10.000	U
trans-1,2-Dichloroethylene							
Chloroform	UG/L	2.000	J	10.000	U	10.000	U
2-Butanone	UG/L	10.000	U	10.000	U	10.000	U
1-Butanol							
1,1,1-Trichloroethane	UG/L	10.000	U	10.000	U	10.000	U
Carbon Tetrachloride	UG/L	10.000	U	10.000	U	10.000	U
Bromodichloromethane	UG/L	10.000	U	10.000	U	10.000	U
1,2-Dichloropropane	UG/L	10.000	U	10.000	U	10.000	U
cis-1,3-Dichloropropene	UG/L	10.000	U	10.000	U	10.000	U
Trichloroethene	UG/L	2.000	J	10.000	U	10.000	U
Dibromochloromethane	UG/L	10.000	U	10.000	U	10.000	U
1,1,2-Trichloroethane	UG/L	10.000	U	10.000	U	10.000	U
Benzene	UG/L	10.000	U	10.000	U	10.000	U
trans-1,3-Dichloropropene	UG/L	10.000	U	10.000	U	10.000	U
Bromoform	UG/L	10.000	U	10.000	U	10.000	U
4-Methyl-2-Pentanone	UG/L	10.000	U	10.000	U	10.000	U
2-Hexanone	UG/L	10.000	U	10.000	U	10.000	U
Tetrachloroethene	UG/L	10.000	U	10.000	U	10.000	U
Toluene	UG/L	10.000	U	10.000	U	10.000	U
1,1,2,2-Tetrachloroethane	UG/L	10.000	U	10.000	U	10.000	U
Chlorobenzene	UG/L	10.000	U	10.000	U	10.000	U
Ethyl Benzene	UG/L	10.000	U	10.000	U	10.000	U
Ethyl Cyanide							
Styrene	UG/L	10.000	U	10.000	U	10.000	U
Xylenes (total)	UG/L	10.000	U	10.000	U	10.000	U
Hydrazine							

QA VOLATILE ORGANIC Analysis Results

Program		CERCLA		RCRA		RCRA	
Well ID		399-4-10		FER239		TRP561	
Round		6		7		7	
Date		9-27-93		6-23-94		4-18-94	
Sample Type		TRIP BL		FIELD BL		FIELD BL	
Lab ID		TMA		DATA CHEM		DATA CHEM	
Filtered		NO					
Filter Size (in microns)		NAN		NAN		NAN	
Sample ID		B095M9		B09GT7		B09G29	
Parameter	Units	Conc.	Q	Conc.	Q	Conc.	Q
Chloromethane	UG/L	10.000	U				
Bromomethane	UG/L	10.000	U				
Vinyl Chloride	UG/L	10.000	U	0.140	U	0.140	U
Chloroethane	UG/L	10.000	U				
Methylene Chloride	UG/L	1.000	J	0.950	BL	0.077	U
Acetone	UG/L	10.000	U	21.000	U	21.000	U
Carbon Disulfide	UG/L	10.000	U	0.450	U	0.450	U
1,1-Dichloroethene	UG/L	10.000	U				
1,1-Dichloroethane	UG/L	10.000	U	0.082	U	0.082	U
1,2-Dichloroethene (total)	UG/L	10.000	U	0.210	U	0.210	U
cis-1,2-Dichloroethylene							
1,2-Dichloroethane	UG/L	10.000	U	0.150	U	0.150	U
trans-1,2-Dichloroethylene							
Chloroform	UG/L	10.000	U	0.170	U	0.170	U
2-Butanone	UG/L	10.000	U	20.000	U	20.000	U
1-Butanol	UG/L			170.000	U	170.000	U
1,1,1-Trichloroethane	UG/L	10.000	U	0.580	U	0.580	U
Carbon Tetrachloride	UG/L	10.000	U	1.100	U	1.100	U
Bromodichloromethane	UG/L	10.000	U				
1,2-Dichloropropane	UG/L	10.000	U				
cis-1,3-Dichloropropene	UG/L	10.000	U				
Trichloroethene	UG/L	10.000	U	0.110	U	0.110	U
Dibromochloromethane	UG/L	10.000	U				
1,1,2-Trichloroethane	UG/L	10.000	U	0.160	U	0.160	U
Benzene	UG/L	10.000	U	0.110	U	0.110	U
trans-1,3-Dichloropropene	UG/L	10.000	U				
Bromoform	UG/L	10.000	U				
4-Methyl-2-Pentanone	UG/L	10.000	U	18.000	U	18.000	U
2-Hexanone	UG/L	10.000	U				
Tetrachloroethene	UG/L	10.000	U	0.130	U	0.130	U
Toluene	UG/L	10.000	U	0.120	U	0.120	U
1,1,2,2-Tetrachloroethane	UG/L	10.000	U				
Chlorobenzene	UG/L	10.000	U				
Ethyl Benzene	UG/L	10.000	U				
Ethyl Cyanide	UG/L			3.000	U	3.000	U
Styrene	UG/L	10.000	U				
Xylenes (total)	UG/L	10.000	U	0.170	U	0.170	U
Hydrazine							

QA VOLATILE ORGANIC Analysis Results

Program		RCRA		RCRA		CERCLA	
Well ID		TRP600		TRP601		399-1-5	
Round		7		7		7	
Date		6-22-94		6-23-94		6-24-94	
Sample Type		FIELD BL		FIELD BL		TRIP BL	
Lab ID		DATA CHEM		DATA CHEM		IT	
Filtered						NO	
Filter Size (in microns)		NAN		NAN		NAN	
Sample ID		B09GP8		B09GP9		B0BZN4	
Parameter	Units	Conc.	Q	Conc.	Q	Conc.	Q
Chloromethane	UG/L					10.000	U
Bromomethane	UG/L					10.000	U
Vinyl Chloride	UG/L	0.140	U	0.140	U	10.000	U
Chloroethane	UG/L					10.000	U
Methylene Chloride	UG/L	0.970	BL	0.880	BL	10.000	U
Acetone	UG/L	21.000	U	21.000	U	10.000	U
Carbon Disulfide	UG/L	0.450	U	0.450	U	10.000	U
1,1-Dichloroethene	UG/L					10.000	U
1,1-Dichloroethane	UG/L	0.082	U	0.082	U	10.000	U
1,2-Dichloroethene (total)	UG/L	0.210	U	0.210	U	10.000	U
cis-1,2-Dichloroethylene							
1,2-Dichloroethane	UG/L	0.150	U	0.150	U	10.000	U
trans-1,2-Dichloroethylene							
Chloroform	UG/L	0.170	U	0.170	U	10.000	U
2-Butanone	UG/L	20.000	U	20.000	U	10.000	U
1-Butanol	UG/L	170.000	U	170.000	U		
1,1,1-Trichloroethane	UG/L	0.580	U	0.580	U	10.000	UJ
Carbon Tetrachloride	UG/L	1.100	U	1.100	U	10.000	UJ
Bromodichloromethane	UG/L					10.000	UJ
1,2-Dichloropropane	UG/L					10.000	U
cis-1,3-Dichloropropene	UG/L					10.000	U
Trichloroethene	UG/L	0.110	U	0.110	U	10.000	UJ
Dibromochloromethane	UG/L					10.000	UJ
1,1,2-Trichloroethane	UG/L	0.160	U	0.160	U	10.000	UJ
Benzene	UG/L	0.110	U	0.110	U	10.000	U
trans-1,3-Dichloropropene	UG/L					10.000	U
Bromoform	UG/L					10.000	U
4-Methyl-2-Pentanone	UG/L	18.000	U	18.000	U	10.000	U
2-Hexanone	UG/L					10.000	U
Tetrachloroethene	UG/L	0.130	U	0.130	U	10.000	UJ
Toluene	UG/L	0.120	U	0.120	U	10.000	UJ
1,1,2,2-Tetrachloroethane	UG/L					10.000	UJ
Chlorobenzene	UG/L					10.000	U
Ethyl Benzene	UG/L					10.000	UJ
Ethyl Cyanide	UG/L	3.000	U	3.000	U		
Styrene	UG/L					10.000	UJ
Xylenes (total)	UG/L	0.170	U	0.170	U	10.000	UJ
Hydrazine							

QA VOLATILE ORGANIC Analysis Results

Program		CERCLA		CERCLA		CERCLA	
Well ID		399-1-5		399-1-7		399-2-2	
Round		7		7		7	
Date		6-24-94		6-23-94		6-23-94	
Sample Type		SPLIT		TRIP BL		TRIP BL	
Lab ID		TMA		IT		IT	
Filtered		NO		NO		NO	
Filter Size (in microns)		NAN		NAN		NAN	
Sample ID		BOBZJ4		BOBZN1		BOBZN3	
Parameter	Units	Conc.	Q	Conc.	Q	Conc.	Q
Chloromethane	UG/L	10.000	U	10.000	U	10.000	U
Bromomethane	UG/L	10.000	UJ	10.000	UJ	10.000	U
Vinyl Chloride	UG/L	10.000	U	10.000	U	10.000	U
Chloroethane	UG/L	10.000	U	10.000	U	10.000	U
Methylene Chloride	UG/L	10.000	U	10.000	U	10.000	U
Acetone	UG/L	4.000	J	10.000	U	10.000	U
Carbon Disulfide	UG/L	10.000	U	10.000	U	10.000	U
1,1-Dichloroethene	UG/L	10.000	U	10.000	U	10.000	U
1,1-Dichloroethane	UG/L	10.000	U	10.000	U	10.000	U
1,2-Dichloroethene (total)	UG/L	10.000	U	10.000	U	10.000	U
cis-1,2-Dichloroethylene							
1,2-Dichloroethane	UG/L	10.000	U	10.000	U	10.000	U
trans-1,2-Dichloroethylene							
Chloroform	UG/L	10.000	U	1.000	J	10.000	U
2-Butanone	UG/L	10.000	U	10.000	U	10.000	U
1-Butanol							
1,1,1-Trichloroethane	UG/L	10.000	U	10.000	U	10.000	UJ
Carbon Tetrachloride	UG/L	10.000	U	10.000	U	10.000	UJ
Bromodichloromethane	UG/L	10.000	U	10.000	U	10.000	UJ
1,2-Dichloropropane	UG/L	10.000	U	10.000	U	10.000	U
cis-1,3-Dichloropropene	UG/L	10.000	U	10.000	U	10.000	U
Trichloroethene	UG/L	10.000	U	10.000	U	10.000	UJ
Dibromochloromethane	UG/L	10.000	U	10.000	U	10.000	UJ
1,1,2-Trichloroethane	UG/L	10.000	U	10.000	U	10.000	UJ
Benzene	UG/L	10.000	U	10.000	U	10.000	U
trans-1,3-Dichloropropene	UG/L	10.000	U	10.000	U	10.000	U
Bromoform	UG/L	10.000	U	10.000	U	10.000	U
4-Methyl-2-Pentanone	UG/L	10.000	U	10.000	U	10.000	U
2-Hexanone	UG/L	10.000	U	10.000	U	10.000	U
Tetrachloroethene	UG/L	10.000	U	10.000	U	10.000	UJ
Toluene	UG/L	10.000	U	10.000	UJ	10.000	UJ
1,1,2,2-Tetrachloroethane	UG/L	10.000	U	10.000	U	10.000	UJ
Chlorobenzene	UG/L	10.000	U	10.000	U	10.000	U
Ethyl Benzene	UG/L	10.000	U	10.000	UJ	10.000	UJ
Ethyl Cyanide							
Styrene	UG/L	10.000	U	10.000	UJ	10.000	UJ
Xylenes (total)	UG/L	10.000	U	10.000	UJ	10.000	UJ
Hydrazine							

QA VOLATILE ORGANIC Analysis Results

Program		CERCLA		CERCLA		CERCLA	
Well ID		399-3-11		399-3-11		399-3-11	
Round		7		7		7	
Date		6-22-94		6-22-94		6-22-94	
Sample Type		DUPLICATE		EQUIP.BL		TRIP BL	
Lab ID		IT		IT		IT	
Filtered		NO		NO		NO	
Filter Size (in microns)		NAN		NAN		NAN	
Sample ID		BOBZL2		BOBZM6		BOBZN2	
Parameter	Units	Conc.	Q	Conc.	Q	Conc.	Q
Chloromethane	UG/L	10.000	U	10.000	U	10.000	U
Bromomethane	UG/L	10.000	U	10.000	UJ	10.000	UJ
Vinyl Chloride	UG/L	10.000	U	10.000	U	10.000	U
Chloroethane	UG/L	10.000	U	10.000	U	10.000	U
Methylene Chloride	UG/L	10.000	U	10.000	U	10.000	U
Acetone	UG/L	10.000	U	10.000	U	10.000	U
Carbon Disulfide	UG/L	10.000	U	10.000	U	10.000	U
1,1-Dichloroethene	UG/L	10.000	U	10.000	U	10.000	U
1,1-Dichloroethane	UG/L	10.000	U	10.000	U	10.000	U
1,2-Dichloroethene (total)	UG/L	10.000	U	10.000	U	10.000	U
cis-1,2-Dichloroethylene							
1,2-Dichloroethane	UG/L	10.000	U	10.000	U	10.000	U
trans-1,2-Dichloroethylene							
Chloroform	UG/L	2.000	J	2.000	J	10.000	U
2-Butanone	UG/L	10.000	U	10.000	U	10.000	U
1-Butanol							
1,1,1-Trichloroethane	UG/L	10.000	U	10.000	U	10.000	U
Carbon Tetrachloride	UG/L	10.000	U	10.000	U	10.000	U
Bromodichloromethane	UG/L	10.000	U	10.000	U	10.000	U
1,2-Dichloropropane	UG/L	10.000	U	10.000	U	10.000	U
cis-1,3-Dichloropropene	UG/L	10.000	U	10.000	U	10.000	U
Trichloroethene	UG/L	2.000	J	10.000	U	10.000	U
Dibromochloromethane	UG/L	10.000	U	10.000	U	10.000	U
1,1,2-Trichloroethane	UG/L	10.000	U	10.000	U	10.000	U
Benzene	UG/L	10.000	U	10.000	U	10.000	U
trans-1,3-Dichloropropene	UG/L	10.000	U	10.000	U	10.000	U
Bromoform	UG/L	10.000	U	10.000	U	10.000	U
4-Methyl-2-Pentanone	UG/L	10.000	U	10.000	U	10.000	U
2-Hexanone	UG/L	10.000	U	10.000	U	10.000	U
Tetrachloroethene	UG/L	10.000	U	10.000	U	10.000	U
Toluene	UG/L	10.000	UJ	10.000	UJ	10.000	UJ
1,1,2,2-Tetrachloroethane	UG/L	10.000	U	10.000	U	10.000	U
Chlorobenzene	UG/L	10.000	U	10.000	U	10.000	U
Ethyl Benzene	UG/L	10.000	UJ	10.000	UJ	10.000	UJ
Ethyl Cyanide							
Styrene	UG/L	10.000	UJ	10.000	UJ	10.000	UJ
Xylenes (total)	UG/L	10.000	UJ	10.000	UJ	10.000	UJ
Hydrazine							

QA VOLATILE ORGANIC Analysis Results

Program		CERCLA		CERCLA		CERCLA	
Well ID		399-3-12		399-4-7		399-4-7	
Round		7		7		7	
Date		6-22-94		6-23-94		6-23-94	
Sample Type		EQUIP.BL		TRIP BL		SPLIT	
Lab ID		IT		IT		TMA	
Filtered		NO		NO		NO	
Filter Size (in microns)		NAN		NAN		NAN	
Sample ID		BOBZM8		BOBZN0		BOBZL8	
Parameter	Units	Conc.	Q	Conc.	Q	Conc.	Q
Chloromethane	UG/L	10.000	U	10.000	U	10.000	U
Bromomethane	UG/L	10.000	UJ	10.000	U	10.000	UJ
Vinyl Chloride	UG/L	10.000	U	10.000	U	10.000	U
Chloroethane	UG/L	10.000	U	10.000	U	10.000	U
Methylene Chloride	UG/L	10.000	U	10.000	U	10.000	U
Acetone	UG/L	10.000	U	10.000	U	9.000	J
Carbon Disulfide	UG/L	10.000	U	10.000	U	10.000	U
1,1-Dichloroethene	UG/L	10.000	U	10.000	U	10.000	U
1,1-Dichloroethane	UG/L	10.000	U	10.000	U	10.000	U
1,2-Dichloroethene (total)	UG/L	10.000	U	10.000	U	10.000	U
cis-1,2-Dichloroethylene							
1,2-Dichloroethane	UG/L	10.000	U	10.000	U	10.000	U
trans-1,2-Dichloroethylene							
Chloroform	UG/L	3.000	J	2.000	J	3.000	J
2-Butanone	UG/L	10.000	U	10.000	U	10.000	U
1-Butanol							
1,1,1-Trichloroethane	UG/L	10.000	U	10.000	UJ	10.000	U
Carbon Tetrachloride	UG/L	10.000	U	10.000	UJ	10.000	U
Bromodichloromethane	UG/L	10.000	U	10.000	UJ	10.000	U
1,2-Dichloropropane	UG/L	10.000	U	10.000	U	10.000	U
cis-1,3-Dichloropropene	UG/L	10.000	U	10.000	U	10.000	U
Trichloroethene	UG/L	10.000	U	10.000	UJ	2.000	J
Dibromochloromethane	UG/L	10.000	U	10.000	UJ	10.000	U
1,1,2-Trichloroethane	UG/L	10.000	U	10.000	UJ	10.000	U
Benzene	UG/L	10.000	U	10.000	U	10.000	U
trans-1,3-Dichloropropene	UG/L	10.000	U	10.000	U	10.000	U
Bromoform	UG/L	10.000	U	10.000	U	10.000	U
4-Methyl-2-Pentanone	UG/L	10.000	U	10.000	U	10.000	U
2-Hexanone	UG/L	10.000	U	10.000	U	10.000	U
Tetrachloroethene	UG/L	10.000	U	10.000	UJ	10.000	U
Toluene	UG/L	10.000	UJ	10.000	UJ	10.000	U
1,1,2,2-Tetrachloroethane	UG/L	10.000	U	10.000	UJ	10.000	U
Chlorobenzene	UG/L	10.000	U	10.000	U	10.000	U
Ethyl Benzene	UG/L	10.000	UJ	10.000	UJ	10.000	U
Ethyl Cyanide							
Styrene	UG/L	10.000	UJ	10.000	UJ	10.000	U
Xylenes (total)	UG/L	10.000	UJ	10.000	UJ	10.000	U
Hydrazine							

QA VOLATILE ORGANIC Analysis Results

Program		CERCLA	
Well ID		399-4-10	
Round		7	
Date		6-23-94	
Sample Type		DUPLICATE	
Lab ID		IT	
Filtered		NO	
Filter Size (in microns)		NAN	
Sample ID		BOBZM2	
Parameter	Units	Conc.	Q
Chloromethane	UG/L	10.000	U
Bromomethane	UG/L	10.000	U
Vinyl Chloride	UG/L	10.000	U
Chloroethane	UG/L	10.000	U
Methylene Chloride	UG/L	10.000	U
Acetone	UG/L	10.000	U
Carbon Disulfide	UG/L	10.000	U
1,1-Dichloroethene	UG/L	10.000	U
1,1-Dichloroethane	UG/L	10.000	U
1,2-Dichloroethene (total)	UG/L	10.000	U
cis-1,2-Dichloroethylene			
1,2-Dichloroethane	UG/L	10.000	U
trans-1,2-Dichloroethylene			
Chloroform	UG/L	4.000	J
2-Butanone	UG/L	10.000	U
1-Butanol			
1,1,1-Trichloroethane	UG/L	10.000	UJ
Carbon Tetrachloride	UG/L	10.000	UJ
Bromodichloromethane	UG/L	10.000	UJ
1,2-Dichloropropane	UG/L	10.000	U
cis-1,3-Dichloropropene	UG/L	10.000	U
Trichloroethene	UG/L	1.000	J
Dibromochloromethane	UG/L	10.000	UJ
1,1,2-Trichloroethane	UG/L	10.000	UJ
Benzene	UG/L	10.000	U
trans-1,3-Dichloropropene	UG/L	10.000	U
Bromoform	UG/L	10.000	U
4-Methyl-2-Pentanone	UG/L	10.000	U
2-Hexanone	UG/L	10.000	U
Tetrachloroethene	UG/L	10.000	UJ
Toluene	UG/L	10.000	UJ
1,1,2,2-Tetrachloroethane	UG/L	10.000	UJ
Chlorobenzene	UG/L	10.000	U
Ethyl Benzene	UG/L	10.000	UJ
Ethyl Cyanide			
Styrene	UG/L	10.000	UJ
Xylenes (total)	UG/L	10.000	UJ
Hydrazine			

FIELD Analysis Results

Program		CERCLA		RCRA		RCRA		CERCLA		RCRA	
Well ID		399-1-5		399-1-5		399-1-5		399-1-7		399-1-7	
Round		5		5		5		5		5	
Date		3-10-93		5-14-93		5-20-93		3-9-93		5-14-93	
Sample Type		SAMPLE		SAMPLE		SAMPLE		SAMPLE		SAMPLE	
Filtered		NO		NO		NO		NO		NO	
Filter Size (in microns)											
Sample ID		B086P9		B07BM9		B07BQ6		B086Q0		B07BM7	
Parameter	Units	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q
Specific conductance	UMHO/CM	433.000		434.000		420.000		341.000		408.000	
Turbidity										/	
Temperature	DEG C	15.800		17.400		17.000		17.700		18.600	
PH	STD.UNIT	7.410		7.430		7.630		7.250		7.450	

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FIELD Analysis Results

Program		RCRA		CERCLA		RCRA		RCRA		RCRA	
Well ID		399-1-7		399-1-10A		399-1-10A		399-1-10A		399-1-10A	
Round		5		5		5		5		5	
Date		5-20-93		3-10-93		2-12-93		5-14-93		5-20-93	
Sample Type		SAMPLE		SAMPLE		SAMPLE		SAMPLE		SAMPLE	
Filtered		NO		NO		NO		NO		NO	
Filter Size (in microns)											
Sample ID		B07BQ4		B086Q1		B085D8		B07BM5		B07BQ7	
Parameter	Units	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q
Specific conductance	UMHO/CM	369.000		416.000		453.000		325.000		234.000	
Turbidity										/	
Temperature	DEG C	18.500		16.000		16.300		16.600		17.100	
PH	STD.UNIT	7.480		7.510		7.260		7.350		7.320	

FIELD Analysis Results

Program		RCRA		RCRA		RCRA		RCRA		CERCLA	
Well ID		399-1-10B		399-1-11		399-1-12		399-1-12		399-1-13A	
Round		5		5		5		5		5	
Date		2-16-93		2-12-93		2-12-93		5-20-93		3-10-93	
Sample Type		SAMPLE		SAMPLE		SAMPLE		SAMPLE		SAMPLE	
Filtered		NO		NO		NO		NO		NO	
Filter Size (in microns)											
Sample ID		B085D2		B085F0		B085F2		B07BR0		B086Q2	
Parameter	Units	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q
Specific conductance	UMHO/CM	315.000		435.000		427.000		417.000		406.000	
Turbidity											
Temperature	DEG C	16.200		16.700		16.500		17.900		16.100	
PH	STD.UNIT	7.690		7.910		7.950		7.520		8.090	

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FIELD Analysis Results

Program		RCRA		RCRA		CERCLA		RCRA		RCRA	
Well ID		399-1-14A		399-1-14B		399-1-15		399-1-16A		399-1-16A	
Round		5		5		5		5		5	
Date		2-12-93		2-16-93		3-10-93		2-16-93		5-14-93	
Sample Type		SAMPLE		SAMPLE		SAMPLE		SAMPLE		SAMPLE	
Filtered		NO		NO		NO		NO		NO	
Filter Size (in microns)											
Sample ID		B085F4		B085D4		B086Q3		B085F6		B07BM8	
Parameter	Units	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q
Specific conductance	UMHO/CM	441.000		367.000		444.000		432.000		414.000	
Turbidity										/	
Temperature	DEG C	16.400		16.600		16.800		17.100		17.100	
PH	STD.UNIT	7.790		7.750		8.090		7.500		7.350	

FIELD Analysis Results

Program		RCRA		RCRA		CERCLA		RCRA		RCRA	
Well ID		399-1-16A		399-1-16B		399-1-16C		399-1-17A		399-1-17A	
Round		5		5		5		5		5	
Date		5-20-93		2-18-93		3-1-93		1-8-93		1-14-93	
Sample Type		SAMPLE		SAMPLE		SAMPLE		SAMPLE		SAMPLE	
Filtered		NO		NO		NO		NO		NO	
Filter Size (in microns)											
Sample ID		B07BQ8		B085G0		B086Q4		B07TJ0		B07TJ4	
Parameter	Units	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q
Specific conductance	UMHO/CM	395.000		347.000		360.000		507.000		530.000	
Turbidity											
Temperature	DEG C	17.900		12.800		15.400		17.000		16.800	
PH	STD.UNIT	7.220		8.230		8.230		7.150		7.300	

FIELD Analysis Results

Program		RCRA		RCRA		RCRA		RCRA		RCRA	
Well ID		399-1-17A		399-1-17A		399-1-17A		399-1-17A		399-1-17A	
Round		5		5		5		5		5	
Date		1-21-93		1-27-93		2-12-93		5-14-93		5-20-93	
Sample Type		SAMPLE		SAMPLE		SAMPLE		SAMPLE		SAMPLE	
Filtered		NO		NO		NO		NO		NO	
Filter Size (in microns)											
Sample ID		B07TJ1		B07TJ2		B07TJ3		B08JD0		B07BQ5	
Parameter	Units	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q
Specific conductance	UMHO/CM	415.000		307.000		443.000		206.000		223.000	
Turbidity											
Temperature	DEG C	16.200		16.300		15.900		20.000		20.500	
PH	STD.UNIT	7.850		6.640		8.100		7.480		7.520	

FIELD Analysis Results

Program		RCRA		RCRA		CERCLA		RCRA		RCRA	
Well ID		399-1-17B		399-1-18A		399-1-21A		399-1-21A		399-2-1	
Round		5		5		5		5		5	
Date		2-18-93		2-12-93		3-9-93		5-20-93		2-16-93	
Sample Type		SAMPLE		SAMPLE		SAMPLE		SAMPLE		SAMPLE	
Filtered		NO		NO		NO		NO		NO	
Filter Size (in microns)											
Sample ID		B085G2		B085G6		B086Q5		B07BR1		B085G8	
Parameter	Units	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q
Specific conductance	UMHO/CM	340.000		536.000		426.000		403.000		366.000	
Turbidity											
Temperature	DEG C	17.300		16.000		17.200		17.500		18.100	
PH	STD.UNIT	7.790		7.950		7.320		7.620		6.970	

FIELD Analysis Results

Program		CERCLA		CERCLA		RCRA		CERCLA		RCRA	
Well ID		399-2-2		399-2-2		399-2-2		399-3-2		399-3-10	
Round		5		5		5		5		5	
Date		3-11-93		3-17-93		5-20-93		3-8-93		2-16-93	
Sample Type		SAMPLE		SAMPLE		SAMPLE		SAMPLE		SAMPLE	
Filtered		NO		NO		NO		NO		NO	
Filter Size (in microns)											
Sample ID		B086Q6		B08BF2		B07BQ9		B086Q7		B085H0	
Parameter	Units	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q
Specific conductance	UMHO/CM	356.000		470.000		208.000		381.000		505.000	
Turbidity											
Temperature	DEG C	17.200		18.800		17.900		19.400		16.300	
PH	STD.UNIT	7.520		7.450		7.970		7.790		7.460	

FIELD Analysis Results

Program		CERCLA		CERCLA		CERCLA		CERCLA		CERCLA	
Well ID		399-3-11		399-3-12		399-4-1		399-4-7		399-4-10	
Round		5		5		5		5		5	
Date		3-3-93		2-25-93		3-12-93		2-25-93		3-3-93	
Sample Type		SAMPLE		SAMPLE		SAMPLE		SAMPLE		SAMPLE	
Filtered		NO		NO		NO		NO		NO	
Filter Size (in microns)											
Sample ID		B086Q8		B086Q9		B086R0		B086R1		B086R2	
Parameter	Units	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q
Specific conductance	UMHO/CM	378.000		418.000		354.000		380.000		360.000	
Turbidity											
Temperature	DEG C	16.200		17.000		17.500		17.600		17.300	
PH	STD.UNIT	7.610		7.610		7.760		7.350		7.260	

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FIELD Analysis Results

Program		CERCLA		CERCLA		CERCLA		CERCLA		CERCLA	
Well ID		399-4-11		399-4-12		399-5-1		399-6-1		399-8-1	
Round		5		5		5		5		5	
Date		3-9-93		2-25-93		2-26-93		2-26-93		3-8-93	
Sample Type		SAMPLE		SAMPLE		SAMPLE		SAMPLE		SAMPLE	
Filtered		NO		NO		NO		NO		NO	
Filter Size (in microns)											
Sample ID		B086R3		B086R4		B086S7		B086R5		B086R8	
Parameter	Units	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q
Specific conductance	UMHO/CM	325.000		370.000		573.000		476.000		353.000	
Turbidity											
Temperature	DEG C	14.900		16.300		16.100		16.000		15.900	
PH	STD.UNIT	7.540		7.630		7.820		8.030		8.000	

FIELD Analysis Results

Program		CERCLA		CERCLA		CERCLA		CERCLA		CERCLA	
Well ID		399-8-3		399-8-3		399-8-5A		699-S27-E14		699-S28-E12	
Round		5		5		5		5		5	
Date		3-11-93		3-17-93		2-25-93		2-26-93		3-12-93	
Sample Type		SAMPLE		SAMPLE		SAMPLE		SAMPLE		SAMPLE	
Filtered		NO		NO		NO		NO		NO	
Filter Size (in microns)											
Sample ID		B086R6		B08BF1		B086R7		B086S8		B089B0	
Parameter	Units	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q
Specific conductance	UMHO/CM	360.000		514.000		342.000		420.000		586.000	
Turbidity											
Temperature	DEG C	15.900		16.100		15.400		16.300		15.200	
PH	STD.UNIT	7.900		9.170		7.610		7.780		7.810	

FIELD Analysis Results

Program		RCRA		RCRA		RCRA		RCRA		RCRA	
Well ID		399-1-10A		399-1-11		399-1-12		399-1-14A		399-1-16A	
Round		6		6		6		6		6	
Date		9-14-93		9-14-93		9-14-93		9-14-93		9-29-93	
Sample Type		SAMPLE		SAMPLE		SAMPLE		SAMPLE		SAMPLE	
Filtered		NO		NO		NO		NO		NO	
Filter Size (in microns)											
Sample ID		B09641		B09643		B09645		B09647		B09649	
Parameter	Units	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q
Specific conductance	UMHO/CM	437.000		441.000		436.000		453.000		389.000	
Turbidity											
Temperature	DEG C	16.400		16.800		16.500		16.500		17.200	
PH	STD.UNIT	7.480		7.660		7.620		7.790		7.520	

FIELD Analysis Results

Program		RCRA		RCRA		RCRA		RCRA		RCRA	
Well ID		399-1-16B		399-1-17A		399-1-17A		399-1-17A		399-1-17A	
Round		6		6		6		6		6	
Date		9-29-93		9-3-93		12-9-93		12-9-93		12-9-93	
Sample Type		SAMPLE		SAMPLE		SAMPLE		SAMPLE		SAMPLE	
Filtered		NO		NO		NO		NO		NO	
Filter Size (in microns)											
Sample ID		B09651		B09653		B09MX4		B09MX5		B09MX6	
Parameter	Units	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q
Specific conductance	UMHO/CM	332.000		159.000		609.000		609.000		609.000	
Turbidity											
Temperature	DEG C	16.900		25.100							
PH	STD.UNIT	8.070		7.010		7.320		7.310		7.310	

FIELD Analysis Results

Program		RCRA		RCRA		RCRA		SURV		RCRA	
Well ID		399-1-17A		399-1-17B		399-1-18A		399-1-21A		399-2-1	
Round		6		6		6		6		6	
Date		12-9-93		9-7-93		9-7-93		9-14-93		9-16-93	
Sample Type		SAMPLE		SAMPLE		SAMPLE		SAMPLE		SAMPLE	
Filtered		NO		NO		NO		NO		NO	
Filter Size (in microns)											
Sample ID		B09MX7		B09655		B09657		B08ZV2		B09663	
Parameter	Units	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q
Specific conductance	UMHO/CM	612.000		366.000		452.000		414.000		338.000	
Turbidity										/	
Temperature	DEG C			17.800		17.000		17.600		19.900	
PH	STD.UNIT	7.300		7.840		7.760		7.710		7.190	

FIELD Analysis Results

Program		RCRA		RCRA		RCRA		RCRA		RCRA	
Well ID		399-3-10		399-1-10A		399-1-11		399-1-12		399-1-14A	
Round		6		7		7		7		7	
Date		9-3-93		6-23-94		6-22-94		6-22-94		6-22-94	
Sample Type		SAMPLE		SAMPLE		SAMPLE		SAMPLE		SAMPLE	
Filtered		NO		NO		NO		NO		NO	
Filter Size (in microns)											
Sample ID		B09659		B0BYJ9		B0BYK1		B0BYK3		B0BYK5	
Parameter	Units	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q
Specific conductance	UMHO/CM	323.000		390.000		447.000		435.000		474.000	
Turbidity											
Temperature	DEG C	17.600									
PH	STD.UNIT	7.170		7.640		7.720		7.720		7.700	

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FIELD Analysis Results

Program		RCRA		RCRA		RCRA		RCRA		RCRA	
Well ID		399-1-16A		399-1-16B		399-1-17A		399-1-17A		399-1-17A	
Round		7		7		7		7		7	
Date		6-23-94		6-22-94		6-22-94		6-22-94		6-22-94	
Sample Type		SAMPLE		SAMPLE		SAMPLE		SAMPLE		SAMPLE	
Filtered		NO		NO		NO		NO		NO	
Filter Size (in microns)											
Sample ID		B0BYK7		B0BYK9		B0BYL1		B0BYL2		B0BYL3	
Parameter	Units	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q
Specific conductance	UMHO/CM	360.000		342.000		303.000		302.000		302.000	
Turbidity											
Temperature											
PH	STD.UNIT	7.610		8.030		7.300		7.250		7.210	

FIELD Analysis Results

Program		RCRA		RCRA		RCRA		RCRA		RCRA	
Well ID		399-1-17A		399-1-17B		399-1-18A		399-2-1		399-3-10	
Round		7		7		7		7		7	
Date		6-22-94		6-22-94		6-22-94		6-23-94		6-23-94	
Sample Type		SAMPLE		SAMPLE		SAMPLE		SAMPLE		SAMPLE	
Filtered		NO		NO		NO		NO		NO	
Filter Size (in microns)											
Sample ID		BOBYL4		BOBYL6		BOBYL8		BOBYM0		BOBYM2	
Parameter	Units	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q
Specific conductance	UMHO/CM	302.000		387.000		470.000		250.000		364.000	
Turbidity											
Temperature											
PH	STD.UNIT	7.200		7.900		7.900		7.350		7.300	

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FIELD Analysis Results

Program	
Well ID	
Round	
Date	
Sample Type	
Filtered	
Filter Size (in microns)	
Sample ID	
Parameter	Units
Specific conductance	
Turbidity	
Temperature	
PH	

GENERAL CHEMISTRY Analysis Results

Program		RCRA		RCRA		RCRA		RCRA		RCRA	
Well ID		399-1-5		399-1-5		399-1-7		399-1-7		399-1-10A	
Round		5		5		5		5		5	
Date		5-14-93		5-20-93		5-14-93		5-20-93		2-12-93	
Sample Type		SAMPLE		SAMPLE		SAMPLE		SAMPLE		SAMPLE	
Lab ID		DATA CHEM		DATA CHEM		DATA CHEM		DATA CHEM		DATA CHEM	
Filtered		NO		NO		NO		NO		NO	
Filter Size (in microns)											
Sample ID		B07BM9		B07BQ6		B07BM7		B07BQ4		B085B9	
Parameter	Units	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q
Alkalinity											
Bromide											
Chloride	UG/L									17000.000	
Fluoride	UG/L									200.000	
Nitrate	UG/L									21000.000	
Nitrite											
Phosphate											
Sulfate	UG/L									51000.000	
Coliform Bacteria											
Total Dissolved Solids											
Total Organic Carbon	UG/L	300.000	L	500.000	L	400.000	L	500.000	L		
Total organic halides											
Specific conductance	UMHO/CM	434.000		420.000		408.000		369.000			
Ammonium ion											
PH	STD.UNIT	7.430		7.630		7.450		7.480			

9513333.1451

GENERAL CHEMISTRY Analysis Results

Program		RCRA		RCRA		RCRA		RCRA		RCRA	
Well ID		399-1-10A		399-1-10A		399-1-10A		399-1-10B		399-1-11	
Round		5		5		5		5		5	
Date		2-12-93		5-14-93		5-20-93		2-16-93		2-12-93	
Sample Type		SAMPLE		SAMPLE		SAMPLE		SAMPLE		SAMPLE	
Lab ID		DATA CHEM		DATA CHEM		DATA CHEM		DATA CHEM		DATA CHEM	
Filtered		NO		NO		NO		NO		NO	
Filter Size (in microns)											
Sample ID		B085D8		B07BM5		B07BQ7		B085D2		B085C0	
Parameter	Units	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q
Alkalinity	MG/L	120.000								/	
Bromide											
Chloride	UG/L							7600.000		17000.000	
Fluoride	UG/L							1200.000		300.000	
Nitrate	UG/L									20000.000	
Nitrite											
Phosphate											
Sulfate	UG/L									51000.000	
Coliform Bacteria	C/DL	1.000	U								
Total Dissolved Solids											
Total Organic Carbon	UG/L	1000.000	U	400.000	L	800.000	L				
Total organic halides	UG/L	10.000	U								
Specific conductance	UMHO/CM	453.000		325.000		234.000		315.000			
Ammonium ion											
PH	STD.UNIT	7.260		7.350		7.320		7.690			

GENERAL CHEMISTRY Analysis Results

Program		RCRA		RCRA		RCRA		RCRA		RCRA	
Well ID		399-1-11		399-1-12		399-1-12		399-1-12		399-1-14A	
Round		5		5		5		5		5	
Date		2-12-93		2-12-93		2-12-93		5-20-93		2-12-93	
Sample Type		SAMPLE		SAMPLE		SAMPLE		SAMPLE		SAMPLE	
Lab ID		DATA CHEM		DATA CHEM		DATA CHEM		DATA CHEM		DATA CHEM	
Filtered		NO		NO		NO		NO		NO	
Filter Size (in microns)											
Sample ID		B085F0		B085C1		B085F2		B07BR0		B085C2	
Parameter	Units	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q
Alkalinity	MG/L	120.000				120.000					
Bromide											
Chloride	UG/L			16000.000						17000.000	
Fluoride	UG/L			200.000						300.000	
Nitrate	UG/L			21000.000						20000.000	
Nitrite											
Phosphate											
Sulfate	UG/L			49000.000						50000.000	
Coliform Bacteria	C/DL	1.000	U			1.000	U				
Total Dissolved Solids											
Total Organic Carbon	UG/L	1000.000	U			1000.000	U	400.000	L		
Total organic halides	UG/L	10.000	U			10.000	U				
Specific conductance	UMHO/CM	435.000				427.000		417.000			
Ammonium ion											
PH	STD.UNIT	7.910				7.950		7.520			

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GENERAL CHEMISTRY Analysis Results

Program		RCRA		RCRA		RCRA		RCRA		RCRA	
Well ID		399-1-14A		399-1-14B		399-1-16A		399-1-16A		399-1-16A	
Round		5		5		5		5		5	
Date		2-12-93		2-16-93		2-16-93		2-16-93		5-14-93	
Sample Type		SAMPLE		SAMPLE		SAMPLE		SAMPLE		SAMPLE	
Lab ID		DATA CHEM		DATA CHEM		DATA CHEM		DATA CHEM		DATA CHEM	
Filtered		NO		NO		NO		NO		NO	
Filter Size (in microns)											
Sample ID		B085F4		B085D4		B085C3		B085F6		B07BM8	
Parameter	Units	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q
Alkalinity	MG/L	130.000						110.000		/	
Bromide											
Chloride	UG/L			7600.000		18000.000					
Fluoride	UG/L			1200.000		500.000					
Nitrate	UG/L					20000.000					
Nitrite											
Phosphate											
Sulfate	UG/L					46000.000					
Coliform Bacteria	C/DL	1.000	U					1.000	U		
Total Dissolved Solids											
Total Organic Carbon	UG/L	1000.000	U					1000.000	U	300.000	L
Total organic halides	UG/L	10.000	U					10.000	U		
Specific conductance	UMHO/CM	441.000		367.000				432.000		414.000	
Ammonium ion											
PH	STD.UNIT	7.790		7.750				7.500		7.350	

9513333.1453

GENERAL CHEMISTRY Analysis Results

Program		RCRA		RCRA		RCRA		RCRA		RCRA	
Well ID		399-1-16A		399-1-16B		399-1-16B		399-1-17A		399-1-17A	
Round		5		5		5		5		5	
Date		5-20-93		2-18-93		2-18-93		1-8-93		1-14-93	
Sample Type		SAMPLE		SAMPLE		SAMPLE		SAMPLE		SAMPLE	
Lab ID		DATA CHEM		DATA CHEM		DATA CHEM		DATA CHEM		DATA CHEM	
Filtered		NO		NO		NO		NO		NO	
Filter Size (in microns)											
Sample ID		B07BQ8		B085C4		B085G0		B07TJ0		B07TJ4	
Parameter	Units	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q
Alkalinity	MG/L					130.000					
Bromide	UG/L							500.000	U	500.000	U
Chloride	UG/L			11000.000				100000.000		110000.000	
Fluoride	UG/L			1200.000				400.000		400.000	
Nitrate	UG/L			600.000				1300.000		1200.000	
Nitrite	UG/L							200.000	U	200.000	U
Phosphate	UG/L							400.000	U	400.000	U
Sulfate	UG/L			20000.000				13000.000		13000.000	
Coliform Bacteria	C/DL					1.000	U				
Total Dissolved Solids											
Total Organic Carbon	UG/L	500.000	L			1000.000	U				
Total organic halides	UG/L					80.000					
Specific conductance	UMHO/CM	395.000				347.000		507.000		530.000	
Ammonium ion											
PH	STD.UNIT	7.220				8.230		7.150		7.300	

GENERAL CHEMISTRY Analysis Results

Program		RCRA		RCRA		RCRA		RCRA		RCRA	
Well ID		399-1-17A		399-1-17A		399-1-17A		399-1-17A		399-1-17A	
Round		5		5		5		5		5	
Date		1-21-93		1-27-93		2-12-93		5-14-93		5-20-93	
Sample Type		SAMPLE		SAMPLE		SAMPLE		SAMPLE		SAMPLE	
Lab ID		DATA CHEM		DATA CHEM		DATA CHEM		DATA CHEM		DATA CHEM	
Filtered		NO		NO		NO		NO		NO	
Filter Size (in microns)											
Sample ID		B07TJ1		B07TJ2		B07TJ3		B08JD0		B07BQ5	
Parameter	Units	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q
Alkalinity	MG/L							60.000			
Bromide	UG/L	500.000	U	500.000	U	500.000	U				
Chloride	UG/L	81000.000		44000.000		39000.000					
Fluoride	UG/L	200.000		300.000		100.000					
Nitrate	UG/L	2300.000		2000.000		1400.000					
Nitrite	UG/L	200.000	U	200.000	U	200.000	U				
Phosphate	UG/L	400.000	U	400.000	U	400.000	U				
Sulfate	UG/L	13000.000		14000.000		14000.000					
Coliform Bacteria	C/DL							1.000			
Total Dissolved Solids											
Total Organic Carbon	UG/L							800.000	L	900.000	L
Total organic halides	UG/L							30.000			
Specific conductance	UMHO/CM	415.000		307.000		443.000		206.000		223.000	
Ammonium ion											
PH	STD.UNIT	7.850		6.640		8.100		7.480		7.520	

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GENERAL CHEMISTRY Analysis Results

Program		RCRA		RCRA		RCRA		RCRA		RCRA	
Well ID		399-1-17B		399-1-18A		399-1-18A		399-1-21A		399-2-1	
Round		5		5		5		5		5	
Date		2-18-93		2-12-93		2-12-93		5-20-93		2-16-93	
Sample Type		SAMPLE		SAMPLE		SAMPLE		SAMPLE		SAMPLE	
Lab ID		DATA CHEM		DATA CHEM		DATA CHEM		DATA CHEM		DATA CHEM	
Filtered		NO		NO		NO		NO		NO	
Filter Size (in microns)											
Sample ID		B085G2		B085C5		B085G6		B07BR1		B085C6	
Parameter	Units	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q
Alkalinity	MG/L	170.000				130.000				/	
Bromide											
Chloride	UG/L			17000.000						28000.000	
Fluoride	UG/L			300.000						400.000	
Nitrate	UG/L			23000.000						17000.000	
Nitrite											
Phosphate											
Sulfate	UG/L			51000.000						29000.000	
Coliform Bacteria	C/DL	1.000	U			1.000	U				
Total Dissolved Solids											
Total Organic Carbon	UG/L	1000.000	U			1000.000	U	600.000	L		
Total organic halides	UG/L	20.000				10.000	U				
Specific conductance	UMHO/CM	340.000				536.000		403.000			
Ammonium ion											
PH	STD.UNIT	7.790				7.950		7.620			

GENERAL CHEMISTRY Analysis Results

Program		RCRA		RCRA		RCRA		RCRA		RCRA	
Well ID		399-2-1		399-2-2		399-3-10		399-3-10		399-1-10A	
Round		5		5		5		5		6	
Date		2-16-93		5-20-93		2-16-93		2-16-93		9-14-93	
Sample Type		SAMPLE		SAMPLE		SAMPLE		SAMPLE		SAMPLE	
Lab ID		DATA CHEM		DATA CHEM		DATA CHEM		DATA CHEM		DATA CHEM	
Filtered		NO		NO		NO		NO		NO	
Filter Size (in microns)											
Sample ID		B085G8		B07BQ9		B085C7		B085H0		B09641	
Parameter	Units	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q
Alkalinity	MG/L	70.000						80.000		120.000	B
Bromide											
Chloride	UG/L					15000.000					
Fluoride	UG/L					500.000					
Nitrate	UG/L					15000.000					
Nitrite											
Phosphate											
Sulfate	UG/L					26000.000					
Coliform Bacteria	C/DL	1.000	U					1.000	U	1.000	U
Total Dissolved Solids											
Total Organic Carbon	UG/L	1000.000	U	700.000	L			1000.000	U	400.000	L
Total organic halides	UG/L	10.000						10.000	U	30.000	
Specific conductance	UMHO/CM	366.000		208.000				505.000		437.000	
Ammonium ion											
PH	STD.UNIT	6.970		7.970				7.460		7.480	

GENERAL CHEMISTRY Analysis Results

Program		RCRA		RCRA		RCRA		RCRA		RCRA	
Well ID		399-1-11		399-1-12		399-1-14A		399-1-16A		399-1-16B	
Round		6		6		6		6		6	
Date		9-14-93		9-14-93		9-14-93		9-29-93		9-29-93	
Sample Type		SAMPLE		SAMPLE		SAMPLE		SAMPLE		SAMPLE	
Lab ID		DATA CHEM		DATA CHEM		DATA CHEM		DATA CHEM		DATA CHEM	
Filtered		NO		NO		NO		NO		NO	
Filter Size (in microns)											
Sample ID		B09643		B09645		B09647		B09649		B09651	
Parameter	Units	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q
Alkalinity	MG/L	120.000	B	120.000	B	120.000	B	100.000	B	130.000	B
Bromide											
Chloride											
Fluoride											
Nitrate											
Nitrite											
Phosphate											
Sulfate											
Coliform Bacteria	C/DL	1.000	U	1.000	U	1.000	U	1.000	U	1.000	U
Total Dissolved Solids											
Total Organic Carbon	UG/L	400.000	L	400.000	L	400.000	L	500.000	LB	500.000	LB
Total organic halides	UG/L	10.000	L	10.000		10.000		20.000		70.000	
Specific conductance	UMHO/CM	441.000		436.000		453.000		389.000		332.000	
Ammonium ion											
PH	STD.UNIT	7.660		7.620		7.790		7.520		8.070	

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GENERAL CHEMISTRY Analysis Results

Program		RCRA		RCRA		RCRA		RCRA		RCRA	
Well ID		399-1-17A		399-1-17A		399-1-17A		399-1-17A		399-1-17A	
Round		6		6		6		6		6	
Date		9-3-93		12-9-93		12-9-93		12-9-93		12-9-93	
Sample Type		SAMPLE		SAMPLE		SAMPLE		SAMPLE		SAMPLE	
Lab ID		DATA CHEM		DATA CHEM		DATA CHEM		DATA CHEM		DATA CHEM	
Filtered		NO		NO		NO		NO		NO	
Filter Size (in microns)											
Sample ID		B09653		B09MX4		B09MX5		B09MX6		B09MX7	
Parameter	Units	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q
Alkalinity	MG/L	50.000	B								
Bromide											
Chloride	UG/L			140000.000	U	140000.000	D				
Fluoride	UG/L			400.000		400.000					
Nitrate	UG/L			2200.000		2200.000					
Nitrite											
Phosphate											
Sulfate	UG/L			19000.000	D	16000.000	D				
Coliform Bacteria	C/DL	1.000	U								
Total Dissolved Solids											
Total Organic Carbon	UG/L	1000.000		700.000	L	600.000	L	700.000	L	600.000	L
Total organic halides	UG/L	100.000									
Specific conductance	UMHO/CM	159.000		609.000		609.000		609.000		612.000	
Ammonium ion											
PH	STD.UNIT	7.010		7.320		7.310		7.310		7.300	

GENERAL CHEMISTRY Analysis Results

Program		RCRA		RCRA		RCRA		RCRA		RCRA	
Well ID		399-1-17A		399-1-17A		399-1-17A		399-1-17A		399-1-17B	
Round		6		6		6		6		6	
Date		12-9-93		12-9-93		12-9-93		12-9-93		9-7-93	
Sample Type		SAMPLE		SAMPLE		SAMPLE		SAMPLE		SAMPLE	
Lab ID		DATA CHEM		DATA CHEM		DATA CHEM		DATA CHEM		DATA CHEM	
Filtered		NO		NO		NO		NO		NO	
Filter Size (in microns)											
Sample ID		B09MX8		B09MX9		B09MY0		B09MY1		B09655	
Parameter	Units	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q
Alkalinity	MG/L									180.000	B
Bromide											
Chloride											
Fluoride											
Nitrate											
Nitrite											
Phosphate											
Sulfate											
Coliform Bacteria	C/DL									1.000	U
Total Dissolved Solids											
Total Organic Carbon	UG/L	700.000	L	700.000	L	700.000	L	600.000	L	400.000	L
Total organic halides	UG/L									8.000	U
Specific conductance	UMHO/CM	630.000		630.000		630.000		630.000		366.000	
Ammonium ion											
PH	STD.UNIT	6.900		6.800		6.900		6.900		7.840	

GENERAL CHEMISTRY Analysis Results

Program		RCRA		SURV		RCRA		RCRA		RCRA	
Well ID		399-1-18A		399-1-21A		399-2-1		399-3-10		399-1-10A	
Round		6		6		6		6		7	
Date		9-7-93		9-14-93		9-16-93		9-3-93		6-23-94	
Sample Type		SAMPLE		SAMPLE		SAMPLE		SAMPLE		SAMPLE	
Lab ID		DATA CHEM		DATA CHEM		DATA CHEM		DATA CHEM		DATA CHEM	
Filtered		NO		NO		NO		NO		NO	
Filter Size (in microns)											
Sample ID		B09657		B08ZV2		B09663		B09659		B0BYJ9	
Parameter	Units	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q
Alkalinity	MG/L	130.000	B			80.000	B	70.000	B	110.000	
Bromide	UG/L			100.000	L						
Chloride	UG/L			16000.000	D						
Fluoride	UG/L			400.000							
Nitrate	UG/L			21000.000	D						
Nitrite											
Phosphate											
Sulfate	UG/L			39000.000	D						
Coliform Bacteria	C/DL	1.000	U			1.000		1.000	U	1.000	U
Total Dissolved Solids											
Total Organic Carbon	UG/L	400.000	L			500.000	L	600.000	L	330.000	L
Total organic halides	UG/L	8.000	U			10.000		10.000			
Specific conductance	UMHO/CM	452.000		414.000		338.000		323.000		390.000	
Ammonium ion											
PH	STD.UNIT	7.760		7.710		7.190		7.170		7.640	

GENERAL CHEMISTRY Analysis Results

Program		RCRA		RCRA		RCRA		RCRA		RCRA	
Well ID		399-1-11		399-1-12		399-1-14A		399-1-16A		399-1-16B	
Round		7		7		7		7		7	
Date		6-22-94		6-22-94		6-22-94		6-23-94		6-22-94	
Sample Type		SAMPLE		SAMPLE		SAMPLE		SAMPLE		SAMPLE	
Lab ID		DATA CHEM		DATA CHEM		DATA CHEM		DATA CHEM		DATA CHEM	
Filtered		NO		NO		NO		NO		NO	
Filter Size (in microns)											
Sample ID		B0BYK1		B0BYK3		B0BYK5		B0BYK7		B0BYK9	
Parameter	Units	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q
Alkalinity	MG/L	120.000	B	120.000	B	130.000	B	110.000		140.000	B
Bromide											
Chloride											
Fluoride											
Nitrate											
Nitrite											
Phosphate											
Sulfate											
Coliform Bacteria	C/DL	1.000	U	1.000	U	1.000	U	1.000	U	1.000	
Total Dissolved Solids											
Total Organic Carbon	UG/L	320.000	U	320.000	U	320.000	U	320.000	U	320.000	U
Total organic halides	UG/L	5.000	U	10.000		5.000	U	5.000	U	93.900	
Specific conductance	UMHO/CM	447.000		435.000		474.000		360.000		342.000	
Ammonium ion											
PH	STD.UNIT	7.720		7.720		7.700		7.610		8.030	

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GENERAL CHEMISTRY Analysis Results

Program		RCRA		RCRA		RCRA		RCRA		RCRA	
Well ID		399-1-17A		399-1-17A		399-1-17A		399-1-17A		399-1-17A	
Round		7		7		7		7		7	
Date		4-18-94		4-18-94		4-18-94		4-18-94		6-22-94	
Sample Type		SAMPLE		SAMPLE		SAMPLE		SAMPLE		SAMPLE	
Lab ID		DATA CHEM		DATA CHEM		DATA CHEM		DATA CHEM		DATA CHEM	
Filtered		NO		NO		NO		NO		NO	
Filter Size (in microns)											
Sample ID		B09G49		B09G50		B09G51		B0BQM6		B0BYL1	
Parameter	Units	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q
Alkalinity	MG/L									90.000	B
Bromide											
Chloride	UG/L							8300.000			
Fluoride	UG/L							500.000			
Nitrate	UG/L							1800.000			
Nitrite											
Phosphate											
Sulfate	UG/L							16000.000			
Coliform Bacteria	C/DL									1.000	U
Total Dissolved Solids											
Total Organic Carbon	UG/L	600.000	L	500.000	L	500.000	L	600.000	L	2000.000	
Total organic halides	UG/L	35.600		36.000		30.300		67.900		45.100	
Specific conductance	UMHO/CM							180.000		303.000	
Ammonium ion											
PH	STD.UNIT							8.300		7.300	

GENERAL CHEMISTRY Analysis Results

Program		RCRA		RCRA		RCRA		RCRA		RCRA	
Well ID		399-1-17A		399-1-17A		399-1-17A		399-1-17B		399-1-18A	
Round		7		7		7		7		7	
Date		6-22-94		6-22-94		6-22-94		6-22-94		6-22-94	
Sample Type		SAMPLE		SAMPLE		SAMPLE		SAMPLE		SAMPLE	
Lab ID		DATA CHEM		DATA CHEM		DATA CHEM		DATA CHEM		DATA CHEM	
Filtered		NO		NO		NO		NO		NO	
Filter Size (in microns)											
Sample ID		BOBYL2		BOBYL3		BOBYL4		BOBYL6		BOBYL8	
Parameter	Units	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q
Alkalinity	MG/L							190.000	B	130.000	B
Bromide											
Chloride											
Fluoride											
Nitrate											
Nitrite											
Phosphate											
Sulfate											
Coliform Bacteria	C/DL							1.000	U	1.000	U
Total Dissolved Solids											
Total Organic Carbon	UG/L	2000.000		2000.000		2000.000		320.000	U	320.000	U
Total organic halides	UG/L	46.500		44.800		45.500		11.200		5.000	U
Specific conductance	UMHO/CM	302.000		302.000		302.000		387.000		470.000	
Ammonium ion											
PH	STD.UNIT	7.250		7.210		7.200		7.900		7.900	

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GENERAL CHEMISTRY Analysis Results

Program		RCRA		RCRA	
Well ID		399-2-1		399-3-10	
Round		7		7	
Date		6-23-94		6-23-94	
Sample Type		SAMPLE		SAMPLE	
Lab ID		DATA CHEM		DATA CHEM	
Filtered		NO		NO	
Filter Size (in microns)					
Sample ID		BOBYM0		BOBYM2	
Parameter	Units	Conc.	Q	Conc.	Q
Alkalinity	MG/L	70.000		90.000	
Bromide					
Chloride					
Fluoride					
Nitrate					
Nitrite					
Phosphate					
Sulfate					
Coliform Bacteria	C/DL	1.000	U	1.000	U
Total Dissolved Solids					
Total Organic Carbon	UG/L	500.000	L	500.000	L
Total organic halides	UG/L	8.100			
Specific conductance	UMHO/CM	250.000		364.000	
Ammonium ion					
PH	STD.UNIT	7.350		7.300	

HERBICIDES ORGANIC Analysis Results

Program		RCRA		RCRA		RCRA		RCRA		RCRA	
Well ID		399-1-10A		399-1-11		399-1-12		399-1-14A		399-1-16A	
Round		5		5		5		5		5	
Date		2-12-93		2-12-93		2-12-93		2-12-93		2-16-93	
Sample Type		SAMPLE		SAMPLE		SAMPLE		SAMPLE		SAMPLE	
Lab ID		DATA CHEM		DATA CHEM		DATA CHEM		DATA CHEM		DATA CHEM	
Filtered		NO		NO		NO		NO		NO	
Filter Size (in microns)											
Sample ID		B085D8		B085F0		B085F2		B085F4		B085F6	
Parameter	Units	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q
2,4,5-T	UG/L	2.000	U	2.000	U	2.000	U	2.000	U	2.000	U
2,4,5-TP	UG/L	2.000	U	2.000	U	2.000	U	2.000	U	2.000	U
2,4-Dichlorophenoxyacetic acid	UG/L	10.000	U	10.000	U	10.000	U	10.000	U	10.000	U
2-secButyl-4,6-dinitrophenol(DNBP)	UG/L	5.000	U	5.000	U	5.000	U	5.000	U	5.000	U

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HERBICIDES ORGANIC Analysis Results

Program		RCRA		RCRA		RCRA		RCRA		RCRA	
Well ID		399-1-16B		399-1-17A		399-1-17B		399-1-18A		399-2-1	
Round		5		5		5		5		5	
Date		2-18-93		5-14-93		2-18-93		2-12-93		2-16-93	
Sample Type		SAMPLE		SAMPLE		SAMPLE		SAMPLE		SAMPLE	
Lab ID		DATA CHEM		DATA CHEM		DATA CHEM		DATA CHEM		DATA CHEM	
Filtered		NO		NO		NO		NO		NO	
Filter Size (in microns)											
Sample ID		B085G0		B08JD0		B085G2		B085G6		B085G8	
Parameter	Units	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q
2,4,5-T	UG/L	2.000	U	2.000	U	2.000	U	2.000	U	2.000	U
2,4,5-TP	UG/L	2.000	U	2.000	U	2.000	U	2.000	U	2.000	U
2,4-Dichlorophenoxyacetic acid	UG/L	10.000	U	10.000	U	10.000	U	10.000	U	10.000	U
2-secButyl-4,6-dinitrophenol(DNBP)	UG/L	5.000	U	5.000	U	5.000	U	5.000	U	5.000	U

HERBICIDES ORGANIC Analysis Results

Program		RCRA		RCRA		RCRA		RCRA		RCRA	
Well ID		399-3-10		399-1-10A		399-1-11		399-1-12		399-1-14A	
Round		5		6		6		6		6	
Date		2-16-93		9-14-93		9-14-93		9-14-93		9-14-93	
Sample Type		SAMPLE		SAMPLE		SAMPLE		SAMPLE		SAMPLE	
Lab ID		DATA CHEM		DATA CHEM		DATA CHEM		DATA CHEM		DATA CHEM	
Filtered		NO		NO		NO		NO		NO	
Filter Size (in microns)											
Sample ID		B085H0		B09641		B09643		B09645		B09647	
Parameter	Units	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q
2,4,5-T	UG/L	2.000	U	0.384	U	0.380	L	0.384	U	0.384	U
2,4,5-TP	UG/L	2.000	U	0.408	U	0.360	L	0.408	U	0.408	U
2,4-Dichlorophenoxyacetic acid	UG/L	10.000	U	0.186	U	0.910	L	0.186	U	0.186	U
2-secButyl-4,6-dinitrophenol(DNBP)	UG/L	5.000	U	2.000	U	2.000	U	2.000	U	2.000	U

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HERBICIDES ORGANIC Analysis Results

Program		RCRA		RCRA		RCRA		RCRA		RCRA	
Well ID		399-1-16A		399-1-16B		399-1-17A		399-1-17B		399-1-18A	
Round		6		6		6		6		6	
Date		9-29-93		9-29-93		9-3-93		9-7-93		9-7-93	
Sample Type		SAMPLE		SAMPLE		SAMPLE		SAMPLE		SAMPLE	
Lab ID		DATA CHEM		DATA CHEM		DATA CHEM		DATA CHEM		DATA CHEM	
Filtered		NO		NO		NO		NO		NO	
Filter Size (in microns)											
Sample ID		B09649		B09651		B09653		B09655		B09657	
Parameter	Units	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q
2,4,5-T	UG/L	0.384	U	0.384	U	0.384	U	0.384	U	0.384	U
2,4,5-TP	UG/L	0.408	U	0.408	U	0.408	U	0.408	U	0.408	U
2,4-Dichlorophenoxyacetic acid	UG/L	0.186	U	0.186	U	0.186	U	0.186	U	0.186	U
2-secButyl-4,6-dinitrophenol(DNBP)	UG/L	1.350	U	1.350	U	1.350	U	1.350	U	1.350	U

HERBICIDES ORGANIC Analysis Results

Program		RCRA		RCRA		RCRA		RCRA		RCRA	
Well ID		399-2-1		399-3-10		399-1-10A		399-1-11		399-1-12	
Round		6		6		7		7		7	
Date		9-16-93		9-3-93		6-23-94		6-22-94		6-22-94	
Sample Type		SAMPLE		SAMPLE		SAMPLE		SAMPLE		SAMPLE	
Lab ID		DATA CHEM		DATA CHEM		DATA CHEM		DATA CHEM		DATA CHEM	
Filtered		NO		NO		NO		NO		NO	
Filter Size (in microns)											
Sample ID		B09663		B09659		B0BYJ9		B0BYK1		B0BYK3	
Parameter	Units	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q
2,4,5-T	UG/L	0.384	U	0.384	U	0.018	U	0.018	U	0.018	U
2,4,5-TP	UG/L	0.408	U	0.408	U	0.015	U	0.015	U	0.015	U
2,4-Dichlorophenoxyacetic acid	UG/L	0.186	U	0.186	U	0.052	U	0.052	U	0.052	U
2-secButyl-4,6-dinitrophenol(DNBP)	UG/L	2.000	U	1.350	U	0.240	U	1.700	U	1.700	U

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HERBICIDES ORGANIC Analysis Results

Program		RCRA		RCRA		RCRA		RCRA		RCRA	
Well ID		399-1-14A		399-1-16A		399-1-16B		399-1-17A		399-1-17B	
Round		7		7		7		7		7	
Date		6-22-94		6-23-94		6-22-94		6-22-94		6-22-94	
Sample Type		SAMPLE		SAMPLE		SAMPLE		SAMPLE		SAMPLE	
Lab ID		DATA CHEM		DATA CHEM		DATA CHEM		DATA CHEM		DATA CHEM	
Filtered		NO		NO		NO		NO		NO	
Filter Size (in microns)											
Sample ID		BOBYK5		BOBYK7		BOBYK9		BOBYL1		BOBYL6	
Parameter	Units	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q
2,4,5-T	UG/L	0.018	U	0.018	U	0.018	U	0.018	U	0.018	U
2,4,5-TP	UG/L	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U
2,4-Dichlorophenoxyacetic acid	UG/L	0.052	U	0.052	U	0.052	U	0.680	L	0.052	U
2-secButyl-4,6-dinitrophenol(DNBP)	UG/L	1.700	U	0.240	U	1.700	U	1.700	U	1.700	U

HERBICIDES ORGANIC Analysis Results

Program		RCRA		RCRA		RCRA	
Well ID		399-1-18A		399-2-1		399-3-10	
Round		7		7		7	
Date		6-22-94		6-23-94		6-23-94	
Sample Type		SAMPLE		SAMPLE		SAMPLE	
Lab ID		DATA CHEM		DATA CHEM		DATA CHEM	
Filtered		NO		NO		NO	
Filter Size (in microns)							
Sample ID		BOBYL8		BOBYM0		BOBYM2	
Parameter	Units	Conc.	Q	Conc.	Q	Conc.	Q
2,4,5-T	UG/L	0.018	U	0.018	U	0.018	U
2,4,5-TP	UG/L	0.015	U	0.015	U	0.015	U
2,4-Dichlorophenoxyacetic acid	UG/L	0.052	U	0.052	U	0.052	U
2-secButyl-4,6-dinitrophenol(DNBP)	UG/L	1.700	U	0.240	U	0.240	U

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METALS Analysis Results

Program		RCRA		RCRA		RCRA		RCRA		RCRA	
Well ID		399-1-10A		399-1-10A		399-1-10B		399-1-11		399-1-11	
Round		5		5		5		5		5	
Date		2-12-93		2-12-93		2-16-93		2-12-93		2-12-93	
Sample Type		SAMPLE		SAMPLE		SAMPLE		SAMPLE		SAMPLE	
Lab ID		DATA CHEM		DATA CHEM		DATA CHEM		DATA CHEM		DATA CHEM	
Filtered		NO		YES		YES		NO		YES	
Filter Size (in microns)											
Sample ID		B085D8		B085D9		B085D3		B085F0		B085F1	
Parameter	Units	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q
Aluminum											
Antimony	UG/L	200.000	U	200.000	U			200.000	U	200.000	U
Arsenic	UG/L	5.000	U	5.000	U			5.000	U	5.000	U
Barium	UG/L	60.000		60.000		50.000		40.000		40.000	
Beryllium	UG/L	3.000	U	3.000	U			3.000	U	3.000	U
Cadmium	UG/L	10.000	U	10.000	U			10.000	U	10.000	U
Calcium	UG/L	50000.000		55000.000		16000.000		51000.000		47000.000	
Chromium	UG/L	20.000	U	20.000	U			20.000	U	20.000	U
Cobalt	UG/L	20.000	U	20.000	U			20.000	U	20.000	U
Copper	UG/L	20.000	U	20.000	U			20.000	U	20.000	U
Iron	UG/L	20.000	U	20.000	U	200.000		20.000	U	20.000	U
Lead	UG/L	5.000	U	5.000	U			5.000	U	5.000	U
Magnesium	UG/L	10000.000		11000.000		6100.000		11000.000		9900.000	
Manganese	UG/L	10.000	U	10.000	U	170.000		10.000	U	10.000	U
Mercury	UG/L	0.200	U	0.200	U			0.200	U	0.200	U
Nickel	UG/L	30.000	U	30.000	U			30.000	U	30.000	U
Potassium	UG/L	3800.000		4100.000		5800.000		3200.000		3200.000	
Selenium	UG/L	10.000	U	10.000	U			10.000	U	10.000	U
Silver	UG/L	20.000	U	20.000	U			20.000	U	20.000	U
Sodium	UG/L	22000.000		23000.000		45000.000		24000.000		22000.000	
Tin	UG/L	100.000	U	100.000	U			100.000	U	100.000	U
Vanadium	UG/L	30.000	U	30.000	U			30.000	U	30.000	U
Zinc	UG/L	10.000	U	10.000	U			10.000	U	10.000	U

METALS & Analysis Results

Program		RCRA		RCRA		RCRA		RCRA		RCRA	
Well ID		399-1-12		399-1-12		399-1-14A		399-1-14A		399-1-14B	
Round		5		5		5		5		5	
Date		2-12-93		2-12-93		2-12-93		2-12-93		2-16-93	
Sample Type		SAMPLE		SAMPLE		SAMPLE		SAMPLE		SAMPLE	
Lab ID		DATA CHEM		DATA CHEM		DATA CHEM		DATA CHEM		DATA CHEM	
Filtered		NO		YES		NO		YES		YES	
Filter Size (in microns)											
Sample ID		B085F2		B085F3		B085F4		B085F5		B085D5	
Parameter	Units	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q
Aluminum											
Antimony	UG/L	200.000	U	200.000	U	200.000	U	200.000	U		
Arsenic	UG/L	5.000	U	5.000	U	5.000	U	5.000	U		
Barium	UG/L	30.000		40.000		40.000		40.000		60.000	
Beryllium	UG/L	3.000	U	3.000	U	3.000	U	3.000	U		
Cadmium	UG/L	10.000	U	10.000	U	10.000	U	10.000	U		
Calcium	UG/L	30000.000		51000.000		49000.000		50000.000		15000.000	
Chromium	UG/L	20.000	U	20.000	U	20.000	U	20.000	U		
Cobalt	UG/L	20.000	U	20.000	U	20.000	U	20.000	U		
Copper	UG/L	20.000	U	20.000	U	20.000	U	20.000	U		
Iron	UG/L	20.000	U	20.000	U	30.000	U	20.000	U	430.000	
Lead	UG/L	5.000	U	5.000	U	5.000	U	5.000	U		
Magnesium	UG/L	6000.000		11000.000		10000.000		11000.000		5500.000	
Manganese	UG/L	10.000	U	10.000	U	10.000	U	10.000	U	160.000	
Mercury	UG/L	0.200	U	0.200	U	0.200	U	0.200	U		
Nickel	UG/L	30.000	U	40.000		30.000	U	30.000	U		
Potassium	UG/L	2200.000		3500.000		5200.000		4600.000		6600.000	
Selenium	UG/L	10.000	U	10.000	U	10.000	U	10.000	U		
Silver	UG/L	20.000	U	20.000	U	20.000	U	20.000	U		
Sodium	UG/L	14000.000		21000.000		22000.000		23000.000		53000.000	
Tin	UG/L	100.000	U	100.000	U	100.000	U	100.000	U		
Vanadium	UG/L	30.000	U	30.000	U	30.000	U	30.000	U		
Zinc	UG/L	10.000	U	10.000	U	10.000	U	10.000	U		

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METALS Analysis Results

Program		RCRA		RCRA		RCRA		RCRA		RCRA	
Well ID		399-1-16A		399-1-16A		399-1-16B		399-1-16B		399-1-17A	
Round		5		5		5		5		5	
Date		2-16-93		2-16-93		2-18-93		2-18-93		5-14-93	
Sample Type		SAMPLE		SAMPLE		SAMPLE		SAMPLE		SAMPLE	
Lab ID		DATA CHEM		DATA CHEM		DATA CHEM		DATA CHEM		DATA CHEM	
Filtered		NO		YES		NO		YES		NO	
Filter Size (in microns)											
Sample ID		B085F6		B085F7		B085G0		B085G1		B08JD0	
Parameter	Units	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q
Aluminum	UG/L									61.000	L
Antimony	UG/L	200.000	U	200.000	U	200.000	U	200.000	U	200.000	U
Arsenic	UG/L	5.000	U	5.000	U	5.000	U	5.000	U	5.000	U
Barium	UG/L	60.000		60.000		50.000		50.000		17.000	L
Beryllium	UG/L	3.000	U	3.000	U	3.000	U	3.000	U	3.000	U
Cadmium	UG/L	10.000	U	10.000	U	10.000	U	10.000	U	10.000	U
Calcium	UG/L	52000.000		52000.000		17000.000		17000.000		18000.000	
Chromium	UG/L	70.000		20.000	U	40.000		20.000	U	20.000	U
Cobalt	UG/L	20.000	U	20.000	U	20.000	U	20.000	U	20.000	U
Copper	UG/L	20.000	U	20.000	U	20.000	U	20.000	U	20.000	U
Iron	UG/L	300.000		20.000	U	310.000		130.000		50.000	U
Lead	UG/L	5.000	U	5.000	U	5.000	U	5.000	U	5.000	U
Magnesium	UG/L	9600.000		9700.000		5800.000		5800.000		4000.000	
Manganese	UG/L	20.000		10.000	U	80.000		70.000		20.000	
Mercury	UG/L	0.200	U	0.200	U	0.200	U	0.200	U	0.200	U
Nickel	UG/L	170.000		140.000		40.000		30.000	U	30.000	U
Potassium	UG/L	4000.000		3600.000		5200.000		5800.000		2400.000	
Selenium	UG/L	10.000	U	10.000	U	10.000	U	10.000	U	10.000	U
Silver	UG/L	20.000	U	20.000	U	20.000	U	20.000	U	20.000	U
Sodium	UG/L	19000.000		20000.000		46000.000		46000.000		16000.000	
Tin	UG/L	100.000	U	100.000	U	100.000	U	100.000	U		
Vanadium	UG/L	30.000	U	30.000	U	30.000	U	30.000	U	8.400	L
Zinc	UG/L	10.000	U	10.000	U	10.000		10.000	U	9.400	L

METALS Analysis Results

Program		RCRA		RCRA		RCRA		RCRA		RCRA	
Well ID		399-1-17A		399-1-17B		399-1-17B		399-1-18A		399-1-18A	
Round		5		5		5		5		5	
Date		5-14-93		2-18-93		2-18-93		2-12-93		2-12-93	
Sample Type		SAMPLE		SAMPLE		SAMPLE		SAMPLE		SAMPLE	
Lab ID		DATA CHEM		DATA CHEM		DATA CHEM		DATA CHEM		DATA CHEM	
Filtered		YES		NO		YES		NO		YES	
Filter Size (in microns)											
Sample ID		B08JD1		B085G2		B085G4		B085G6		B085G7	
Parameter	Units	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q
Aluminum	UG/L	66.000	L								
Antimony	UG/L	200.000	U	200.000	U	200.000	U	200.000	U	200.000	U
Arsenic	UG/L	5.000	U	5.000	U	5.000	U	5.200		5.200	
Barium	UG/L	17.000	L	70.000		70.000		50.000		50.000	
Beryllium	UG/L	3.000	U	3.000	U	3.000	U	5.000		3.000	U
Cadmium	UG/L	10.000	U	10.000	U	10.000	U	10.000	U	10.000	U
Calcium	UG/L	18000.000		19000.000		19000.000		46000.000		46000.000	
Chromium	UG/L	20.000	U	50.000		20.000	U	20.000	U	20.000	U
Cobalt	UG/L	20.000	U	20.000	U	20.000	U	20.000	U	20.000	U
Copper	UG/L	20.000	U	20.000	U	20.000	U	20.000	U	20.000	U
Iron	UG/L	20.000	U	610.000		320.000		110.000		20.000	U
Lead	UG/L	5.000	U	5.000	U	5.000	U	5.000	U	5.000	U
Magnesium	UG/L	3900.000		6800.000		6800.000		13000.000		13000.000	
Manganese	UG/L	10.000		80.000		80.000		10.000	U	10.000	U
Mercury	UG/L	0.200	U	0.200	U	0.200	U	0.200	U	0.200	U
Nickel	UG/L	30.000	U	50.000		30.000	U	30.000	U	30.000	U
Potassium	UG/L	2400.000	U	6700.000		6100.000		6600.000		6800.000	
Selenium	UG/L	1.000	L	10.000	U	10.000	U	10.000	U	10.000	U
Silver	UG/L	20.000	U	20.000	U	20.000	U	20.000	U	20.000	U
Sodium	UG/L	16000.000		50000.000		50000.000		24000.000		24000.000	
Tin	UG/L			100.000	U	100.000	U	100.000	U	100.000	U
Vanadium	UG/L	6.000	L	30.000	U	30.000	U	30.000	U	30.000	U
Zinc	UG/L	8.100	L	10.000	U	10.000	U	10.000	U	10.000	U

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METALS Analysis Results

Program		RCRA		RCRA		RCRA		RCRA		RCRA	
Well ID		399-2-1		399-2-1		399-3-10		399-3-10		399-1-10A	
Round		5		5		5		5		6	
Date		2-16-93		2-16-93		2-16-93		2-16-93		9-14-93	
Sample Type		SAMPLE		SAMPLE		SAMPLE		SAMPLE		SAMPLE	
Lab ID		DATA CHEM		DATA CHEM		DATA CHEM		DATA CHEM		DATA CHEM	
Filtered		NO		YES		NO		YES		NO	
Filter Size (in microns)											
Sample ID		B085G8		B085G9		B085H0		B085H1		B09641	
Parameter	Units	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q
Aluminum	UG/L									32.500	U
Antimony	UG/L	200.000	U	200.000	U	200.000	U	200.000	U	69.400	U
Arsenic	UG/L	5.000	U	5.000	U	5.000	U	5.000	U	1.380	U
Barium	UG/L	70.000		70.000		50.000		50.000		51.000	
Beryllium	UG/L	3.000	U	3.000	U	3.000	U	3.000	U	0.814	U
Cadmium	UG/L	10.000	U	10.000	U	10.000	U	10.000	U	4.700	U
Calcium	UG/L	39000.000		39000.000		34000.000		34000.000		45000.000	
Chromium	UG/L	20.000	U	20.000	U	20.000	U	20.000	U	40.000	
Cobalt	UG/L	20.000	U	20.000	U	20.000	U	20.000	U	4.050	U
Copper	UG/L	20.000	U	20.000	U	20.000	U	20.000	U	2.650	U
Iron	UG/L	130.000		60.000		330.000		140.000		220.000	
Lead	UG/L	5.000	U	5.000	U	5.000	U	5.000	U	2.000	U
Magnesium	UG/L	7700.000		7700.000		7400.000		7500.000		9800.000	
Manganese	UG/L	10.000	U	10.000	U	10.000	U	10.000	U	1.350	U
Mercury	UG/L	0.200	U	0.200	U	0.200	U	0.200	U	0.158	U
Nickel	UG/L	30.000	U	30.000	U	30.000	U	30.000	U	17.900	U
Potassium	UG/L	3700.000		4300.000		4200.000		4200.000		3300.000	
Selenium	UG/L	10.000	U	10.000	U	10.000	U	10.000	U	2.000	L
Silver	UG/L	20.000	U	20.000	U	20.000	U	20.000	U	2.870	U
Sodium	UG/L	18000.000		17000.000		13000.000		13000.000		20000.000	
Tin	UG/L	100.000	U	100.000	U	100.000	U	100.000	U	51.100	U
Vanadium	UG/L	30.000	U	30.000	U	30.000	U	30.000	U	3.840	U
Zinc	UG/L	10.000	U	20.000		10.000	U	10.000	U	24.000	

METALS Analysis Results

Program		RCRA		RCRA		RCRA		RCRA		RCRA	
Well ID		399-1-10A		399-1-11		399-1-11		399-1-12		399-1-12	
Round		6		6		6		6		6	
Date		9-14-93		9-14-93		9-14-93		9-14-93		9-14-93	
Sample Type		SAMPLE		SAMPLE		SAMPLE		SAMPLE		SAMPLE	
Lab ID		DATA CHEM		DATA CHEM		DATA CHEM		DATA CHEM		DATA CHEM	
Filtered		YES		NO		YES		NO		YES	
Filter Size (in microns)											
Sample ID		B09642		B09643		B09644		B09645		B09646	
Parameter	Units	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q
Aluminum	UG/L	32.500	U	32.500	U	32.500	U	32.500	U	32.500	U
Antimony	UG/L	69.400	U	69.400	U	69.400	U	69.400	U	69.400	U
Arsenic	UG/L	1.380	U	2.000	L	2.600	L	1.380	U	2.000	L
Barium	UG/L	50.000		38.000		38.000		38.000		38.000	
Beryllium	UG/L	0.814	U	0.814	U	0.814	U	0.814	U	0.814	U
Cadmium	UG/L	4.700	U	4.700	U	4.700	U	4.700	U	4.700	U
Calcium	UG/L	46000.000		46000.000		46000.000		46000.000		45000.000	
Chromium	UG/L	5.420	U	5.420	U	5.420	U	33.000		5.420	U
Cobalt	UG/L	4.050	U	4.050	U	4.050	U	4.050	U	4.050	U
Copper	UG/L	2.650	U	2.650	U	2.650	U	2.650	U	2.650	U
Iron	UG/L	10.300	U	150.000		32.000		130.000		25.000	
Lead	UG/L	0.600	L	0.670	L	2.000	U	0.650	L	0.720	L
Magnesium	UG/L	9800.000		10000.000		10000.000		9800.000		9700.000	
Manganese	UG/L	1.350	U	1.350	U	1.350	U	1.350	U	1.350	U
Mercury	UG/L	0.158	U	0.158	U	0.158	U	0.158	U	0.158	U
Nickel	UG/L	17.900	U	17.900	U	17.900	U	44.000		51.000	
Potassium	UG/L	3700.000		3600.000		3400.000		3700.000		3000.000	
Selenium	UG/L	1.210	U	1.210	U	1.210	U	1.210	U	1.210	U
Silver	UG/L	2.870	U	2.870	U	2.870	U	2.870	U	2.870	U
Sodium	UG/L	20000.000		21000.000		21000.000		20000.000		20000.000	
Tin	UG/L	51.100	U	51.100	U	51.100	U	51.100	U	51.100	U
Vanadium	UG/L	3.840	U	3.840	U	3.840	U	3.840	U	3.840	U
Zinc	UG/L	3.440	U	3.440	U	3.440	U	3.440	U	3.440	U

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METALS Analysis Results

Program		RCRA		RCRA		RCRA		RCRA		RCRA	
Well ID		399-1-14A		399-1-14A		399-1-16A		399-1-16A		399-1-16B	
Round		6		6		6		6		6	
Date		9-14-93		9-14-93		9-29-93		9-29-93		9-29-93	
Sample Type		SAMPLE		SAMPLE		SAMPLE		SAMPLE		SAMPLE	
Lab ID		DATA CHEM		DATA CHEM		DATA CHEM		DATA CHEM		DATA CHEM	
Filtered		NO		YES		NO		YES		NO	
Filter Size (in microns)											
Sample ID		B09647		B09648		B09649		B09650		B09651	
Parameter	Units	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q
Aluminum	UG/L	32.500	U	32.500	U	32.500	U	32.500	U	32.500	U
Antimony	UG/L	69.400	U	69.400	U	69.400	U	69.400	U	69.400	U
Arsenic	UG/L	5.300		4.500	L	3.100	L	2.700	L	1.380	U
Barium	UG/L	40.000		40.000		56.000		55.000		48.000	
Beryllium	UG/L	0.814	U	0.814	U	0.814	U	0.814	U	0.814	U
Cadmium	UG/L	4.700	U	4.700	U	4.700	U	4.700	U	4.700	U
Calcium	UG/L	45000.000		45000.000		45000.000		44000.000		17000.000	
Chromium	UG/L	5.420	U	5.420	U	9.500	L	5.420	U	62.000	
Cobalt	UG/L	4.050	U	4.050	U	4.050	U	4.050	U	4.050	U
Copper	UG/L	2.650	U	2.650	U	2.650	U	2.650	U	2.650	U
Iron	UG/L	150.000		10.300	U	71.000		29.000		340.000	
Lead	UG/L	1.100	L	2.000	U	1.200	BL	0.508	U	0.700	BL
Magnesium	UG/L	10000.000		10000.000		8800.000		8600.000		5800.000	
Manganese	UG/L	1.350	U	1.350	U	5.200	L	5.200	L	79.000	
Mercury	UG/L	0.158	U	0.158	U	0.158	U	0.158	U	0.158	U
Nickel	UG/L	17.900	U	17.900	U	94.000		87.000		29.000	L
Potassium	UG/L	5600.000		5200.000		2300.000		2500.000		3600.000	
Selenium	UG/L	1.210	U	1.210	U	3.400	L	2.200	L	2.000	L
Silver	UG/L	2.870	U	2.870	U	2.870	U	2.870	U	2.870	U
Sodium	UG/L	22000.000		22000.000		19000.000		19000.000		45000.000	
Tin	UG/L	51.100	U	51.100	U	51.100	U	51.100	U	51.100	U
Vanadium	UG/L	3.840	U	3.840	U	3.840	U	3.840	U	3.840	U
Zinc	UG/L	3.440	U	3.440	U	7.300	L	5.300	L	6.200	L

METALS Analysis Results

Program		RCRA		RCRA		RCRA		RCRA		RCRA	
Well ID		399-1-16B		399-1-17A		399-1-17A		399-1-17B		399-1-17B	
Round		6		6		6		6		6	
Date		9-29-93		9-3-93		9-3-93		9-7-93		9-7-93	
Sample Type		SAMPLE		SAMPLE		SAMPLE		SAMPLE		SAMPLE	
Lab ID		DATA CHEM		DATA CHEM		DATA CHEM		DATA CHEM		DATA CHEM	
Filtered		YES		NO		YES		NO		YES	
Filter Size (in microns)											
Sample ID		B09652		B09653		B09654		B09655		B09656	
Parameter	Units	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q
Aluminum	UG/L	32.500	U	39.000	L	34.000	L	32.500	U	32.500	U
Antimony	UG/L	69.400	U	69.400	U	69.400	U	69.400	U	69.400	U
Arsenic	UG/L	1.380	U	1.380	U	1.380	U	1.380	U	1.380	U
Barium	UG/L	49.000		15.000	L	15.000	L	66.000		67.000	
Beryllium	UG/L	0.814	U	1.000	L	0.814	U	0.814	U	0.814	U
Cadmium	UG/L	4.700	U	4.700	U	4.700	U	4.700	U	4.700	U
Calcium	UG/L	17000.000		18000.000		18000.000		19000.000		19000.000	
Chromium	UG/L	5.420	U	45.000		5.420	U	76.000		5.420	U
Cobalt	UG/L	4.050	U	4.050	U	5.800	L	4.050	U	4.050	U
Copper	UG/L	2.650	U	2.650	U	2.650	U	2.650	U	2.650	U
Iron	UG/L	86.000		210.000		12.000	L	730.000		440.000	
Lead	UG/L	2.200	BL	0.508	U	0.860	L	0.800	LB	0.890	LB
Magnesium	UG/L	5700.000		3400.000		3400.000		6900.000		6900.000	
Manganese	UG/L	74.000		6.000	L	1.350	U	87.000		82.000	
Mercury	UG/L	0.158	U	0.158	U	0.158	U	0.158	U	0.158	U
Nickel	UG/L	17.900	U	26.000	L	17.900	U	32.000		17.900	U
Potassium	UG/L	3500.000		860.000	L	1900.000		6400.000		5800.000	
Selenium	UG/L	1.210	U	1.210	U	1.210	U	1.210	U	1.210	U
Silver	UG/L	2.870	U	2.870	U	3.600	L	2.870	U	2.870	U
Sodium	UG/L	45000.000		11000.000		11000.000		49000.000		49000.000	
Tin	UG/L	51.100	U	51.100	U	51.100	U	51.100	U	51.100	U
Vanadium	UG/L	3.840	U	3.840	U	3.840	U	3.840	U	3.840	U
Zinc	UG/L	3.500	L	4.400	L	3.440	U	3.440	U	3.440	U

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METALS Analysis Results

Program		RCRA		RCRA		SURV		RCRA		RCRA	
Well ID		399-1-18A		399-1-18A		399-1-21A		399-2-1		399-2-1	
Round		6		6		6		6		6	
Date		9-7-93		9-7-93		9-14-93		9-16-93		9-16-93	
Sample Type		SAMPLE		SAMPLE		SAMPLE		SAMPLE		SAMPLE	
Lab ID		DATA CHEM		DATA CHEM		DATA CHEM		DATA CHEM		DATA CHEM	
Filtered		NO		YES		YES		NO		YES	
Filter Size (in microns)											
Sample ID		B09657		B09658		B08ZV3		B09663		B09664	
Parameter	Units	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q
Aluminum	UG/L	32.500	U	32.500	U			32.500	U	32.500	U
Antimony	UG/L	69.400	U	69.400	U			69.400	U	69.400	U
Arsenic	UG/L	6.700		6.200				1.000	U	1.000	U
Barium	UG/L	47.000		46.000		41.000		65.000		64.000	
Beryllium	UG/L	0.814	U	0.814	U			0.814	U	0.814	U
Cadmium	UG/L	4.700	U	4.700	U			4.700	U	4.700	U
Calcium	UG/L	46000.000		46000.000		42000.000		37000.000		36000.000	
Chromium	UG/L	81.000		5.420	U			5.420	U	5.420	U
Cobalt	UG/L	4.050	U	4.050	U			4.050	U	4.050	U
Copper	UG/L	2.650	U	2.650	U			5.600	L	4.500	L
Iron	UG/L	560.000		10.300	U			210.000		74.000	
Lead	UG/L	10.000	B	0.508	U			1.100	L	0.600	L
Magnesium	UG/L	13000.000		13000.000		8800.000		7000.000		6900.000	
Manganese	UG/L	11.000		1.350	U			2.800	L	1.350	U
Mercury	UG/L	0.158	U	0.158	U			0.158	U	0.158	U
Nickel	UG/L	48.000		17.900	U			17.900	U	17.900	U
Potassium	UG/L	6200.000		6400.000		4900.000		3100.000		3300.000	
Selenium	UG/L	2.500	L	2.400	L			2.000	L	2.000	L
Silver	UG/L	2.870	U	2.870	U			2.870	U	2.870	U
Sodium	UG/L	23000.000		23000.000		21000.000		19000.000		19000.000	
Tin	UG/L	51.100	U	51.100	U			51.100	U	51.100	U
Vanadium	UG/L	3.840	U	3.840	U			3.840	U	3.840	U
Zinc	UG/L	100.000		3.440	U			25.000		22.000	

METALS Analysis Results

Program		RCRA		RCRA		CERCLA		CERCLA		CERCLA	
Well ID		399-3-10		399-3-10		399-1-5		399-1-5		399-1-7	
Round		6		6		7		7		7	
Date		9-3-93		9-3-93		6-24-94		6-24-94		6-23-94	
Sample Type		SAMPLE		SAMPLE		SAMPLE		SAMPLE		SAMPLE	
Lab ID		DATA CHEM		DATA CHEM		IT		IT		IT	
Filtered		NO		YES		NO		YES		NO	
Filter Size (in microns)											
Sample ID		B09659		B09661		B0BZJ2		B0BZJ3		B0BZJ8	
Parameter	Units	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q
Aluminum	UG/L	32.500	U	35.000	L	19.000	UJ	19.000	UJ	34.500	U
Antimony	UG/L	69.400	U	69.400	U	19.500	UJ	19.500	UJ	30.500	U
Arsenic	UG/L	1.380	U	1.380	U						
Barium	UG/L	52.000		53.000		38.800	B	39.300	B	26.300	B
Beryllium	UG/L	0.814	U	0.814	U	0.800	U	0.800	U	0.400	U
Cadmium	UG/L	4.700	U	4.700	U	1.800	UJ	1.800	UJ	2.200	U
Calcium	UG/L	39000.000		40000.000		52600.000		55500.000		32200.000	
Chromium	UG/L	6.400	L	5.420	U	2.900	U	2.800	UJ	3.000	UJ
Cobalt	UG/L	4.050	U	4.100	L	2.900	UJ	2.900	UJ	3.200	UJ
Copper	UG/L	4.200	L	2.650	U	4.500	UJ	4.500	UJ	2.100	UJ
Iron	UG/L	300.000		83.000		34.200	U	106.000		22.900	U
Lead	UG/L	0.508	U	0.508	U						
Magnesium	UG/L	7500.000		7500.000		11000.000		11100.000		6240.000	
Manganese	UG/L	9.400	L	7.700	L	1.400	UJ	1.200	BJ	0.600	UJ
Mercury	UG/L	0.158	U	0.158	U						
Nickel	UG/L	17.900	U	17.900	U	4.900	UJ	4.900	UJ	11.400	U
Potassium	UG/L	4000.000		3900.000		3040.000	B	3120.000	B	2900.000	B
Selenium	UG/L	1.210	U	1.210	U						
Silver	UG/L	3.000	L	3.800	L	4.200	UJ	4.200	UJ	3.000	UJ
Sodium	UG/L	14000.000		14000.000		23300.000		24000.000		31600.000	
Tin	UG/L	51.100	U	51.100	U						
Vanadium	UG/L	6.000	L	3.840	U	9.800	UJ	9.800	UJ	1.900	UJ
Zinc	UG/L	3.440	U	3.440	U	4.000	U	8.500	U	3.800	U

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METALS Analysis Results

Program		CERCLA		RCRA		RCRA		RCRA		RCRA	
Well ID		399-1-7		399-1-10A		399-1-10A		399-1-11		399-1-11	
Round		7		7		7		7		7	
Date		6-23-94		6-23-94		6-23-94		6-22-94		6-22-94	
Sample Type		SAMPLE		SAMPLE		SAMPLE		SAMPLE		SAMPLE	
Lab ID		IT		DATA CHEM		DATA CHEM		DATA CHEM		DATA CHEM	
Filtered		YES		NO		YES		NO		YES	
Filter Size (in microns)											
Sample ID		B0BZJ9		B0BYJ9		B0BYK0		B0BYK1		B0BYK2	
Parameter	Units	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q
Aluminum	UG/L	34.500	U	25.000	U	19.000	U	19.000	U	19.000	U
Antimony	UG/L	30.500	U	26.000	U	26.000	U	26.000	U	26.000	U
Arsenic	UG/L			2.000	L	2.100	L	3.100	L	3.000	L
Barium	UG/L	27.400	B	52.000		49.000		39.000		41.000	
Beryllium	UG/L	0.400	U	1.500	U	1.500	U	1.500	U	1.500	U
Cadmium	UG/L	2.200	U	3.000	U	3.000	U	3.000	U	3.000	U
Calcium	UG/L	32700.000		45000.000		43000.000		48000.000		49000.000	
Chromium	UG/L	3.000	UJ	60.000		11.000	U	48.000		11.000	U
Cobalt	UG/L	3.200	UJ	6.500	U	6.500	U	6.500	U	6.500	U
Copper	UG/L	2.100	UJ	3.600	U	2.600	U	2.600	U	2.600	U
Iron	UG/L	24.900	U	290.000		29.000		220.000		26.000	
Lead	UG/L			1.700	BL	2.200	BL	2.900	L	1.900	L
Magnesium	UG/L	6340.000		9300.000		9000.000		10000.000	B	11000.000	B
Manganese	UG/L	0.600	UJ	6.400	L	1.000	U	3.000	L	1.200	L
Mercury	UG/L			0.095	U	0.095	U	0.095	U	0.095	U
Nickel	UG/L	11.400	U	29.000	L	16.000	U	18.000	L	16.000	U
Potassium	UG/L	2890.000	B	3600.000		4000.000		2900.000		2800.000	
Selenium	UG/L			2.000	L	2.200	L	2.400	L	2.400	L
Silver	UG/L	3.000	UJ	3.400	U	3.400	U	3.400	U	3.400	U
Sodium	UG/L	31900.000		20000.000		20000.000		21000.000		21000.000	
Tin	UG/L			24.000	U	33.000	L	24.000	U	24.000	U
Vanadium	UG/L	1.900	UJ	6.400	U	6.400	U	6.400	U	6.400	U
Zinc	UG/L	3.800	U	4.400	U	4.400	U	4.400	U	4.400	U

METALS Analysis Results

Program		RCRA		RCRA		RCRA		RCRA		RCRA	
Well ID		399-1-12		399-1-12		399-1-14A		399-1-14A		399-1-16A	
Round		7		7		7		7		7	
Date		6-22-94		6-22-94		6-22-94		6-22-94		6-23-94	
Sample Type		SAMPLE		SAMPLE		SAMPLE		SAMPLE		SAMPLE	
Lab ID		DATA CHEM		DATA CHEM		DATA CHEM		DATA CHEM		DATA CHEM	
Filtered		NO		YES		NO		YES		NO	
Filter Size (in microns)											
Sample ID		BOBYK3		BOBYK4		BOBYK5		BOBYK6		BOBYK7	
Parameter	Units	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q
Aluminum	UG/L	19.000	U	19.000	U	24.000	U	19.000	U	24.000	U
Antimony	UG/L	26.000	U	26.000	U	26.000	U	26.000	U	26.000	U
Arsenic	UG/L	2.500	L	2.400	L	3.600	L	4.300	L	0.640	U
Barium	UG/L	41.000		40.000		43.000		44.000		52.000	
Beryllium	UG/L	1.500	U	1.500	U	1.500	U	1.500	U	1.500	U
Cadmium	UG/L	3.000	U	3.000	U	3.000	U	3.000	U	3.000	U
Calcium	UG/L	50000.000		48000.000		49000.000		50000.000		41000.000	
Chromium	UG/L	84.000		11.000	U	11.000	U	11.000	U	19.000	L
Cobalt	UG/L	6.500	U	6.500	U	6.500	U	6.500	U	6.500	U
Copper	UG/L	3.000	U	2.600	U	2.600	U	2.600	U	2.600	U
Iron	UG/L	330.000		59.000		87.000	U	18.000	U	150.000	
Lead	UG/L	1.100	L	0.770	L	1.300	L	1.300	L	3.200	BL
Magnesium	UG/L	10000.000	B	10000.000	B	11000.000	B	11000.000	B	7900.000	
Manganese	UG/L	6.400	L	1.300	L	1.300	L	1.000	U	3.800	L
Mercury	UG/L	0.095	U	0.095	U	0.095	U	0.095	U	0.095	U
Nickel	UG/L	69.000		41.000		16.000	U	16.000	U	83.000	
Potassium	UG/L	2900.000		2900.000		4800.000		4800.000		3500.000	
Selenium	UG/L	2.200	L	3.000	L	2.200	L	2.400	L	1.400	U
Silver	UG/L	3.400	U	3.400	U	3.400	U	3.400	U	3.400	U
Sodium	UG/L	21000.000		21000.000		22000.000		23000.000		20000.000	
Tin	UG/L	24.000	U	33.000	L	24.000	U	24.000	U	37.000	L
Vanadium	UG/L	6.400	U	6.400	U	8.300	L	9.100	L	6.400	U
Zinc	UG/L	12.000		4.400	U	4.400	U	4.400	U	10.000	

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METALS Analysis Results

Program		RCRA		RCRA		RCRA		CERCLA		CERCLA	
Well ID		399-1-16A		399-1-16B		399-1-16B		399-1-16C		399-1-16C	
Round		7		7		7		7		7	
Date		6-23-94		6-22-94		6-22-94		6-24-94		6-24-94	
Sample Type		SAMPLE		SAMPLE		SAMPLE		SAMPLE		SAMPLE	
Lab ID		DATA CHEM		DATA CHEM		DATA CHEM		IT		IT	
Filtered		YES		NO		YES		NO		YES	
Filter Size (in microns)											
Sample ID		B0BYK8		B0BYK9		B0BYL0		B0BZK0		B0BZK1	
Parameter	Units	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q
Aluminum	UG/L	19.000	U	19.000	U	19.000	U	113.000	UJ	36.200	UJ
Antimony	UG/L	26.000	U	26.000	U	26.000	U	19.500	UJ	19.500	UJ
Arsenic	UG/L	0.640	U	0.640	U	0.640	U				
Barium	UG/L	49.000		48.000		48.000		70.400	B	68.900	B
Beryllium	UG/L	1.500	U	1.500	U	1.500	U	0.600	U	0.800	U
Cadmium	UG/L	3.000	U	3.000	U	3.000	U	1.800	UJ	1.800	UJ
Calcium	UG/L	39000.000		16000.000		17000.000		12400.000		11900.000	
Chromium	UG/L	11.000	U	56.000		11.000	U	5.800	U	2.800	UJ
Cobalt	UG/L	6.500	U	6.500	U	6.500	U	2.900	UJ	2.900	UJ
Copper	UG/L	4.200	U	2.600	U	2.600	U	4.500	UJ	4.500	UJ
Iron	UG/L	27.000		330.000		120.000		271.000		64.800	U
Lead	UG/L	1.000	BL	1.400	L	0.700	L				
Magnesium	UG/L	7600.000		5500.000	B	5600.000	B	4930.000	B	4770.000	B
Manganese	UG/L	3.100	L	77.000		74.000		40.800		35.300	
Mercury	UG/L	0.095	U	0.095	U	0.095	U				
Nickel	UG/L	86.000		23.000	L	16.000	U	4.900	UJ	4.900	UJ
Potassium	UG/L	3800.000		4700.000		5500.000		9890.000		9750.000	
Selenium	UG/L	2.000	L	1.400	U	1.400	U				
Silver	UG/L	3.400	U	3.400	U	3.400	U	4.200	UJ	4.200	UJ
Sodium	UG/L	19000.000		44000.000		45000.000		67800.000		67100.000	
Tin	UG/L	53.000	L	24.000	U	28.000	L				
Vanadium	UG/L	6.400	U	6.400	U	6.400	U	9.800	UJ	9.800	UJ
Zinc	UG/L	10.000		4.800	L	6.500	L	27.200	U	4.500	U

METALS Analysis Results

Program		RCRA		RCRA		RCRA		RCRA		RCRA	
Well ID		399-1-17A		399-1-17A		399-1-17B		399-1-17B		399-1-18A	
Round		7		7		7		7		7	
Date		6-22-94		6-22-94		6-22-94		6-22-94		6-22-94	
Sample Type		SAMPLE		SAMPLE		SAMPLE		SAMPLE		SAMPLE	
Lab ID		DATA CHEM		DATA CHEM		DATA CHEM		DATA CHEM		DATA CHEM	
Filtered		NO		YES		NO		YES		NO	
Filter Size (in microns)											
Sample ID		BOBYL1		BOBYL5		BOBYL6		BOBYL7		BOBYL8	
Parameter	Units	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q
Aluminum	UG/L	19.000	U	19.000	U	19.000	U	19.000	U	24.000	U
Antimony	UG/L	26.000	U	26.000	U	37.000	L	26.000	U	26.000	U
Arsenic	UG/L	0.640	U	0.640	U	0.640	U	0.640	U	5.600	
Barium	UG/L	25.000		25.000		67.000		66.000		46.000	
Beryllium	UG/L	1.500	U	1.500	U	1.500	U	1.500	U	1.500	U
Cadmium	UG/L	3.000	U	3.000	U	3.000	U	3.000	U	3.000	U
Calcium	UG/L	28000.000		29000.000		19000.000		19000.000		46000.000	
Chromium	UG/L	29.000		11.000	U	45.000		11.000	U	120.000	
Cobalt	UG/L	6.500	U	6.500	U	7.600	L	6.500	U	6.500	U
Copper	UG/L	6.600	U	2.600	U	2.600	U	2.600	U	3.600	U
Iron	UG/L	180.000		95.000		600.000		450.000		570.000	
Lead	UG/L	0.860	U	4.100	L	0.940	L	0.860	U	0.600	L
Magnesium	UG/L	6500.000	B	6800.000	B	6900.000	B	6800.000	B	13000.000	B
Manganese	UG/L	170.000		170.000		86.000		83.000		11.000	
Mercury	UG/L	0.095	U	0.095	U	0.095	U	0.095	U	0.095	U
Nickel	UG/L	23.000	L	16.000	U	29.000	L	16.000	U	55.000	
Potassium	UG/L	1400.000		1400.000		6400.000		6000.000		6800.000	
Selenium	UG/L	1.400	U	1.400	U	1.400	U	1.400	U	2.600	L
Silver	UG/L	3.400	U	3.400	U	3.400	U	3.400	U	3.400	U
Sodium	UG/L	18000.000		19000.000		49000.000		49000.000		22000.000	
Tin	UG/L	41.000	L	24.000	U	24.000	U	24.000	U	65.000	L
Vanadium	UG/L	6.400	U	6.400	U	6.400	U	6.400	U	11.000	L
Zinc	UG/L	4.400	U	4.400	U	4.400	U	4.400	U	28.000	

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METALS Analysis Results

Program		RCRA		CERCLA		CERCLA		RCRA		RCRA	
Well ID		399-1-18A		399-1-21A		399-1-21A		399-2-1		399-2-1	
Round		7		7		7		7		7	
Date		6-22-94		6-24-94		6-24-94		6-23-94		6-23-94	
Sample Type		SAMPLE		SAMPLE		SAMPLE		SAMPLE		SAMPLE	
Lab ID		DATA CHEM		IT		IT		DATA CHEM		DATA CHEM	
Filtered		YES		NO		YES		NO		YES	
Filter Size (in microns)											
Sample ID		BOBYL9		BOBZK2		BOBZK3		BOBYM0		BOBYM1	
Parameter	Units	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q
Aluminum	UG/L	19.000	U	19.000	UJ	19.000	UJ	25.000	U	19.000	U
Antimony	UG/L	26.000	U	19.500	UJ	19.500	UJ	26.000	U	26.000	U
Arsenic	UG/L	5.600						2.000	L	0.640	U
Barium	UG/L	46.000		34.700	B	33.700	B	43.000		41.000	
Beryllium	UG/L	1.500	U	0.800	U	0.800	U	1.500	U	1.500	U
Cadmium	UG/L	3.000	U	1.800	UJ	1.800	UJ	3.000	U	3.000	U
Calcium	UG/L	46000.000		40400.000		39700.000		24000.000		24000.000	
Chromium	UG/L	11.000	U	2.800	UJ	2.800	UJ	11.000	U	11.000	U
Cobalt	UG/L	6.500	U	2.900	UJ	2.900	UJ	6.500	U	6.500	U
Copper	UG/L	2.600	U	4.500	UJ	4.500	UJ	7.200	U	3.600	U
Iron	UG/L	30.000		54.600	U	54.600	U	2300.000		36.000	
Lead	UG/L	0.860	U					1.000	BL	1.300	BL
Magnesium	UG/L	13000.000	B	8190.000		8110.000		4800.000		4800.000	
Manganese	UG/L	1.600	L	2.800	U	1.500	U	19.000		1.000	U
Mercury	UG/L	0.095	U					0.095	U	0.095	U
Nickel	UG/L	16.000	U	4.900	UJ	4.900	UJ	16.000	U	16.000	U
Potassium	UG/L	6600.000		4850.000	B	4850.000	B	3700.000		3500.000	
Selenium	UG/L	2.400	L					1.400	U	1.400	U
Silver	UG/L	3.400	U	4.200	UJ	4.200	UJ	3.400	U	3.400	U
Sodium	UG/L	22000.000		22700.000		22600.000		16000.000		16000.000	
Tin	UG/L	49.000	L					24.000	U	24.000	U
Vanadium	UG/L	12.000	L	9.800	UJ	9.800	UJ	6.400	U	6.400	U
Zinc	UG/L	20.000		1.400	UJ	4.600	U	18.000		9.200	L

METALS Analysis Results

Program		CERCLA		CERCLA		CERCLA		CERCLA		RCRA	
Well ID		399-2-2		399-2-2		399-3-2		399-3-2		399-3-10	
Round		7		7		7		7		7	
Date		6-23-94		6-23-94		6-22-94		6-22-94		6-23-94	
Sample Type		SAMPLE		SAMPLE		SAMPLE		SAMPLE		SAMPLE	
Lab ID		IT		IT		IT		IT		DATA CHEM	
Filtered		NO		YES		NO		YES		NO	
Filter Size (in microns)											
Sample ID		B0BZK4		B0BZK5		B0BZK8		B0BZK9		B0BYM2	
Parameter	Units	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q
Aluminum	UG/L	19.000	UJ	19.000	UJ	34.500	U	34.500	U	110.000	U
Antimony	UG/L	19.500	UJ	19.500	UJ	30.500	U	30.500	U	26.000	U
Arsenic	UG/L									0.640	U
Barium	UG/L	44.800	B	43.800	B	42.000	B	40.500	B	67.000	
Beryllium	UG/L	0.800	U	0.800	U	0.470	U	0.460	U	1.500	U
Cadmium	UG/L	1.800	UJ	1.800	UJ	2.200	U	2.200	U	3.000	U
Calcium	UG/L	44400.000		43800.000		49500.000		48100.000		40000.000	
Chromium	UG/L	2.800	UJ	2.800	UJ	4.800	U	4.500	B	21.000	
Cobalt	UG/L	2.900	UJ	2.900	UJ	3.200	U	3.200	U	6.500	U
Copper	UG/L	4.500	UJ	4.500	UJ	8.600	U	6.400	U	9.600	U
Iron	UG/L	43.100	U	10.400	U	542.000		17.800	U	2600.000	
Lead	UG/L									4.700	BL
Magnesium	UG/L	8210.000		8080.000		10500.000		10300.000		8400.000	
Manganese	UG/L	1.500	B	0.970	BJ	5.900	B	2.800	U	36.000	
Mercury	UG/L									0.095	U
Nickel	UG/L	4.900	UJ	4.900	UJ	11.400	U	11.400	U	16.000	U
Potassium	UG/L	3610.000	B	3550.000	B	6210.000		5990.000		3600.000	
Selenium	UG/L									1.400	U
Silver	UG/L	4.200	UJ	6.000	UJ	3.000	U	3.000	U	3.400	U
Sodium	UG/L	2650.000		26100.000		18100.000		17900.000		15000.000	
Tin	UG/L									24.000	U
Vanadium	UG/L	9.800	UJ	9.800	UJ	17.600	U	14.900	U	6.400	U
Zinc	UG/L	12.500	U	1.400	UJ	8.300	U	6.200	U	4.400	U

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METALS Analysis Results

Program		RCRA		CERCLA		CERCLA		CERCLA		CERCLA	
Well ID		399-3-10		399-3-11		399-3-11		399-3-12		399-3-12	
Round		7		7		7		7		7	
Date		6-23-94		6-22-94		6-22-94		6-22-94		6-22-94	
Sample Type		SAMPLE		SAMPLE		SAMPLE		SAMPLE		SAMPLE	
Lab ID		DATA CHEM		IT		IT		IT		IT	
Filtered		YES		NO		YES		NO		YES	
Filter Size (in microns)											
Sample ID		BOBYM3		BOBZL0		BOBZL1		BOBZL4		BOBZL5	
Parameter	Units	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q
Aluminum	UG/L	26.000	U	34.500	U	34.500	U	34.500	U	34.500	U
Antimony	UG/L	26.000	U	30.500	U	30.500	U	30.500	U	37.700	B
Arsenic	UG/L	0.640	U								
Barium	UG/L	61.000		44.200	B	45.600	B	46.200	B	45.900	B
Beryllium	UG/L	1.500	U	0.460	U	0.470	U	0.470	U	0.200	U
Cadmium	UG/L	3.000	U	2.200	U	2.200	U	2.200	U	2.200	U
Calcium	UG/L	38000.000		47800.000		49400.000		49400.000		49500.000	
Chromium	UG/L	11.000	U	7.200	U	3.400	B	5.300	U	3.000	U
Cobalt	UG/L	6.500	U	3.200	U	3.200	U	3.200	U	3.200	U
Copper	UG/L	8.400	U	10.700	U	7.300	U	8.500	U	4.300	U
Iron	UG/L	170.000		73.200	U	36.800	U	134.000		22.900	U
Lead	UG/L	2.600	BL								
Magnesium	UG/L	8100.000		10000.000		10300.000		10400.000		10400.000	
Manganese	UG/L	12.000		2.600	U	2.600	U	7.200	B	3.500	B
Mercury	UG/L	0.095	U								
Nickel	UG/L	16.000	U	11.400	U	11.400	U	11.400	U	11.400	U
Potassium	UG/L	4300.000		4730.000	B	5700.000		6350.000		4530.000	B
Selenium	UG/L	1.400	U								
Silver	UG/L	3.400	U	3.000	U	3.000	U	3.000	U	3.000	U
Sodium	UG/L	15000.000		20300.000		20900.000		22500.000		23000.000	
Tin	UG/L	24.000	U								
Vanadium	UG/L	6.400	U	14.400	U	14.700	U	16.000	U	11.500	U
Zinc	UG/L	5.900	L	9.400	U	31.900	U	65.100		6.300	U

METALS Analysis Results

Program		CERCLA		CERCLA		CERCLA		CERCLA		CERCLA	
Well ID		399-4-7		399-4-7		399-4-10		399-4-10		399-4-12	
Round		7		7		7		7		7	
Date		6-23-94		6-23-94		6-23-94		6-23-94		6-22-94	
Sample Type		SAMPLE		SAMPLE		SAMPLE		SAMPLE		SAMPLE	
Lab ID		IT		IT		IT		IT		IT	
Filtered		NO		YES		NO		YES		NO	
Filter Size (in microns)											
Sample ID		B0BZL6		B0BZL7		B0BZM0		B0BZM1		B0BZM4	
Parameter	Units	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q
Aluminum	UG/L	19.000	UJ	19.000	UJ	19.000	UJ	19.000	UJ	34.500	U
Antimony	UG/L	19.500	UJ	19.500	UJ	19.500	UJ	19.500	UJ	30.500	U
Arsenic											
Barium	UG/L	44.800	B	43.600	B	53.200	B	52.200	B	39.600	B
Beryllium	UG/L	0.800	U	0.400	U	0.400	U	0.800	U	0.320	U
Cadmium	UG/L	1.800	UJ	1.800	UJ	1.800	UJ	1.800	UJ	2.200	U
Calcium	UG/L	49200.000		50200.000		45300.000		45500.000		46200.000	
Chromium	UG/L	2.800	UJ	2.800	UJ	2.800	UJ	2.800	UJ	4.200	U
Cobalt	UG/L	2.900	UJ	2.900	UJ	2.900	UJ	2.900	UJ	3.200	U
Copper	UG/L	4.500	UJ	4.500	UJ	4.500	UJ	4.500	UJ	8.800	U
Iron	UG/L	928.000		32.400	U	44.200	U	35.500	U	22.300	U
Lead											
Magnesium	UG/L	9070.000		9290.000		8350.000		8300.000		9230.000	
Manganese	UG/L	31.200		1.800	B	1.500	B	1.900	B	1.500	U
Mercury											
Nickel	UG/L	4.900	UJ	4.900	UJ	4.900	UJ	4.900	UJ	11.400	U
Potassium	UG/L	5160.000		5290.000		4840.000	B	4850.000	B	5990.000	
Selenium											
Silver	UG/L	4.200	UJ	4.200	UJ	4.200	UJ	4.700	UJ	3.000	U
Sodium	UG/L	19000.000		19400.000		18600.000		18500.000		17300.000	
Tin											
Vanadium	UG/L	9.800	UJ	9.800	UJ	9.800	UJ	9.800	UJ	14.000	U
Zinc	UG/L	10.900	U	7.200	U	5.700	U	1.300	UJ	13.300	U

METALS Analysis Results

Program		CERCLA	
Well ID		399-4-12	
Round		7	
Date		6-22-94	
Sample Type		SAMPLE	
Lab ID		IT	
Filtered		YES	
Filter Size (in microns)			
Sample ID		B0BZM5	
Parameter	Units	Conc.	Q
Aluminum	UG/L	34.500	U
Antimony	UG/L	33.700	B
Arsenic			
Barium	UG/L	40.200	B
Beryllium	UG/L	0.470	U
Cadmium	UG/L	2.200	U
Calcium	UG/L	46300.000	
Chromium	UG/L	3.000	U
Cobalt	UG/L	3.200	U
Copper	UG/L	8.800	U
Iron	UG/L	22.200	U
Lead			
Magnesium	UG/L	9200.000	
Manganese	UG/L	2.000	U
Mercury			
Nickel	UG/L	11.400	U
Potassium	UG/L	3920.000	B
Selenium			
Silver	UG/L	3.000	U
Sodium	UG/L	17200.000	
Tin			
Vanadium	UG/L	16.200	U
Zinc	UG/L	13.000	U

PESTICIDES/PCBs ORGANIC Analysis Results

Program		RCRA		RCRA		RCRA		RCRA		RCRA	
Well ID		399-1-10A		399-1-11		399-1-12		399-1-14A		399-1-16A	
Round		5		5		5		5		5	
Date		2-12-93		2-12-93		2-12-93		2-12-93		2-16-93	
Sample Type		SAMPLE		SAMPLE		SAMPLE		SAMPLE		SAMPLE	
Lab ID		DATA CHEM		DATA CHEM		DATA CHEM		DATA CHEM		DATA CHEM	
Filtered		NO		NO		NO		NO		NO	
Filter Size (in microns)											
Sample ID		B085D8		B085F0		B085F2		B085F4		B085F6	
Parameter	Units	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q
Aldrin	UG/L	0.050	U	0.050	U	0.050	U	0.050	U	0.050	U
Alpha-BHC	UG/L	0.050	U	0.050	U	0.050	U	0.050	U	0.050	U
Beta-BHC	UG/L	0.050	U	0.050	U	0.050	U	0.050	U	0.050	U
Chlordane	UG/L	0.100	U	0.100	U	0.100	U	0.100	U	0.100	U
Delta-BHC	UG/L	0.100	U	0.100	U	0.100	U	0.100	U	0.100	U
Dieldrin	UG/L	0.050	U	0.050	U	0.050	U	0.050	U	0.050	U
4,4'-DDD	UG/L	0.100	U	0.100	U	0.100	U	0.100	U	0.100	U
4,4'-DDE	UG/L	0.050	U	0.050	U	0.050	U	0.050	U	0.050	U
4,4'-DDT	UG/L	0.100	U	0.100	U	0.100	U	0.100	U	0.100	U
Endosulfan I	UG/L	0.100	U	0.100	U	0.100	U	0.100	U	0.100	U
Endosulfan II	UG/L	0.050	U	0.050	U	0.050	U	0.050	U	0.050	U
Endosulfan sulfate	UG/L	0.500	U	0.500	U	0.500	U	0.500	U	0.500	U
Endrin	UG/L	0.100	U	0.100	U	0.100	U	0.100	U	0.100	U
Endrin aldehyde	UG/L	0.200	U	0.200	U	0.200	U	0.200	U	0.200	U
Gamma-BHC (Lindane)	UG/L	0.050	U	0.050	U	0.050	U	0.050	U	0.050	U
Heptachlor	UG/L	0.050	U	0.050	U	0.050	U	0.050	U	0.050	U
Heptachlor epoxide	UG/L	1.000	U	1.000	U	1.000	U	1.000	U	1.000	U
Methoxychlor	UG/L	2.000	U	2.000	U	2.000	U	2.000	U	2.000	U
Toxaphene	UG/L	2.000	U	2.000	U	2.000	U	2.000	U	2.000	U
Aroclor-1260											
Aroclor-1254											
Aroclor-1221											
Aroclor-1232											
Aroclor-1248											
Aroclor-1016											
Aroclor-1242											

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PESTICIDES/PCBs ORGANIC Analysis Results

Program		RCRA		RCRA		RCRA		RCRA		RCRA	
Well ID		399-1-16B		399-1-17A		399-1-17A		399-1-17A		399-1-17A	
Round		5		5		5		5		5	
Date		2-18-93		1-8-93		1-14-93		1-21-93		1-27-93	
Sample Type		SAMPLE		SAMPLE		SAMPLE		SAMPLE		SAMPLE	
Lab ID		DATA CHEM		DATA CHEM		DATA CHEM		DATA CHEM		DATA CHEM	
Filtered		NO		NO		NO		NO		NO	
Filter Size (in microns)											
Sample ID		B085G0		B07TJ0		B07TJ4		B07TJ1		B07TJ2	
Parameter	Units	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q
Aldrin	UG/L	0.050	U								
Alpha-BHC	UG/L	0.050	U								
Beta-BHC	UG/L	0.050	U								
Chlordane	UG/L	0.100	U								
Delta-BHC	UG/L	0.100	U								
Dieldrin	UG/L	0.050	U								
4,4'-DDD	UG/L	0.100	U								
4,4'-DDE	UG/L	0.050	U								
4,4'-DDT	UG/L	0.100	U								
Endosulfan I	UG/L	0.100	U								
Endosulfan II	UG/L	0.050	U								
Endosulfan sulfate	UG/L	0.500	U								
Endrin	UG/L	0.100	U								
Endrin aldehyde	UG/L	0.200	U								
Gamma-BHC (Lindane)	UG/L	0.050	U								
Heptachlor	UG/L	0.050	U								
Heptachlor epoxide	UG/L	1.000	U								
Methoxychlor	UG/L	2.000	U								
Toxaphene	UG/L	2.000	U								
Aroclor-1260	UG/L			1.000	U	1.000	U	1.000	U	1.000	U
Aroclor-1254	UG/L			1.000	U	1.000	U	1.000	U	1.000	U
Aroclor-1221	UG/L			1.000	U	1.000	U	1.000	U	1.000	U
Aroclor-1232	UG/L			1.000	U	1.000	U	1.000	U	1.000	U
Aroclor-1248	UG/L			1.000	U	1.000	U	1.000	U	1.000	U
Aroclor-1016	UG/L			1.000	U	1.000	U	1.000	U	1.000	U
Aroclor-1242	UG/L			1.000	U	1.000	U	1.000	U	1.000	U

PESTICIDES/PCBs ORGANIC Analysis Results

Program		RCRA		RCRA		RCRA		RCRA		RCRA	
Well ID		399-1-17A		399-1-17A		399-1-17B		399-1-18A		399-2-1	
Round		5		5		5		5		5	
Date		2-12-93		5-14-93		2-18-93		2-12-93		2-16-93	
Sample Type		SAMPLE		SAMPLE		SAMPLE		SAMPLE		SAMPLE	
Lab ID		DATA CHEM		DATA CHEM		DATA CHEM		DATA CHEM		DATA CHEM	
Filtered		NO		NO		NO		NO		NO	
Filter Size (in microns)											
Sample ID		B07TJ3		B08JD0		B085G2		B085G6		B085G8	
Parameter	Units	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q
Aldrin	UG/L			0.050	U	0.050	U	0.050	U	0.050	U
Alpha-BHC	UG/L			0.050	U	0.050	U	0.050	U	0.050	U
Beta-BHC	UG/L			0.050	U	0.050	U	0.050	U	0.050	U
Chlordane	UG/L			0.100	U	0.100	U	0.100	U	0.100	U
Delta-BHC	UG/L			0.100	U	0.100	U	0.100	U	0.100	U
Dieldrin	UG/L			0.050	U	0.050	U	0.050	U	0.050	U
4,4'-DDD	UG/L			0.002	L	0.100	U	0.100	U	0.100	U
4,4'-DDE	UG/L			0.050	U	0.050	U	0.050	U	0.050	U
4,4'-DDT	UG/L			0.100	U	0.100	U	0.100	U	0.100	U
Endosulfan I	UG/L			0.100	U	0.100	U	0.100	U	0.100	U
Endosulfan II	UG/L			0.050	U	0.050	U	0.050	U	0.050	U
Endosulfan sulfate	UG/L			0.500	U	0.500	U	0.500	U	0.500	U
Endrin	UG/L			0.100	U	0.100	U	0.100	U	0.100	U
Endrin aldehyde	UG/L			0.200	U	0.200	U	0.200	U	0.200	U
Gamma-BHC (Lindane)	UG/L			0.050	U	0.050	U	0.050	U	0.050	U
Heptachlor	UG/L			0.050	U	0.050	U	0.050	U	0.050	U
Heptachlor epoxide	UG/L			1.000	U	1.000	U	1.000	U	1.000	U
Methoxychlor	UG/L			2.000	U	2.000	U	2.000	U	2.000	U
Toxaphene	UG/L			2.000	U	2.000	U	2.000	U	2.000	U
Aroclor-1260	UG/L	1.000	U								
Aroclor-1254	UG/L	1.000	U								
Aroclor-1221	UG/L	1.000	U								
Aroclor-1232	UG/L	1.000	U								
Aroclor-1248	UG/L	1.000	U								
Aroclor-1016	UG/L	1.000	U								
Aroclor-1242	UG/L	1.000	U								

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PESTICIDES/PCBs ORGANIC Analysis Results

Program		RCRA		RCRA		RCRA		RCRA		RCRA	
Well ID		399-3-10		399-1-10A		399-1-11		399-1-12		399-1-14A	
Round		5		6		6		6		6	
Date		2-16-93		9-14-93		9-14-93		9-14-93		9-14-93	
Sample Type		SAMPLE		SAMPLE		SAMPLE		SAMPLE		SAMPLE	
Lab ID		DATA CHEM		DATA CHEM		DATA CHEM		DATA CHEM		DATA CHEM	
Filtered		NO		NO		NO		NO		NO	
Filter Size (in microns)											
Sample ID		B085H0		B09641		B09643		B09645		B09647	
Parameter	Units	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q
Aldrin	UG/L	0.050	U	0.050	U	0.050	U	0.050	U	0.050	U
Alpha-BHC	UG/L	0.050	U	0.012	U	0.012	U	0.012	U	0.012	U
Beta-BHC	UG/L	0.050	U	0.003	U	0.003	U	0.003	U	0.003	U
Chlordane	UG/L	0.100	U	0.006	U	0.006	U	0.006	U	0.006	U
Delta-BHC	UG/L	0.100	U	0.001	U	0.001	U	0.001	U	0.001	U
Dieldrin	UG/L	0.050	U	0.019	U	0.019	U	0.019	U	0.019	U
4,4'-DDD	UG/L	0.100	U	0.001	U	0.001	U	0.001	U	0.001	U
4,4'-DDE	UG/L	0.050	U	0.001	U	0.001	U	0.001	U	0.001	U
4,4'-DDT	UG/L	0.100	U	0.011	U	0.011	U	0.011	U	0.011	U
Endosulfan I	UG/L	0.100	U	0.003	U	0.003	U	0.003	U	0.003	U
Endosulfan II	UG/L	0.050	U	0.004	U	0.004	U	0.004	U	0.004	U
Endosulfan sulfate	UG/L	0.500	U	0.007	U	0.007	U	0.007	U	0.007	U
Endrin	UG/L	0.100	U	0.008	U	0.008	U	0.008	U	0.008	U
Endrin aldehyde	UG/L	0.200	U	0.011	U	0.011	U	0.011	U	0.011	U
Gamma-BHC (Lindane)	UG/L	0.050	U	0.002	U	0.002	U	0.002	U	0.002	U
Heptachlor	UG/L	0.050	U	0.002	U	0.002	U	0.002	U	0.002	U
Heptachlor epoxide	UG/L	1.000	U	0.001	U	0.001	U	0.001	U	0.001	U
Methoxychlor	UG/L	2.000	U	0.100	U	0.100	U	0.100	U	0.100	U
Toxaphene	UG/L	2.000	U	0.890	U	0.890	U	0.890	U	0.890	U
Aroclor-1260											
Aroclor-1254											
Aroclor-1221											
Aroclor-1232											
Aroclor-1248											
Aroclor-1016											
Aroclor-1242											

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PESTICIDES/PCBs ORGANIC Analysis Results

Program		RCRA		RCRA		RCRA		RCRA		RCRA	
Well ID		399-1-16A		399-1-16B		399-1-17A		399-1-17B		399-1-18A	
Round		6		6		6		6		6	
Date		9-29-93		9-29-93		9-3-93		9-7-93		9-7-93	
Sample Type		SAMPLE		SAMPLE		SAMPLE		SAMPLE		SAMPLE	
Lab ID		DATA CHEM		DATA CHEM		DATA CHEM		DATA CHEM		DATA CHEM	
Filtered		NO		NO		NO		NO		NO	
Filter Size (in microns)											
Sample ID		B09649		B09651		B09653		B09655		B09657	
Parameter	Units	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q
Aldrin	UG/L	0.050	U	0.050	U	0.050	U	0.050	U	0.050	U
Alpha-BHC	UG/L	0.012	U	0.012	U	0.012	U	0.012	U	0.012	U
Beta-BHC	UG/L	0.003	U	0.003	U	0.003	U	0.003	U	0.003	U
Chlordane	UG/L	0.006	U	0.006	U	0.006	U	0.006	U	0.006	U
Delta-BHC	UG/L	0.001	U	0.001	U	0.001	U	0.001	U	0.001	U
Dieldrin	UG/L	0.019	U	0.019	U	0.019	U	0.019	U	0.019	U
4,4'-DDD	UG/L	0.001	U	0.001	U	0.001	U	0.001	U	0.001	U
4,4'-DDE	UG/L	0.001	U	0.001	U	0.001	U	0.001	U	0.001	U
4,4'-DDT	UG/L	0.011	U	0.011	U	0.011	U	0.011	U	0.011	U
Endosulfan I	UG/L	0.003	U	0.003	U	0.003	U	0.003	U	0.003	U
Endosulfan II	UG/L	0.004	U	0.004	U	0.004	U	0.004	U	0.004	U
Endosulfan sulfate	UG/L	0.007	U	0.007	U	0.007	U	0.014	BL	0.045	BL
Endrin	UG/L	0.008	U	0.008	U	0.008	U	0.008	U	0.008	U
Endrin aldehyde	UG/L	0.011	U	0.011	U	0.011	U	0.011	U	0.011	U
Gamma-BHC (Lindane)	UG/L	0.002	U	0.002	U	0.002	U	0.002	U	0.002	U
Heptachlor	UG/L	0.002	U	0.002	U	0.002	U	0.002	U	0.002	U
Heptachlor epoxide	UG/L	0.001	U	0.001	U	0.001	U	0.001	U	0.001	U
Methoxychlor	UG/L	0.100	U	0.100	U	0.100	U	0.100	U	0.100	U
Toxaphene	UG/L	0.890	U	0.890	U	0.890	U	0.890	U	0.890	U
Aroclor-1260											
Aroclor-1254											
Aroclor-1221											
Aroclor-1232											
Aroclor-1248											
Aroclor-1016											
Aroclor-1242											

PESTICIDES/PCBs ORGANIC Analysis Results

Program		RCRA		RCRA		RCRA		RCRA		RCRA	
Well ID		399-2-1		399-3-10		399-1-10A		399-1-11		399-1-12	
Round		6		6		7		7		7	
Date		9-16-93		9-3-93		6-23-94		6-22-94		6-22-94	
Sample Type		SAMPLE		SAMPLE		SAMPLE		SAMPLE		SAMPLE	
Lab ID		DATA CHEM		DATA CHEM		DATA CHEM		DATA CHEM		DATA CHEM	
Filtered		NO		NO		NO		NO		NO	
Filter Size (in microns)											
Sample ID		B09663		B09659		B0BYJ9		B0BYK1		B0BYK3	
Parameter	Units	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q
Aldrin	UG/L	0.050	U	0.050	U	0.002	U	0.002	U	0.002	U
Alpha-BHC	UG/L	0.012	U	0.012	U	0.003	U	0.003	U	0.003	U
Beta-BHC	UG/L	0.003	U	0.003	U	0.001	U	0.001	U	0.001	U
Chlordane	UG/L	0.006	U	0.006	U	0.042	U	0.042	U	0.042	U
Delta-BHC	UG/L	0.001	U	0.001	U	0.002	U	0.002	U	0.002	U
Dieldrin	UG/L	0.019	U	0.019	U	0.002	U	0.002	U	0.002	U
4,4'-DDD	UG/L	0.001	U	0.001	U	0.004	U	0.004	U	0.004	U
4,4'-DDE	UG/L	0.001	U	0.001	U	0.002	U	0.002	U	0.002	U
4,4'-DDT	UG/L	0.011	U	0.011	U	0.001	U	0.001	U	0.001	U
Endosulfan I	UG/L	0.003	U	0.003	U	0.002	U	0.002	U	0.002	U
Endosulfan II	UG/L	0.004	U	0.004	U	0.001	U	0.001	U	0.001	U
Endosulfan sulfate	UG/L	0.007	U	0.007	U	0.002	U	0.002	U	0.002	U
Endrin	UG/L	0.008	U	0.008	U	0.004	U	0.004	U	0.004	U
Endrin aldehyde	UG/L	0.011	U	0.011	U	0.004	U	0.004	U	0.004	U
Gamma-BHC (Lindane)	UG/L	0.002	U	0.002	U	0.002	U	0.002	L	0.002	U
Heptachlor	UG/L	0.002	U	0.002	U	0.002	U	0.002	U	0.002	U
Heptachlor epoxide	UG/L	0.001	U	0.001	U	0.001	U	0.001	U	0.001	U
Methoxychlor	UG/L	0.100	U	0.100	U	0.022	U	0.022	U	0.022	U
Toxaphene	UG/L	0.890	U	0.890	U	0.700	U	0.700	U	0.700	U
Aroclor-1260											
Aroclor-1254											
Aroclor-1221											
Aroclor-1232											
Aroclor-1248											
Aroclor-1016											
Aroclor-1242											

9513333.1475

PESTICIDES/PCBs ORGANIC Analysis Results

Program		RCRA		RCRA		RCRA		RCRA		RCRA	
Well ID		399-1-14A		399-1-16A		399-1-16B		399-1-17A		399-1-17B	
Round		7		7		7		7		7	
Date		6-22-94		6-23-94		6-22-94		6-22-94		6-22-94	
Sample Type		SAMPLE		SAMPLE		SAMPLE		SAMPLE		SAMPLE	
Lab ID		DATA CHEM		DATA CHEM		DATA CHEM		DATA CHEM		DATA CHEM	
Filtered		NO		NO		NO		NO		NO	
Filter Size (in microns)											
Sample ID		BOBYK5		BOBYK7		BOBYK9		BOBYL1		BOBYL6	
Parameter	Units	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q
Aldrin	UG/L	0.002	U	0.002	U	0.002	U	0.002	U	0.002	U
Alpha-BHC	UG/L	0.003	U	0.003	U	0.003	U	0.003	U	0.003	U
Beta-BHC	UG/L	0.001	U	0.001	U	0.001	U	0.001	U	0.001	U
Chlordane	UG/L	0.042	U	0.042	U	0.042	U	0.042	U	0.042	U
Delta-BHC	UG/L	0.002	U	0.008	L	0.002	U	0.002	U	0.002	U
Dieldrin	UG/L	0.002	U	0.002	U	0.002	U	0.002	U	0.002	U
4,4'-DDD	UG/L	0.004	U	0.004	U	0.004	U	0.004	U	0.004	U
4,4'-DDE	UG/L	0.002	U	0.002	U	0.002	U	0.002	U	0.002	U
4,4'-DDT	UG/L	0.001	U	0.001	U	0.001	U	0.001	U	0.001	U
Endosulfan I	UG/L	0.002	U	0.002	U	0.002	U	0.002	U	0.002	U
Endosulfan II	UG/L	0.001	U	0.001	U	0.001	U	0.001	U	0.001	U
Endosulfan sulfate	UG/L	0.002	U	0.002	U	0.002	U	0.002	U	0.002	U
Endrin	UG/L	0.004	U	0.004	U	0.004	U	0.004	U	0.004	U
Endrin aldehyde	UG/L	0.004	U	0.004	U	0.004	U	0.004	U	0.004	U
Gamma-BHC (Lindane)	UG/L	0.002	U	0.002	U	0.002	U	0.002	U	0.002	U
Heptachlor	UG/L	0.002	U	0.002	U	0.002	U	0.002	U	0.002	U
Heptachlor epoxide	UG/L	0.001	U	0.001	U	0.001	U	0.001	U	0.001	U
Methoxychlor	UG/L	0.022	U	0.022	U	0.022	U	0.022	U	0.022	U
Toxaphene	UG/L	0.700	U	0.700	U	0.700	U	0.700	U	0.700	U
Aroclor-1260											
Aroclor-1254											
Aroclor-1221											
Aroclor-1232											
Aroclor-1248											
Aroclor-1016											
Aroclor-1242											

PESTICIDES/PCBs ORGANIC Analysis Results

Program		RCRA		RCRA		RCRA	
Well ID		399-1-18A		399-2-1		399-3-10	
Round		7		7		7	
Date		6-22-94		6-23-94		6-23-94	
Sample Type		SAMPLE		SAMPLE		SAMPLE	
Lab ID		DATA CHEM		DATA CHEM		DATA CHEM	
Filtered		NO		NO		NO	
Filter Size (in microns)							
Sample ID		BOBYL8		BOBYM0		BOBYM2	
Parameter	Units	Conc.	Q	Conc.	Q	Conc.	Q
Aldrin	UG/L	0.002	U	0.002	U	0.002	U
Alpha-BHC	UG/L	0.003	U	0.003	U	0.003	U
Beta-BHC	UG/L	0.001	U	0.001	U	0.001	U
Chlordane	UG/L	0.042	U	0.042	U	0.042	U
Delta-BHC	UG/L	0.002	U	0.002	U	0.002	U
Dieldrin	UG/L	0.002	U	0.002	U	0.002	U
4,4'-DDD	UG/L	0.004	U	0.004	U	0.004	U
4,4'-DDE	UG/L	0.002	U	0.002	U	0.002	U
4,4'-DDT	UG/L	0.001	U	0.001	U	0.001	U
Endosulfan I	UG/L	0.002	U	0.002	U	0.002	U
Endosulfan II	UG/L	0.001	U	0.001	U	0.001	U
Endosulfan sulfate	UG/L	0.002	U	0.002	U	0.002	U
Endrin	UG/L	0.004	U	0.004	U	0.004	U
Endrin aldehyde	UG/L	0.004	U	0.004	U	0.004	U
Gamma-BHC (Lindane)	UG/L	0.002	U	0.002	U	0.002	U
Heptachlor	UG/L	0.002	U	0.002	U	0.002	U
Heptachlor epoxide	UG/L	0.001	U	0.001	U	0.001	U
Methoxychlor	UG/L	0.022	U	0.022	U	0.022	U
Toxaphene	UG/L	0.700	U	0.700	U	0.700	U
Aroclor-1260							
Aroclor-1254							
Aroclor-1221							
Aroclor-1232							
Aroclor-1248							
Aroclor-1016							
Aroclor-1242							

RADIONUCLIDE Analysis Results

Program		CERCLA		CERCLA		CERCLA		RCRA		RCRA	
Well ID		399-1-5		399-1-7		399-1-10A		399-1-10A		399-1-10B	
Round		5		5		5		5		5	
Date		3-10-93		3-9-93		3-10-93		2-12-93		2-16-93	
Sample Type		SAMPLE		SAMPLE		SAMPLE		SAMPLE		SAMPLE	
Lab ID		TMA		TMA		TMA		DATA CHEM		DATA CHEM	
Filtered		NO		NO		NO		NO		NO	
Filter Size (in microns)											
Sample ID		B086P9		B086Q0		B086Q1		B085D8		B085D2	
Parameter	Units	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q
Antimony-125											
Cesium-137											
Cobalt-60											
Gross Alpha	PCI/L	41.000		40.000		43.000		75.300			
Gross Beta	PCI/L	29.000		22.000		29.000		21.500			
Radium	PCI/L							0.061	U		
Ruthenium-106											
Strontium-90											
Technetium-99	PCI/L									15.100	
Tritium	PCI/L							10200.000		37.000	
Uranium	UG/L	87.000		81.000		110.000		104.000		-0.014	
Uranium-233/234											
Uranium-234											
Uranium-235											
Uranium-238											

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RADIONUCLIDE Analysis Results

Program		RCRA		RCRA		CERCLA		RCRA		RCRA	
Well ID		399-1-11		399-1-12		399-1-13A		399-1-14A		399-1-14B	
Round		5		5		5		5		5	
Date		2-12-93		2-12-93		3-10-93		2-12-93		2-16-93	
Sample Type		SAMPLE		SAMPLE		SAMPLE		SAMPLE		SAMPLE	
Lab ID		DATA CHEM		DATA CHEM		TMA		DATA CHEM		DATA CHEM	
Filtered		NO		NO		NO		NO		NO	
Filter Size (in microns)											
Sample ID		B085F0		B085F2		B086Q2		B085F4		B085D4	
Parameter	Units	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q
Antimony-125											
Cesium-137											
Cobalt-60											
Gross Alpha	PCI/L	20.600		34.300		3.000		3.710	U		
Gross Beta	PCI/L	11.200		17.900		7.800		9.600			
Radium	PCI/L	-0.025	U	-0.011	U			0.004	U		
Ruthenium-106											
Strontium-90											
Technetium-99	PCI/L									10.900	
Tritium	PCI/L	10500.000		9630.000				10000.000		-56.400	
Uranium	UG/L	21.200		44.000		6.300		6.000		0.115	
Uranium-233/234											
Uranium-234											
Uranium-235											
Uranium-238											

RADIONUCLIDE Analysis Results

Program		CERCLA		RCRA		RCRA		CERCLA		RCRA	
Well ID		399-1-15		399-1-16A		399-1-16B		399-1-16C		399-1-17A	
Round		5		5		5		5		5	
Date		3-10-93		2-16-93		2-18-93		3-1-93		1-8-93	
Sample Type		SAMPLE		SAMPLE		SAMPLE		SAMPLE		SAMPLE	
Lab ID		TMA		DATA CHEM		DATA CHEM		TMA		DATA CHEM	
Filtered		NO		NO		NO		NO		NO	
Filter Size (in microns)											
Sample ID		B086Q3		B085F6		B085G0		B086Q4		B07TJ0	
Parameter	Units	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q
Antimony-125	PCI/L									4.610	U
Cesium-137	PCI/L									0.914	U
Cobalt-60	PCI/L									-6.030	U
Gross Alpha	PCI/L	2.000	U	126.000		2.270	U	3.100	J		
Gross Beta	PCI/L	12.000		30.600		7.700	U	8.400			
Radium	PCI/L			0.015	U	0.049	U				
Ruthenium-106	PCI/L									-54.500	U
Strontium-90	PCI/L									2.120	U
Technetium-99											
Tritium	PCI/L			8920.000		358.000	U				
Uranium	UG/L	5.500		145.000		4.940		5.800		24.400	
Uranium-233/234											
Uranium-234	PCI/L									25.000	
Uranium-235	PCI/L									1.490	
Uranium-238	PCI/L									18.200	

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RADIONUCLIDE Analysis Results

Program		RCRA		RCRA		RCRA		RCRA		RCRA	
Well ID		399-1-17A		399-1-17A		399-1-17A		399-1-17A		399-1-17A	
Round		5		5		5		5		5	
Date		1-14-93		1-21-93		1-27-93		2-12-93		5-14-93	
Sample Type		SAMPLE		SAMPLE		SAMPLE		SAMPLE		SAMPLE	
Lab ID		DATA CHEM		DATA CHEM		DATA CHEM		DATA CHEM		DATA CHEM	
Filtered		NO		NO		NO		NO		NO	
Filter Size (in microns)											
Sample ID		B07TJ4		B07TJ1		B07TJ2		B07TJ3		B08JD0	
Parameter	Units	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q
Antimony-125	PCI/L	-7.040	U	-5.800	U	-0.529	U	-0.527	U		
Cesium-137	PCI/L	1.040	U	-5.880	U	-3.740	U	-6.850	U		
Cobalt-60	PCI/L	-1.320	U	-1.930	U	2.060	U	6.580	U		
Gross Alpha	PCI/L									15.500	
Gross Beta	PCI/L									5.870	
Radium	PCI/L									-0.081	U
Ruthenium-106	PCI/L	37.700	U	-0.647	U	-12.400	U	-16.200	U		
Strontium-90	PCI/L	0.873	U	0.503	U	0.114	U	-0.188	U		
Technetium-99											
Tritium	PCI/L									51.100	U
Uranium	UG/L	28.600		29.100		26.400		21.800		15.100	
Uranium-233/234											
Uranium-234	PCI/L	18.200		17.800		16.000		16.800			
Uranium-235	PCI/L	0.980		0.769		0.628		1.690			
Uranium-238	PCI/L	13.600		12.600		11.400		11.800			

RADIONUCLIDE Analysis Results

Program		RCRA		RCRA		CERCLA		RCRA		CERCLA	
Well ID		399-1-17B		399-1-18A		399-1-21A		399-2-1		399-2-2	
Round		5		5		5		5		5	
Date		2-18-93		2-12-93		3-9-93		2-16-93		3-17-93	
Sample Type		SAMPLE		SAMPLE		SAMPLE		SAMPLE		SAMPLE	
Lab ID		DATA CHEM		DATA CHEM		TMA		DATA CHEM		TMA	
Filtered		NO		NO		NO		NO		NO	
Filter Size (in microns)											
Sample ID		B085G2		B085G6		B086Q5		B085G8		B08BF2	
Parameter	Units	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q
Antimony-125											
Cesium-137											
Cobalt-60											
Gross Alpha	PCI/L	-0.136	U	2.950	U	23.000		37.500		54.000	
Gross Beta	PCI/L	3.330	U	9.280		18.000		11.000		27.000	
Radium	PCI/L	-0.043	U	0.015	U			-0.009	U		
Ruthenium-106											
Strontium-90											
Technetium-99											
Tritium	PCI/L	-13.900	U	1600.000				2390.000			
Uranium	UG/L	0.040	U	4.240		46.000		45.500		81.000	
Uranium-233/234											
Uranium-234											
Uranium-235											
Uranium-238											

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RADIONUCLIDE Analysis Results

Program		CERCLA		RCRA		CERCLA		CERCLA		CERCLA	
Well ID		399-3-2		399-3-10		399-3-11		399-3-12		399-4-1	
Round		5		5		5		5		5	
Date		3-8-93		2-16-93		3-3-93		2-25-93		3-12-93	
Sample Type		SAMPLE		SAMPLE		SAMPLE		SAMPLE		SAMPLE	
Lab ID		TMA		DATA CHEM		TMA		TMA		TMA	
Filtered		NO		NO		NO		NO		NO	
Filter Size (in microns)											
Sample ID		B086Q7		B085H0		B086Q8		B086Q9		B086R0	
Parameter	Units	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q
Antimony-125											
Cesium-137											
Cobalt-60											
Gross Alpha	PCI/L	6.200		5.780		12.000	J	12.000	J	10.000	
Gross Beta	PCI/L	5.400		7.250	U	19.000		15.000		10.000	
Radium	PCI/L			-0.020	U						
Ruthenium-106											
Strontium-90											
Technetium-99											
Tritium	PCI/L			2450.000							
Uranium	UG/L	21.000		9.680		34.000		37.000		14.000	
Uranium-233/234											
Uranium-234											
Uranium-235											
Uranium-238											

RADIONUCLIDE Analysis Results

Program		CERCLA		CERCLA		CERCLA		CERCLA		CERCLA	
Well ID		399-4-7		399-4-10		399-4-11		399-4-12		399-5-1	
Round		5		5		5		5		5	
Date		2-25-93		3-3-93		3-9-93		2-25-93		2-26-93	
Sample Type		SAMPLE		SAMPLE		SAMPLE		SAMPLE		SAMPLE	
Lab ID		TMA		TMA		TMA		TMA		TMA	
Filtered		NO		NO		NO		NO		NO	
Filter Size (in microns)											
Sample ID		B086R1		B086R2		B086R3		B086R4		B086S7	
Parameter	Units	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q
Antimony-125											
Cesium-137											
Cobalt-60											
Gross Alpha	PCI/L	20.000	J	20.000	J	7.500		13.000	J	3.100	J
Gross Beta	PCI/L	17.000		14.000		8.800		9.700		33.000	
Radium											
Ruthenium-106											
Strontium-90											
Technetium-99	PCI/L									74.000	B
Tritium											
Uranium	UG/L	48.000		43.000		17.000		25.000			
Uranium-233/234											
Uranium-234											
Uranium-235											
Uranium-238											

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RADIONUCLIDE Analysis Results

Program		CERCLA		CERCLA		CERCLA		CERCLA		CERCLA	
Well ID		399-6-1		399-8-1		399-8-3		399-8-5A		699-S27-E14	
Round		5		5		5		5		5	
Date		2-26-93		3-8-93		3-17-93		2-25-93		2-26-93	
Sample Type		SAMPLE		SAMPLE		SAMPLE		SAMPLE		SAMPLE	
Lab ID		TMA		TMA		TMA		TMA		TMA	
Filtered		NO		NO		NO		NO		NO	
Filter Size (in microns)											
Sample ID		B086R5		B086R8		B08BF1		B086R7		B086S8	
Parameter	Units	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q
Antimony-125											
Cesium-137											
Cobalt-60											
Gross Alpha	PCI/L	4.500	J	2.000	U	0.840	U	7.200	J	1.600	J
Gross Beta	PCI/L	7.400		3.400		8.100		7.100		8.600	
Radium											
Ruthenium-106											
Strontium-90											
Technetium-99	PCI/L									15.000	B
Tritium											
Uranium	UG/L	9.100		4.600		4.800		11.000			
Uranium-233/234											
Uranium-234											
Uranium-235											
Uranium-238											

RADIONUCLIDE Analysis Results

Program		CERCLA		CERCLA		CERCLA		CERCLA		CERCLA	
Well ID		399-1-5		399-1-5		399-1-5		399-1-5		399-1-7	
Round		6		6		6		6		6	
Date		9-24-93		9-24-93		9-24-93		9-24-93		9-16-93	
Sample Type		SAMPLE		FILT.TEST		FILT.TEST		FILT.TEST		SAMPLE	
Lab ID		TMA		TMA		TMA		TMA		TMA	
Filtered		NO		YES		YES		YES		NO	
Filter Size (in microns)				0.10000		0.45000		1.00000			
Sample ID		B095J0		B095J2		B095J3		B095J4		B095J5	
Parameter	Units	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q
Antimony-125											
Cesium-137											
Cobalt-60											
Gross Alpha											
Gross Beta											
Radium											
Ruthenium-106											
Strontium-90											
Technetium-99											
Tritium											
Uranium	UG/L	78.000		51.000		71.000		88.000		96.000	
Uranium-233/234	PCI/L	30.000								45.000	
Uranium-234											
Uranium-235	PCI/L	4.100								7.700	
Uranium-238	PCI/L	21.000								33.000	

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RADIONUCLIDE Analysis Results

Program		CERCLA		CERCLA		CERCLA		RCRA		RCRA	
Well ID		399-1-7		399-1-7		399-1-7		399-1-10A		399-1-11	
Round		6		6		6		6		6	
Date		9-16-93		9-16-93		9-16-93		9-14-93		9-14-93	
Sample Type		FILT.TEST		FILT.TEST		FILT.TEST		SAMPLE		SAMPLE	
Lab ID		TMA		TMA		TMA		DATA CHEM		DATA CHEM	
Filtered		YES		YES		YES		NO		NO	
Filter Size (in microns)		0.10000		0.45000		1.00000					
Sample ID		B095J7		B095J8		B095J9		B09641		B09643	
Parameter	Units	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q
Antimony-125											
Cesium-137											
Cobalt-60											
Gross Alpha	PCI/L							65.800		18.900	
Gross Beta	PCI/L							15.800		10.000	
Radium	PCI/L							0.087	U	0.138	
Ruthenium-106											
Strontium-90											
Technetium-99											
Tritium	PCI/L							10100.000		9510.000	
Uranium	UG/L	110.000		98.000		100.000		65.200		20.300	
Uranium-233/234											
Uranium-234											
Uranium-235											
Uranium-238											

RADIONUCLIDE Analysis Results

Program		RCRA		RCRA		RCRA		RCRA		CERCLA	
Well ID		399-1-12		399-1-14A		399-1-16A		399-1-16B		399-1-16C	
Round		6		6		6		6		6	
Date		9-14-93		9-14-93		9-29-93		9-29-93		9-25-93	
Sample Type		SAMPLE		SAMPLE		SAMPLE		SAMPLE		SAMPLE	
Lab ID		DATA CHEM		DATA CHEM		DATA CHEM		DATA CHEM		TMA	
Filtered		NO		NO		NO		NO		NO	
Filter Size (in microns)											
Sample ID		B09645		B09647		B09649		B09651		B095K0	
Parameter	Units	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q
Antimony-125											
Cesium-137											
Cobalt-60											
Gross Alpha	PCI/L	27.700		2.840		92.300		2.140			
Gross Beta	PCI/L	11.500		7.480		25.300		4.710			
Radium	PCI/L	-0.035	U	-0.004	U	0.076	U	0.037	U		
Ruthenium-106											
Strontium-90											
Technetium-99											
Tritium	PCI/L	8430.000		7300.000		7600.000		240.000			
Uranium	UG/L	25.400		5.410		1.080	F	4.380		0.680	
Uranium-233/234	PCI/L									0.110	U
Uranium-234											
Uranium-235	PCI/L									-0.013	U
Uranium-238	PCI/L									0.140	

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RADIONUCLIDE Analysis Results

Program		RCRA		RCRA		RCRA		RCRA		RCRA	
Well ID		399-1-17A		399-1-17A		399-1-17A		399-1-17B		399-1-18A	
Round		6		6		6		6		6	
Date		9-3-93		12-9-93		12-9-93		9-7-93		9-7-93	
Sample Type		SAMPLE		SAMPLE		SAMPLE		SAMPLE		SAMPLE	
Lab ID		DATA CHEM		DATA CHEM		DATA CHEM		DATA CHEM		DATA CHEM	
Filtered		NO		NO		NO		NO		NO	
Filter Size (in microns)											
Sample ID		B09653		B09MX4		B09MX5		B09655		B09657	
Parameter	Units	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q
Antimony-125											
Cesium-137											
Cobalt-60											
Gross Alpha	PCI/L	8.730						-0.115	U	3.030	
Gross Beta	PCI/L	4.620						8.660		10.900	
Radium	PCI/L	-0.022	U					0.058	U	0.052	U
Ruthenium-106											
Strontium-90	PCI/L			1.000		1.280					
Technetium-99											
Tritium	PCI/L	150.000	U					25.000	U	11100.000	
Uranium	UG/L	9.380		19.800		24.400		0.070	U	5.040	
Uranium-233/234											
Uranium-234	PCI/L			11.800		11.300					
Uranium-235	PCI/L			0.570	Q	0.770	Q				
Uranium-238	PCI/L			8.400		7.970					

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RADIONUCLIDE Analysis Results

Program		CERCLA		SURV		RCRA		CERCLA		CERCLA	
Well ID		399-1-21A		399-1-21A		399-2-1		399-2-2		399-2-2	
Round		6		6		6		6		6	
Date		9-24-93		9-14-93		9-16-93		9-21-93		9-21-93	
Sample Type		SAMPLE		SAMPLE		SAMPLE		SAMPLE		FILT.TEST	
Lab ID		TMA		DATA CHEM		DATA CHEM		TMA		TMA	
Filtered		NO		NO		NO		NO		YES	
Filter Size (in microns)										0.45000	
Sample ID		B095K1		B08ZV2		B09663		B095K2		B095K4	
Parameter	Units	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q
Antimony-125											
Cesium-137											
Cobalt-60											
Gross Alpha	PCI/L					67.300					
Gross Beta	PCI/L					20.500					
Radium	PCI/L					0.067	U				
Ruthenium-106											
Strontium-90											
Technetium-99	PCI/L			5.080							
Tritium	PCI/L			4560.000		6500.000					
Uranium	UG/L	33.000		25.300		0.774	F	110.000		100.000	
Uranium-233/234	PCI/L	11.000						41.000			
Uranium-234											
Uranium-235	PCI/L	1.100						6.300			
Uranium-238	PCI/L	9.100						30.000			

RADIONUCLIDE Analysis Results

Program		CERCLA		CERCLA		RCRA		CERCLA		CERCLA	
Well ID		399-2-2		399-3-2		399-3-10		399-3-11		399-3-12	
Round		6		6		6		6		6	
Date		9-21-93		9-13-93		9-3-93		9-22-93		9-24-93	
Sample Type		FILT.TEST		SAMPLE		SAMPLE		SAMPLE		SAMPLE	
Lab ID		TMA		TMA		DATA CHEM		TMA		TMA	
Filtered		YES		NO		NO		NO		NO	
Filter Size (in microns)		1.00000									
Sample ID		B095K5		B095K6		B09659		B095K7		B095K9	
Parameter	Units	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q
Antimony-125											
Cesium-137											
Cobalt-60											
Gross Alpha	PCI/L					11.800					
Gross Beta	PCI/L					9.490					
Radium	PCI/L					0.005	U				
Ruthenium-106											
Strontium-90											
Technetium-99											
Tritium	PCI/L					2580.000					
Uranium	UG/L	100.000		26.000		25.900		24.000		31.000	
Uranium-233/234	PCI/L			6.700				9.700		12.000	
Uranium-234											
Uranium-235	PCI/L			0.550				0.520		0.740	
Uranium-238	PCI/L			8.700				8.400		11.000	

RADIONUCLIDE Analysis Results

Program		CERCLA		CERCLA		CERCLA		CERCLA		CERCLA	
Well ID		399-4-7		399-4-7		399-4-7		399-4-7		399-4-10	
Round		6		6		6		6		6	
Date		9-17-93		9-17-93		9-17-93		9-17-93		9-22-93	
Sample Type		SAMPLE		FILT.TEST		FILT.TEST		FILT.TEST		SAMPLE	
Lab ID		TMA		TMA		TMA		TMA		TMA	
Filtered		NO		YES		YES		YES		NO	
Filter Size (in microns)				0.10000		0.45000		1.00000			
Sample ID		B095L0		B095L1		B095L2		B095L3		B095L4	
Parameter	Units	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q
Antimony-125											
Cesium-137											
Cobalt-60											
Gross Alpha											
Gross Beta											
Radium											
Ruthenium-106											
Strontium-90											
Technetium-99											
Tritium											
Uranium	UG/L	41.000		46.000		43.000		42.000		70.000	
Uranium-233/234	PCI/L	14.000								22.000	
Uranium-234											
Uranium-235	PCI/L	1.400								2.100	
Uranium-238	PCI/L	13.000								23.000	

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RADIONUCLIDE Analysis Results

Program		CERCLA		CERCLA		CERCLA		CERCLA		CERCLA	
Well ID		399-4-10		399-4-10		399-4-10		399-4-12		399-4-12	
Round		6		6		6		6		6	
Date		9-22-93		9-22-93		9-22-93		9-17-93		9-17-93	
Sample Type		FILT.TEST		FILT.TEST		FILT.TEST		SAMPLE		FILT.TEST	
Lab ID		TMA		TMA		TMA		TMA		TMA	
Filtered		YES		YES		YES		NO		YES	
Filter Size (in microns)		0.10000		0.45000		1.00000				0.10000	
Sample ID		B095L6		B095L7		B095L8		B095L9		B095M0	
Parameter	Units	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q
Antimony-125											
Cesium-137											
Cobalt-60											
Gross Alpha											
Gross Beta											
Radium											
Ruthenium-106											
Strontium-90											
Technetium-99											
Tritium											
Uranium	UG/L	52.000		61.000		70.000		25.000		24.000	
Uranium-233/234	PCI/L							7.500			
Uranium-234											
Uranium-235	PCI/L							0.550			
Uranium-238	PCI/L							7.700			

RADIONUCLIDE Analysis Results

Program		CERCLA		CERCLA		CERCLA		CERCLA		RCRA	
Well ID		399-4-12		399-4-12		399-1-5		399-1-7		399-1-10A	
Round		6		6		7		7		7	
Date		9-17-93		9-17-93		6-24-94		6-23-94		6-23-94	
Sample Type		FILT.TEST		FILT.TEST		SAMPLE		SAMPLE		SAMPLE	
Lab ID		TMA		TMA		IT		IT		DATA CHEM	
Filtered		YES		YES		NO		NO		NO	
Filter Size (in microns)		0.45000		1.00000							
Sample ID		B095M1		B095M2		B0BZJ2		B0BZJ8		B0BYJ9	
Parameter	Units	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q
Antimony-125											
Cesium-137											
Cobalt-60											
Gross Alpha	PCI/L									48.900	
Gross Beta	PCI/L									18.800	
Radium	PCI/L									0.129	
Ruthenium-106											
Strontium-90											
Technetium-99											
Tritium	PCI/L									9240.000	
Uranium	UG/L	24.000		25.000		93.800		131.000		71.100	
Uranium-233/234											
Uranium-234											
Uranium-235											
Uranium-238											

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RADIONUCLIDE Analysis Results

Program		RCRA		RCRA		RCRA		RCRA		RCRA	
Well ID		399-1-11		399-1-12		399-1-14A		399-1-16A		399-1-16B	
Round		7		7		7		7		7	
Date		6-22-94		6-22-94		6-22-94		6-23-94		6-22-94	
Sample Type		SAMPLE		SAMPLE		SAMPLE		SAMPLE		SAMPLE	
Lab ID		DATA CHEM		DATA CHEM		DATA CHEM		DATA CHEM		DATA CHEM	
Filtered		NO		NO		NO		NO		NO	
Filter Size (in microns)											
Sample ID		BOBYK1		BOBYK3		BOBYK5		BOBYK7		BOBYK9	
Parameter	Units	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q
Antimony-125											
Cesium-137											
Cobalt-60											
Gross Alpha	PCI/L	16.000		37.900		5.690		65.200		5.620	
Gross Beta	PCI/L	13.800		14.200		10.800		24.200		8.100	
Radium	PCI/L	-0.020	U	0.119	U	0.029	U	0.175		0.079	U
Ruthenium-106											
Strontium-90											
Technetium-99											
Tritium	PCI/L	10900.000		9640.000		10700.000		7390.000		397.000	
Uranium	UG/L	30.500		50.200		6.740		86.800		5.890	
Uranium-233/234											
Uranium-234											
Uranium-235											
Uranium-238											

RADIONUCLIDE Analysis Results

Program		CERCLA		RCRA		RCRA		RCRA		RCRA	
Well ID		399-1-16C		399-1-17A		399-1-17A		399-1-17B		399-1-18A	
Round		7		7		7		7		7	
Date		6-24-94		4-18-94		6-22-94		6-22-94		6-22-94	
Sample Type		SAMPLE		SAMPLE		SAMPLE		SAMPLE		SAMPLE	
Lab ID		IT		DATA CHEM		DATA CHEM		DATA CHEM		DATA CHEM	
Filtered		NO		NO		NO		NO		NO	
Filter Size (in microns)											
Sample ID		B0BZK0		B0BQM6		B0BYL1		B0BYL6		B0BYL8	
Parameter	Units	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q
Antimony-125											
Cesium-137											
Cobalt-60	PCI/L			8.500							
Gross Alpha	PCI/L					62.900		0.137	U	3.540	
Gross Beta	PCI/L					13.700		6.840		10.200	
Radium	PCI/L					0.002	U	0.179		0.076	U
Ruthenium-106	PCI/L			55.600							
Strontium-90											
Technetium-99											
Tritium	PCI/L					1940.000		74.200	U	11300.000	
Uranium	UG/L	0.163	J	25.700		62.600		0.055	U	5.600	
Uranium-233/234											
Uranium-234	PCI/L			11.600							
Uranium-235	PCI/L			0.610							
Uranium-238	PCI/L			8.010							

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RADIONUCLIDE Analysis Results

Program		CERCLA		RCRA		CERCLA		CERCLA		RCRA	
Well ID		399-1-21A		399-2-1		399-2-2		399-3-2		399-3-10	
Round		7		7		7		7		7	
Date		6-24-94		6-23-94		6-23-94		6-22-94		6-23-94	
Sample Type		SAMPLE		SAMPLE		SAMPLE		SAMPLE		SAMPLE	
Lab ID		IT		DATA CHEM		IT		IT		DATA CHEM	
Filtered		NO		NO		NO		NO		NO	
Filter Size (in microns)											
Sample ID		B0BZK2		B0BYM0		B0BZK4		B0BZK8		B0BYM2	
Parameter	Units	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q
Antimony-125											
Cesium-137											
Cobalt-60											
Gross Alpha	PCI/L			59.800						15.600	
Gross Beta	PCI/L			17.300						7.050	
Radium	PCI/L			0.045	U					0.003	U
Ruthenium-106											
Strontium-90											
Technetium-99											
Tritium	PCI/L			2490.000						2390.000	
Uranium	UG/L	21.000		57.900		150.000		22.300		20.300	
Uranium-233/234											
Uranium-234											
Uranium-235											
Uranium-238											

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RADIONUCLIDE Analysis Results

Program		CERCLA		CERCLA		CERCLA		CERCLA		CERCLA	
Well ID		399-3-11		399-3-12		399-4-7		399-4-10		399-4-12	
Round		7		7		7		7		7	
Date		6-22-94		6-22-94		6-23-94		6-23-94		6-22-94	
Sample Type		SAMPLE		SAMPLE		SAMPLE		SAMPLE		SAMPLE	
Lab ID		IT		IT		IT		IT		IT	
Filtered		NO		NO		NO		NO		NO	
Filter Size (in microns)											
Sample ID		B0BZL0		B0BZL4		B0BZL6		B0BZM0		B0BZM4	
Parameter	Units	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q
Antimony-125											
Cesium-137											
Cobalt-60											
Gross Alpha											
Gross Beta											
Radium											
Ruthenium-106											
Strontium-90											
Technetium-99											
Tritium											
Uranium	UG/L	96.500		38.900		42.800		42.400		19.700	
Uranium-233/234											
Uranium-234											
Uranium-235											
Uranium-238											

SEMI-VOLATILE ORGANIC Analysis Results

Program		RCRA		RCRA		RCRA		RCRA		RCRA	
Well ID		399-1-7		399-1-10A		399-1-11		399-1-12		399-1-14A	
Round		5		5		5		5		5	
Date		5-14-93		2-12-93		2-12-93		2-12-93		2-12-93	
Sample Type		SAMPLE		SAMPLE		SAMPLE		SAMPLE		SAMPLE	
Lab ID		DATA CHEM		DATA CHEM		DATA CHEM		DATA CHEM		DATA CHEM	
Filtered		NO		NO		NO		NO		NO	
Filter Size (in microns)											
Sample ID		B07BM7		B085D8		B085F0		B085F2		B085F4	
Parameter	Units	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q
1,4-Dichlorobenzene	UG/L	5.000	U	5.000	U	5.000	U	5.000	U	5.000	U
2,4,6-Trichlorophenol	UG/L			5.000	U	5.000	U	5.000	U	5.000	U
2,4-Dichlorophenol	UG/L			5.000	U	5.000	U	5.000	U	5.000	U
2,4-Dimethylphenol	UG/L			5.000	U	5.000	U	5.000	U	5.000	U
2,4-Dinitrophenol	UG/L			150.000	U	150.000	U	150.000	U	150.000	U
2,6-Dichlorophenol	UG/L			5.000	U	5.000	U	5.000	U	5.000	U
2-Chlorophenol	UG/L			5.000	U	5.000	U	5.000	U	5.000	U
2-Nitrophenol	UG/L			5.000	U	5.000	U	5.000	U	5.000	U
4,6-Dinitro-o-cresol	UG/L			200.000	U	200.000	U	200.000	U	200.000	U
4-Chloro-3-methylphenol	UG/L			5.000	U	5.000	U	5.000	U	5.000	U
4-Nitrophenol	UG/L			30.000	U	30.000	U	30.000	U	30.000	U
Pentachlorophenol	UG/L			100.000	U	100.000	U	100.000	U	100.000	U
Phenol	UG/L			1.000	U	1.000	U	1.000	U	1.000	U
Tetrachlorophenol	UG/L			10.000	U	10.000	U	10.000	U	10.000	U
Tetrahydrofuran	UG/L	10.000	U	10.000	U	10.000	U	10.000	U	10.000	U
Total cresols	UG/L			10.000	U	10.000	U	10.000	U	10.000	U
Trichlorophenol	UG/L			5.000	U	5.000	U	5.000	U	5.000	U

SEMI-VOLATILE ORGANIC Analysis Results

Program		RCRA		RCRA		RCRA		RCRA		RCRA	
Well ID		399-1-16A		399-1-16B		399-1-17A		399-1-17A		399-1-17A	
Round		5		5		5		5		5	
Date		2-16-93		2-18-93		1-8-93		1-14-93		1-21-93	
Sample Type		SAMPLE		SAMPLE		SAMPLE		SAMPLE		SAMPLE	
Lab ID		DATA CHEM		DATA CHEM		DATA CHEM		DATA CHEM		DATA CHEM	
Filtered		NO		NO		NO		NO		NO	
Filter Size (in microns)											
Sample ID		B085F6		B085G0		B07TJ0		B07TJ4		B07TJ1	
Parameter	Units	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q
1,4-Dichlorobenzene	UG/L	5.000	U	5.000	U	5.000	U	5.000	U	5.000	U
2,4,6-Trichlorophenol	UG/L	5.000	U	5.000	U						
2,4-Dichlorophenol	UG/L	5.000	U	5.000	U						
2,4-Dimethylphenol	UG/L	5.000	U	5.000	U						
2,4-Dinitrophenol	UG/L	150.000	U	150.000	U						
2,6-Dichlorophenol	UG/L	5.000	U	5.000	U						
2-Chlorophenol	UG/L	5.000	U	5.000	U						
2-Nitrophenol	UG/L	5.000	U	5.000	U						
4,6-Dinitro-o-cresol	UG/L	200.000	U	200.000	U						
4-Chloro-3-methylphenol	UG/L	5.000	U	5.000	U						
4-Nitrophenol	UG/L	30.000	U	30.000	U						
Pentachlorophenol	UG/L	100.000	U	100.000	U						
Phenol	UG/L	1.000	U	1.000	U						
Tetrachlorophenol	UG/L	10.000	U	10.000	U						
Tetrahydrofuran	UG/L	10.000	U	10.000	U	10.000	U	10.000	U	10.000	U
Total cresols	UG/L	10.000	U	10.000	U						
Trichlorophenol	UG/L	5.000	U	5.000	U						

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SEMI-VOLATILE ORGANIC Analysis Results

Program		RCRA		RCRA		RCRA		RCRA		RCRA	
Well ID		399-1-17A		399-1-17A		399-1-17A		399-1-17B		399-1-18A	
Round		5		5		5		5		5	
Date		1-27-93		2-12-93		5-14-93		2-18-93		2-12-93	
Sample Type		SAMPLE		SAMPLE		SAMPLE		SAMPLE		SAMPLE	
Lab ID		DATA CHEM		DATA CHEM		DATA CHEM		DATA CHEM		DATA CHEM	
Filtered		NO		NO		NO		NO		NO	
Filter Size (in microns)											
Sample ID		B07TJ2		B07TJ3		B08JD0		B085G2		B085G6	
Parameter	Units	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q
1,4-Dichlorobenzene	UG/L	5.000	U	5.000	U	5.000	U	5.000	U	5.000	U
2,4,6-Trichlorophenol	UG/L					5.000	U	5.000	U	5.000	U
2,4-Dichlorophenol	UG/L					5.000	U	5.000	U	5.000	U
2,4-Dimethylphenol	UG/L					5.000	U	5.000	U	5.000	U
2,4-Dinitrophenol	UG/L					150.000	U	150.000	U	150.000	U
2,6-Dichlorophenol	UG/L					5.000	U	5.000	U	5.000	U
2-Chlorophenol	UG/L					5.000	U	5.000	U	5.000	U
2-Nitrophenol	UG/L							5.000	U	5.000	U
4,6-Dinitro-o-cresol	UG/L					200.000	U	200.000	U	200.000	U
4-Chloro-3-methylphenol	UG/L					5.000	U	5.000	U	5.000	U
4-Nitrophenol	UG/L					30.000	U	30.000	U	30.000	U
Pentachlorophenol	UG/L					100.000	U	100.000	U	100.000	U
Phenol	UG/L					1.000	U	1.000	U	1.000	U
Tetrachlorophenol	UG/L					10.000	U	10.000	U	10.000	U
Tetrahydrofuran	UG/L	10.000	U	10.000	U			10.000	U	10.000	U
Total cresols	UG/L					10.000	U	10.000	U	10.000	U
Trichlorophenol	UG/L					5.000	U	5.000	U	5.000	U

SEMI-VOLATILE ORGANIC Analysis Results

Program		RCRA		RCRA		RCRA		RCRA		RCRA	
Well ID		399-2-1		399-3-10		399-1-10A		399-1-11		399-1-12	
Round		5		5		6		6		6	
Date		2-16-93		2-16-93		9-14-93		9-14-93		9-14-93	
Sample Type		SAMPLE		SAMPLE		SAMPLE		SAMPLE		SAMPLE	
Lab ID		DATA CHEM		DATA CHEM		DATA CHEM		DATA CHEM		DATA CHEM	
Filtered		NO		NO		NO		NO		NO	
Filter Size (in microns)											
Sample ID		B085G8		B085H0		B09641		B09643		B09645	
Parameter	Units	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q
1,4-Dichlorobenzene	UG/L	5.000	U	5.000	U	0.630	U	0.630	U	0.630	U
2,4,6-Trichlorophenol	UG/L	5.000	U	5.000	U	2.000	U	2.000	U	2.000	U
2,4-Dichlorophenol	UG/L	5.000	U	5.000	U	2.000	U	2.000	U	2.000	U
2,4-Dimethylphenol	UG/L	5.000	U	5.000	U	4.000	U	4.000	U	4.000	U
2,4-Dinitrophenol	UG/L	150.000	U	150.000	U	5.000	U	5.000	U	5.000	U
2,6-Dichlorophenol	UG/L	5.000	U	5.000	U	2.000	U	2.000	U	2.000	U
2-Chlorophenol	UG/L	5.000	U	5.000	U	2.000	U	2.000	U	2.000	U
2-Nitrophenol	UG/L	5.000	U	5.000	U	2.000	U	2.000	U	2.000	U
4,6-Dinitro-o-cresol	UG/L	200.000	U	200.000	U	2.000	U	2.000	U	2.000	U
4-Chloro-3-methylphenol	UG/L	5.000	U	5.000	U	3.000	U	3.000	U	3.000	U
4-Nitrophenol	UG/L	30.000	U	30.000	U	4.000	U	4.000	U	4.000	U
Pentachlorophenol	UG/L	100.000	U	100.000	U	3.000	U	3.000	U	3.000	U
Phenol	UG/L	1.000	U	1.000	U	0.400	U	0.400	U	0.400	U
Tetrachlorophenol	UG/L	10.000	U	10.000	U	2.000	U	2.000	U	2.000	U
Tetrahydrofuran	UG/L	10.000	U	10.000	U	3.670	U	3.670	U	3.670	U
Total cresols	UG/L	10.000	U	10.000	U	10.000	U	10.000	U	10.000	U
Trichlorophenol	UG/L	5.000	U	5.000	U	2.000	U	2.000	U	2.000	U

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SEMI-VOLATILE ORGANIC Analysis Results

Program		RCRA		RCRA		RCRA		RCRA		RCRA	
Well ID		399-1-14A		399-1-16A		399-1-16B		399-1-17A		399-1-17B	
Round		6		6		6		6		6	
Date		9-14-93		9-29-93		9-29-93		9-3-93		9-7-93	
Sample Type		SAMPLE		SAMPLE		SAMPLE		SAMPLE		SAMPLE	
Lab ID		DATA CHEM		DATA CHEM		DATA CHEM		DATA CHEM		DATA CHEM	
Filtered		NO		NO		NO		NO		NO	
Filter Size (in microns)											
Sample ID		B09647		B09649		B09651		B09653		B09655	
Parameter	Units	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q
1,4-Dichlorobenzene	UG/L	0.630	U	0.630	U	0.630	U	1.000	U	0.630	U
2,4,6-Trichlorophenol	UG/L	2.000	U	1.450	U	1.450	U	1.450	U	1.450	U
2,4-Dichlorophenol	UG/L	2.000	U	1.500	U	1.500	U	1.500	U	1.500	U
2,4-Dimethylphenol	UG/L	4.000	U	1.010	U	1.010	U	1.010	U	1.010	U
2,4-Dinitrophenol	UG/L	5.000	U	0.960	U	0.960	U	0.960	U	0.960	U
2,6-Dichlorophenol	UG/L	2.000	U	1.590	U	1.590	U	1.590	U	1.590	U
2-Chlorophenol	UG/L	2.000	U	1.420	U	1.420	U	1.420	U	1.420	U
2-Nitrophenol	UG/L	2.000	U	1.560	U	1.560	U	1.560	U	1.560	U
4,6-Dinitro-o-cresol	UG/L	2.000	U	1.180	U	1.180	U	1.180	U	1.180	U
4-Chloro-3-methylphenol	UG/L	3.000	U	1.120	U	1.120	U	1.120	U	1.120	U
4-Nitrophenol	UG/L	4.000	U	0.650	U	0.650	U	0.650	U	0.650	U
Pentachlorophenol	UG/L	3.000	U	0.870	U	0.870	U	0.870	U	0.870	U
Phenol	UG/L	0.400	U	0.310	U	0.310	U	0.310	U	0.310	U
Tetrachlorophenol	UG/L	2.000	U	1.050	U	1.050	U	1.050	U	1.050	U
Tetrahydrofuran	UG/L	3.670	U	3.670	U	3.670	U	0.600	U	3.670	U
Total cresols	UG/L	10.000	U	4.660	U	4.660	U	4.660	U	4.660	U
Trichlorophenol	UG/L	2.000	U	1.110	U	1.110	U	1.110	U	1.110	U

SEMI-VOLATILE ORGANIC Analysis Results

Program		RCRA		RCRA		RCRA		RCRA		RCRA	
Well ID		399-1-18A		399-2-1		399-3-10		399-1-10A		399-1-11	
Round		6		6		6		7		7	
Date		9-7-93		9-16-93		9-3-93		6-23-94		6-22-94	
Sample Type		SAMPLE		SAMPLE		SAMPLE		SAMPLE		SAMPLE	
Lab ID		DATA CHEM		DATA CHEM		DATA CHEM		DATA CHEM		DATA CHEM	
Filtered		NO		NO		NO		NO		NO	
Filter Size (in microns)											
Sample ID		B09657		B09663		B09659		B0BYJ9		B0BYK1	
Parameter	Units	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q
1,4-Dichlorobenzene	UG/L	0.630	U	0.630	U	1.000	U	0.107	U	0.107	U
2,4,6-Trichlorophenol	UG/L	1.450	U	2.000	U	1.450	U			1.600	U
2,4-Dichlorophenol	UG/L	1.500	U	2.000	U	1.500	U			1.500	U
2,4-Dimethylphenol	UG/L	1.010	U	4.000	U	1.010	U			1.500	U
2,4-Dinitrophenol	UG/L	0.960	U	5.000	U	0.960	U			1.800	U
2,6-Dichlorophenol	UG/L	1.590	U	2.000	U	1.590	U			2.200	U
2-Chlorophenol	UG/L	1.420	U	2.000	U	1.420	U			1.500	U
2-Nitrophenol	UG/L	1.560	U	2.000	U	1.560	U			1.700	U
4,6-Dinitro-o-cresol	UG/L	1.180	U	2.000	U	1.180	U			1.600	U
4-Chloro-3-methylphenol	UG/L	1.120	U	3.000	U	1.120	U			1.500	U
4-Nitrophenol	UG/L	0.650	U	4.000	U	0.650	U			1.400	U
Pentachlorophenol	UG/L	0.870	U	3.000	U	0.870	U			1.700	U
Phenol	UG/L	0.310	U	0.400	U	0.310	U			0.570	U
Tetrachlorophenol	UG/L	1.050	U	2.000	U	1.050	U			1.400	U
Tetrahydrofuran	UG/L	3.670	U	3.670	U	0.600	U				
Total cresols	UG/L	4.660	U	10.000	U	4.660	U			4.800	U
Trichlorophenol	UG/L	1.110	U	2.000	U	1.110	U			2.100	U

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SEMI-VOLATILE ORGANIC Analysis Results

Program		RCRA		RCRA		RCRA		RCRA		RCRA	
Well ID		399-1-12		399-1-14A		399-1-16A		399-1-16B		399-1-17A	
Round		7		7		7		7		7	
Date		6-22-94		6-22-94		6-23-94		6-22-94		6-22-94	
Sample Type		SAMPLE		SAMPLE		SAMPLE		SAMPLE		SAMPLE	
Lab ID		DATA CHEM		DATA CHEM		DATA CHEM		DATA CHEM		DATA CHEM	
Filtered		NO		NO		NO		NO		NO	
Filter Size (in microns)											
Sample ID		BOBYK3		BOBYK5		BOBYK7		BOBYK9		BOBYL1	
Parameter	Units	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q
1,4-Dichlorobenzene	UG/L	0.107	U	0.107	U	0.107	U	0.107	U	0.107	U
2,4,6-Trichlorophenol	UG/L	1.600	U	1.600	U			1.600	U	1.600	U
2,4-Dichlorophenol	UG/L	1.500	U	1.500	U			1.500	U	1.500	U
2,4-Dimethylphenol	UG/L	1.500	U	1.500	U			1.500	U	1.500	U
2,4-Dinitrophenol	UG/L	1.800	U	1.800	U			1.800	U	1.800	U
2,6-Dichlorophenol	UG/L	2.200	U	2.200	U			2.200	U	2.200	U
2-Chlorophenol	UG/L	1.500	U	1.500	U			1.500	U	1.500	U
2-Nitrophenol	UG/L	1.700	U	1.700	U			1.700	U	1.700	U
4,6-Dinitro-o-cresol	UG/L	1.600	U	1.600	U			1.600	U	1.600	U
4-Chloro-3-methylphenol	UG/L	1.500	U	1.500	U			1.500	U	1.500	U
4-Nitrophenol	UG/L	1.400	U	1.400	U			1.400	U	1.400	U
Pentachlorophenol	UG/L	1.700	U	1.700	U			1.700	U	1.700	U
Phenol	UG/L	0.570	U	0.570	U			0.570	U	0.570	U
Tetrachlorophenol	UG/L	1.400	U	1.400	U			1.400	U	1.400	U
Tetrahydrofuran											
Total cresols	UG/L	4.800	U	4.800	U			4.800	U	4.800	U
Trichlorophenol	UG/L	2.100	U	2.100	U			2.100	U	2.100	U

SEMI-VOLATILE ORGANIC Analysis Results

Program		RCRA		RCRA		RCRA		RCRA	
Well ID		399-1-17B		399-1-18A		399-2-1		399-3-10	
Round		7		7		7		7	
Date		6-22-94		6-22-94		6-23-94		6-23-94	
Sample Type		SAMPLE		SAMPLE		SAMPLE		SAMPLE	
Lab ID		DATA CHEM		DATA CHEM		DATA CHEM		DATA CHEM	
Filtered		NO		NO		NO		NO	
Filter Size (in microns)									
Sample ID		BOBYL6		BOBYL8		BOBYM0		BOBYM2	
Parameter	Units	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q
1,4-Dichlorobenzene	UG/L	0.107	U	0.107	U	0.107	U	0.107	U
2,4,6-Trichlorophenol	UG/L	1.600	U	1.600	U				
2,4-Dichlorophenol	UG/L	1.500	U	1.500	U				
2,4-Dimethylphenol	UG/L	1.500	U	1.500	U				
2,4-Dinitrophenol	UG/L	1.800	U	1.800	U				
2,6-Dichlorophenol	UG/L	2.200	U	2.200	U				
2-Chlorophenol	UG/L	1.500	U	1.500	U				
2-Nitrophenol	UG/L	1.700	U	1.700	U				
4,6-Dinitro-o-cresol	UG/L	1.600	U	1.600	U				
4-Chloro-3-methylphenol	UG/L	1.500	U	1.500	U				
4-Nitrophenol	UG/L	1.400	U	1.400	U				
Pentachlorophenol	UG/L	1.700	U	1.700	U				
Phenol	UG/L	0.570	U	0.570	U				
Tetrachlorophenol	UG/L	1.400	U	1.400	U				
Tetrahydrofuran									
Total cresols	UG/L	4.800	U	4.800	U				
Trichlorophenol	UG/L	2.100	U	2.100	U				

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VOLATILE ORGANIC Analysis Results

Program		CERCLA		CERCLA		RCRA	
Well ID		399-1-5		399-1-7		399-1-7	
Round		5		5		5	
Date		3-10-93		3-9-93		5-14-93	
Sample Type		SAMPLE		SAMPLE		SAMPLE	
Lab ID		TMA		TMA		DATA CHEM	
Filtered		NO		NO		NO	
Filter Size (in microns)		NAN		NAN		NAN	
Sample ID		B086P9		B086Q0		B07BM7	
Parameter	Units	Conc.	Q	Conc.	Q	Conc.	Q
Chloromethane	UG/L	10.000	U	10.000	U		
Bromomethane	UG/L	10.000	U	10.000	U		
Vinyl Chloride	UG/L	10.000	U	10.000	U	10.000	U
Chloroethane	UG/L	10.000	U	10.000	U		
Methylene Chloride	UG/L	10.000	U	10.000	U	1.900	U
Acetone	UG/L	9.000	U	10.000	U	15.000	U
Carbon Disulfide	UG/L	10.000	U	10.000	U	5.000	U
1,1-Dichloroethene	UG/L	10.000	U	10.000	U		
1,1-Dichloroethane	UG/L	10.000	U	10.000	U	5.000	U
1,2-Dichloroethene (total)	UG/L	10.000	U	10.000	U	5.000	U
cis-1,2-Dichloroethylene							
1,2-Dichloroethane	UG/L	10.000	U	10.000	U	5.000	U
trans-1,2-Dichloroethylene							
Chloroform	UG/L	10.000	U	6.000	J	6.000	
2-Butanone	UG/L	10.000	U	10.000	U	100.000	U
1-Butanol	UG/L					1.000	U
1,1,1-Trichloroethane	UG/L	10.000	U	10.000	U	5.000	U
Carbon Tetrachloride	UG/L	10.000	U	10.000	U	5.000	U
Bromodichloromethane	UG/L	10.000	U	10.000	U		
1,2-Dichloropropane	UG/L	10.000	U	10.000	U		
cis-1,3-Dichloropropene	UG/L	10.000	U	10.000	U		
Trichloroethene	UG/L	10.000	U	1.000	J	3.900	L
Dibromochloromethane	UG/L	10.000	U	10.000	U		
1,1,2-Trichloroethane	UG/L	10.000	U	10.000	U	5.000	U
Benzene	UG/L	10.000	U	10.000	U	5.000	U
trans-1,3-Dichloropropene	UG/L	10.000	U	10.000	U		
Bromoform	UG/L	10.000	U	10.000	U		
4-Methyl-2-Pentanone	UG/L	10.000	U	10.000	U	50.000	U
2-Hexanone	UG/L	10.000	U	10.000	U		
Tetrachloroethene	UG/L	10.000	U	10.000	U	5.000	U
Toluene	UG/L	10.000	U	1.000	U	5.000	U
1,1,2,2-Tetrachloroethane	UG/L	10.000	U	10.000	U		
Chlorobenzene	UG/L	10.000	U	10.000	U		
Ethyl Benzene	UG/L	10.000	U	10.000	U		
Ethyl Cyanide	UG/L					5.000	U
Styrene	UG/L	10.000	U	10.000	U		
Xylenes (total)	UG/L	10.000	U	10.000	U	5.000	U
Hydrazine							

VOLATILE ORGANIC Analysis Results

Program		CERCLA		RCRA		RCRA	
Well ID		399-1-10A		399-1-10A		399-1-11	
Round		5		5		5	
Date		3-10-93		2-12-93		2-12-93	
Sample Type		SAMPLE		SAMPLE		SAMPLE	
Lab ID		TMA		DATA CHEM		DATA CHEM	
Filtered		NO		NO		NO	
Filter Size (in microns)		NAN		NAN		NAN	
Sample ID		B086Q1		B085D8		B085F0	
Parameter	Units	Conc.	Q	Conc.	Q	Conc.	Q
Chloromethane	UG/L	10.000	U				
Bromomethane	UG/L	10.000	U				
Vinyl Chloride	UG/L	10.000	U	10.000	U	10.000	U
Chloroethane	UG/L	10.000	U				
Methylene Chloride	UG/L	10.000	U	2.900	B	2.300	B
Acetone	UG/L	10.000	U	100.000	U	100.000	U
Carbon Disulfide	UG/L	10.000	U				
1,1-Dichloroethene	UG/L	10.000	U				
1,1-Dichloroethane	UG/L	10.000	U	5.000	U	5.000	U
1,2-Dichloroethene (total)	UG/L	10.000	U				
cis-1,2-Dichloroethylene							
1,2-Dichloroethane	UG/L	10.000	U	5.000	U	5.000	U
trans-1,2-Dichloroethylene	UG/L			5.000	U	5.000	U
Chloroform	UG/L	10.000	U	5.000	U	5.000	U
2-Butanone	UG/L	10.000	U	100.000	U	100.000	U
1-Butanol	UG/L			1000.000	U	1000.000	U
1,1,1-Trichloroethane	UG/L	10.000	U	5.000	U	5.000	U
Carbon Tetrachloride	UG/L	10.000	U	5.000	U	5.000	U
Bromodichloromethane	UG/L	10.000	U				
1,2-Dichloropropane	UG/L	10.000	U				
cis-1,3-Dichloropropene	UG/L	10.000	U				
Trichloroethene	UG/L	10.000	U	5.000	U	5.000	U
Dibromochloromethane	UG/L	10.000	U				
1,1,2-Trichloroethane	UG/L	10.000	U	5.000	U	5.000	U
Benzene	UG/L	10.000	U	5.000	U	5.000	U
trans-1,3-Dichloropropene	UG/L	10.000	U				
Bromoform	UG/L	10.000	U				
4-Methyl-2-Pentanone	UG/L	10.000	U	50.000	U	50.000	U
2-Hexanone	UG/L	10.000	U				
Tetrachloroethene	UG/L	10.000	U	5.000	U	0.610	JU
Toluene	UG/L	10.000	U	5.000	U	5.000	U
1,1,2,2-Tetrachloroethane	UG/L	10.000	U				
Chlorobenzene	UG/L	10.000	U				
Ethyl Benzene	UG/L	10.000	U				
Ethyl Cyanide							
Styrene	UG/L	10.000	U				
Xylenes (total)	UG/L	10.000	U	5.000	U	5.000	U
Hydrazine							

VOLATILE ORGANIC Analysis Results

Program		RCRA		CERCLA		RCRA	
Well ID		399-1-12		399-1-13A		399-1-14A	
Round		5		5		5	
Date		2-12-93		3-10-93		2-12-93	
Sample Type		SAMPLE		SAMPLE		SAMPLE	
Lab ID		DATA CHEM		TMA		DATA CHEM	
Filtered		NO		NO		NO	
Filter Size (in microns)		NAN		NAN		NAN	
Sample ID		B085F2		B086Q2		B085F4	
Parameter	Units	Conc.	Q	Conc.	Q	Conc.	Q
Chloromethane	UG/L			10.000	U		
Bromomethane	UG/L			10.000	U		
Vinyl Chloride	UG/L	10.000	U	10.000	U	10.000	U
Chloroethane	UG/L			10.000	U		
Methylene Chloride	UG/L	2.400	B	10.000	U	2.900	B
Acetone	UG/L	100.000	U	10.000	U	100.000	U
Carbon Disulfide	UG/L			10.000	U		
1,1-Dichloroethene	UG/L			10.000	U		
1,1-Dichloroethane	UG/L	5.000	U	10.000	U	5.000	U
1,2-Dichloroethene (total)	UG/L			10.000	U		
cis-1,2-Dichloroethylene							
1,2-Dichloroethane	UG/L	5.000	U	10.000	U	5.000	U
trans-1,2-Dichloroethylene	UG/L	5.000	U			5.000	U
Chloroform	UG/L	5.000	U	10.000	U	5.000	U
2-Butanone	UG/L	100.000	U	10.000	U	100.000	U
1-Butanol	UG/L	1000.000	U			1000.000	U
1,1,1-Trichloroethane	UG/L	5.000	U	10.000	U	5.000	U
Carbon Tetrachloride	UG/L	5.000	U	10.000	U	5.000	U
Bromodichloromethane	UG/L			10.000	U		
1,2-Dichloropropane	UG/L			10.000	U		
cis-1,3-Dichloropropene	UG/L			10.000	U		
Trichloroethene	UG/L	1.200	U	10.000	U	5.000	U
Dibromochloromethane	UG/L			10.000	U		
1,1,2-Trichloroethane	UG/L	5.000	U	10.000	U	5.000	U
Benzene	UG/L	5.000	U	10.000	U	5.000	U
trans-1,3-Dichloropropene	UG/L			10.000	U		
Bromoform	UG/L			10.000	U		
4-Methyl-2-Pentanone	UG/L	50.000	U	10.000	U	50.000	U
2-Hexanone	UG/L			10.000	U		
Tetrachloroethene	UG/L	0.530	JU	10.000	U	0.340	JU
Toluene	UG/L	5.000	U	10.000	U	5.000	U
1,1,2,2-Tetrachloroethane	UG/L			10.000	U		
Chlorobenzene	UG/L			10.000	U		
Ethyl Benzene	UG/L			10.000	U		
Ethyl Cyanide							
Styrene	UG/L			10.000	U		
Xylenes (total)	UG/L	5.000	U	10.000	U	5.000	U
Hydrazine							

VOLATILE ORGANIC Analysis Results

Program		CERCLA		RCRA		RCRA	
Well ID		399-1-15		399-1-16A		399-1-16B	
Round		5		5		5	
Date		3-10-93		2-16-93		2-18-93	
Sample Type		SAMPLE		SAMPLE		SAMPLE	
Lab ID		TMA		DATA CHEM		DATA CHEM	
Filtered		NO		NO		NO	
Filter Size (in microns)		NAN		NAN		NAN	
Sample ID		B086Q3		B085F6		B085G0	
Parameter	Units	Conc.	Q	Conc.	Q	Conc.	Q
Chloromethane	UG/L	10.000	U				
Bromomethane	UG/L	10.000	U				
Vinyl Chloride	UG/L	10.000	U	10.000	U	10.000	U
Chloroethane	UG/L	10.000	U				
Methylene Chloride	UG/L	10.000	U	3.400	B	2.100	B
Acetone	UG/L	10.000	U	2.100	U	100.000	U
Carbon Disulfide	UG/L	10.000	U				
1,1-Dichloroethene	UG/L	10.000	U				
1,1-Dichloroethane	UG/L	10.000	U	5.000	U	5.000	U
1,2-Dichloroethene (total)	UG/L	10.000	U				
cis-1,2-Dichloroethylene							
1,2-Dichloroethane	UG/L	10.000	U	5.000	U	5.000	U
trans-1,2-Dichloroethylene	UG/L			5.000	U	150.000	
Chloroform	UG/L	10.000	U	1.300	U	5.000	U
2-Butanone	UG/L	10.000	U	100.000	U	100.000	U
1-Butanol	UG/L			1000.000	U	1000.000	U
1,1,1-Trichloroethane	UG/L	10.000	U	5.000	U	5.000	U
Carbon Tetrachloride	UG/L	10.000	U	5.000	U	5.000	U
Bromodichloromethane	UG/L	10.000	U				
1,2-Dichloropropane	UG/L	10.000	U				
cis-1,3-Dichloropropene	UG/L	10.000	U				
Trichloroethene	UG/L	10.000	U	1.900	U	9.600	
Dibromochloromethane	UG/L	10.000	U				
1,1,2-Trichloroethane	UG/L	10.000	U	5.000	U	5.000	U
Benzene	UG/L	10.000	U	5.000	U	5.000	U
trans-1,3-Dichloropropene	UG/L	10.000	U				
Bromoform	UG/L	10.000	U				
4-Methyl-2-Pentanone	UG/L	10.000	U	50.000	U	50.000	U
2-Hexanone	UG/L	10.000	U				
Tetrachloroethene	UG/L	10.000	U	0.600	U	5.000	U
Toluene	UG/L	10.000	U	5.000	U	5.000	U
1,1,2,2-Tetrachloroethane	UG/L	10.000	U				
Chlorobenzene	UG/L	10.000	U				
Ethyl Benzene	UG/L	10.000	U				
Ethyl Cyanide							
Styrene	UG/L	10.000	U				
Xylenes (total)	UG/L	10.000	U	5.000	U	5.000	U
Hydrazine							

VOLATILE ORGANIC Analysis Results

Program		CERCLA		RCRA		RCRA	
Well ID		399-1-16C		399-1-17A		399-1-17A	
Round		5		5		5	
Date		3-1-93		1-8-93		1-14-93	
Sample Type		SAMPLE		SAMPLE		SAMPLE	
Lab ID		TMA		DATA CHEM		DATA CHEM	
Filtered		NO		NO		NO	
Filter Size (in microns)		NAN		NAN		NAN	
Sample ID		B086Q4		B07TJ0		B07TJ4	
Parameter	Units	Conc.	Q	Conc.	Q	Conc.	Q
Chloromethane	UG/L	10.000	U				
Bromomethane	UG/L	10.000	U				
Vinyl Chloride	UG/L	10.000	U	10.000	U	10.000	U
Chloroethane	UG/L	10.000	U				
Methylene Chloride	UG/L	10.000	U	5.000	U	5.000	U
Acetone	UG/L	10.000	U	73.000	B	100.000	U
Carbon Disulfide	UG/L	10.000	U				
1,1-Dichloroethene	UG/L	10.000	U				
1,1-Dichloroethane	UG/L	10.000	U	5.000	U	5.000	U
1,2-Dichloroethene (total)	UG/L	4.000	J				
cis-1,2-Dichloroethylene							
1,2-Dichloroethane	UG/L	10.000	U	5.000	U	5.000	U
trans-1,2-Dichloroethylene	UG/L			5.000	U	5.000	U
Chloroform	UG/L	10.000	U	5.700		6.600	
2-Butanone	UG/L	10.000	U	100.000	U	100.000	U
1-Butanol	UG/L			1000.000	U	1000.000	U
1,1,1-Trichloroethane	UG/L	10.000	U	5.000	U	5.000	U
Carbon Tetrachloride	UG/L	10.000	U	5.000	U	5.000	U
Bromodichloromethane	UG/L	10.000	U				
1,2-Dichloropropane	UG/L	10.000	U				
cis-1,3-Dichloropropene	UG/L	10.000	U				
Trichloroethene	UG/L	10.000	U	5.000	U	5.000	U
Dibromochloromethane	UG/L	10.000	U				
1,1,2-Trichloroethane	UG/L	10.000	U	5.000	U	5.000	U
Benzene	UG/L	10.000	U	5.000	U	5.000	U
trans-1,3-Dichloropropene	UG/L	10.000	U				
Bromoform	UG/L	10.000	U				
4-Methyl-2-Pentanone	UG/L	10.000	U	50.000	U	50.000	U
2-Hexanone	UG/L	10.000	U				
Tetrachloroethene	UG/L	10.000	U	5.000	U	5.000	U
Toluene	UG/L	10.000	U	5.000	U	5.000	U
1,1,2,2-Tetrachloroethane	UG/L	10.000	U				
Chlorobenzene	UG/L	10.000	U				
Ethyl Benzene	UG/L	10.000	U				
Ethyl Cyanide							
Styrene	UG/L	10.000	U				
Xylenes (total)	UG/L	10.000	U	5.000	U	5.000	U
Hydrazine							

VOLATILE ORGANIC Analysis Results

Program		RCRA		RCRA		RCRA	
Well ID		399-1-17A		399-1-17A		399-1-17A	
Round		5		5		5	
Date		1-21-93		1-27-93		2-12-93	
Sample Type		SAMPLE		SAMPLE		SAMPLE	
Lab ID		DATA CHEM		DATA CHEM		DATA CHEM	
Filtered		NO		NO		NO	
Filter Size (in microns)		NAN		NAN		NAN	
Sample ID		B07TJ1		B07TJ2		B07TJ3	
Parameter	Units	Conc.	Q	Conc.	Q	Conc.	Q
Chloromethane							
Bromomethane							
Vinyl Chloride	UG/L	10.000	U	10.000	U	10.000	U
Chloroethane							
Methylene Chloride	UG/L	0.900	JU	2.000	B	2.300	B
Acetone	UG/L	7.500	U	100.000	U	100.000	U
Carbon Disulfide							
1,1-Dichloroethene							
1,1-Dichloroethane	UG/L	5.000	U	5.000	U	5.000	U
1,2-Dichloroethene (total)							
cis-1,2-Dichloroethylene							
1,2-Dichloroethane	UG/L	5.000	U	5.000	U	5.000	U
trans-1,2-Dichloroethylene	UG/L	5.000	U	5.000	U	5.000	U
Chloroform	UG/L	6.200		9.100		5.700	
2-Butanone	UG/L	100.000	U	100.000	U	100.000	U
1-Butanol	UG/L	1000.000	U	1000.000	U	1000.000	U
1,1,1-Trichloroethane	UG/L	5.000	U	5.000	U	5.000	U
Carbon Tetrachloride	UG/L	5.000	U	5.000	U	5.000	U
Bromodichloromethane							
1,2-Dichloropropane							
cis-1,3-Dichloropropene							
Trichloroethene	UG/L	5.000	U	5.000	U	5.000	U
Dibromochloromethane							
1,1,2-Trichloroethane	UG/L	5.000	U	5.000	U	5.000	U
Benzene	UG/L	5.000	U	5.000	U	5.000	U
trans-1,3-Dichloropropene							
Bromoform							
4-Methyl-2-Pentanone	UG/L	50.000	U	50.000	U	50.000	U
2-Hexanone							
Tetrachloroethene	UG/L	5.000	U	5.000	U	5.000	U
Toluene	UG/L	5.000	U	5.000	U	5.000	U
1,1,2,2-Tetrachloroethane							
Chlorobenzene							
Ethyl Benzene							
Ethyl Cyanide							
Styrene							
Xylenes (total)	UG/L	5.000	U	5.000	U	5.000	U
Hydrazine							

VOLATILE ORGANIC Analysis Results

Program		RCRA		RCRA		RCRA	
Well ID		399-1-17A		399-1-17B		399-1-18A	
Round		5		5		5	
Date		5-14-93		2-18-93		2-12-93	
Sample Type		SAMPLE		SAMPLE		SAMPLE	
Lab ID		DATA CHEM		DATA CHEM		DATA CHEM	
Filtered		NO		NO		NO	
Filter Size (in microns)		NAN		NAN		NAN	
Sample ID		B08JD0		B085G2		B085G6	
Parameter	Units	Conc.	Q	Conc.	Q	Conc.	Q
Chloromethane							
Bromomethane							
Vinyl Chloride	UG/L	10.000	U	10.000	U	10.000	U
Chloroethane							
Methylene Chloride	UG/L	9.500	U	2.200	B	2.200	B
Acetone	UG/L	100.000	U	100.000	U	100.000	U
Carbon Disulfide	UG/L	5.000	U				
1,1-Dichloroethene							
1,1-Dichloroethane	UG/L	5.000	U	5.000	U	5.000	U
1,2-Dichloroethene (total)	UG/L	5.000	U				
cis-1,2-Dichloroethylene							
1,2-Dichloroethane	UG/L	5.000	U	5.000	U	5.000	U
trans-1,2-Dichloroethylene	UG/L			4.700	U	5.000	U
Chloroform	UG/L	13.000		5.000	U	5.000	U
2-Butanone	UG/L	100.000	U	100.000	U	100.000	U
1-Butanol	UG/L	1.000	U	1000.000	U	1000.000	U
1,1,1-Trichloroethane	UG/L	5.000	U	5.000	U	5.000	U
Carbon Tetrachloride	UG/L	5.000	U	5.000	U	5.000	U
Bromodichloromethane							
1,2-Dichloropropane							
cis-1,3-Dichloropropene							
Trichloroethene	UG/L	5.000	U	5.000	U	5.000	U
Dibromochloromethane							
1,1,2-Trichloroethane	UG/L	5.000	U	5.000	U	5.000	U
Benzene	UG/L	5.000	U	5.000	U	5.000	U
trans-1,3-Dichloropropene							
Bromoform							
4-Methyl-2-Pentanone	UG/L			50.000	U	50.000	U
2-Hexanone							
Tetrachloroethene	UG/L	5.000	U	5.000	U	5.000	U
Toluene	UG/L	5.000	U	1.400	U	5.000	U
1,1,2,2-Tetrachloroethane							
Chlorobenzene							
Ethyl Benzene							
Ethyl Cyanide	UG/L	5.000	U				
Styrene							
Xylenes (total)	UG/L	5.000	U	5.000	U	5.000	U
Hydrazine							

VOLATILE ORGANIC Analysis Results

Program		CERCLA		RCRA		CERCLA	
Well ID		399-1-21A		399-2-1		399-2-2	
Round		5		5		5	
Date		3-9-93		2-16-93		3-17-93	
Sample Type		SAMPLE		SAMPLE		SAMPLE	
Lab ID		TMA		DATA CHEM		TMA	
Filtered		NO		NO		NO	
Filter Size (in microns)		NAN		NAN		NAN	
Sample ID		B086Q5		B085G8		B08BF2	
Parameter	Units	Conc.	Q	Conc.	Q	Conc.	Q
Chloromethane	UG/L	10.000	U			10.000	U
Bromomethane	UG/L	10.000	U			10.000	U
Vinyl Chloride	UG/L	10.000	U	10.000	U	10.000	U
Chloroethane	UG/L	10.000	U			10.000	U
Methylene Chloride	UG/L	10.000	U	2.900	B	10.000	U
Acetone	UG/L	10.000	U	100.000	U	10.000	U
Carbon Disulfide	UG/L	10.000	U			10.000	U
1,1-Dichloroethene	UG/L	10.000	U			10.000	U
1,1-Dichloroethane	UG/L	10.000	U	5.000	U	10.000	U
1,2-Dichloroethene (total)	UG/L	10.000	U			10.000	U
cis-1,2-Dichloroethylene							
1,2-Dichloroethane	UG/L	10.000	U	5.000	U	10.000	U
trans-1,2-Dichloroethylene	UG/L			5.000	U		
Chloroform	UG/L	10.000	U	3.500	U	6.000	J
2-Butanone	UG/L	11.000		100.000	U	10.000	U
1-Butanol	UG/L			1000.000	U		
1,1,1-Trichloroethane	UG/L	10.000	U	5.000	U	10.000	U
Carbon Tetrachloride	UG/L	10.000	U	5.000	U	10.000	U
Bromodichloromethane	UG/L	10.000	U			10.000	U
1,2-Dichloropropane	UG/L	10.000	U			10.000	U
cis-1,3-Dichloropropene	UG/L	10.000	U			10.000	U
Trichloroethene	UG/L	2.000	J	0.900	U	1.000	J
Dibromochloromethane	UG/L	10.000	U			10.000	U
1,1,2-Trichloroethane	UG/L	10.000	U	5.000	U	10.000	U
Benzene	UG/L	10.000	U	5.000	U	10.000	U
trans-1,3-Dichloropropene	UG/L	10.000	U			10.000	U
Bromoform	UG/L	10.000	U			10.000	U
4-Methyl-2-Pentanone	UG/L	10.000	U	50.000	U	10.000	U
2-Hexanone	UG/L	10.000	U			10.000	U
Tetrachloroethene	UG/L	10.000	U	5.000	U	10.000	U
Toluene	UG/L	10.000	U	5.000	U	10.000	U
1,1,2,2-Tetrachloroethane	UG/L	10.000	U			10.000	U
Chlorobenzene	UG/L	10.000	U			10.000	U
Ethyl Benzene	UG/L	10.000	U			10.000	U
Ethyl Cyanide							
Styrene	UG/L	10.000	U			10.000	U
Xylenes (total)	UG/L	10.000	U	5.000	U	10.000	U
Hydrazine							

VOLATILE ORGANIC Analysis Results

Program		CERCLA		RCRA		CERCLA	
Well ID		399-3-2		399-3-10		399-3-11	
Round		5		5		5	
Date		3-8-93		2-16-93		3-3-93	
Sample Type		SAMPLE		SAMPLE		SAMPLE	
Lab ID		TMA		DATA CHEM		TMA	
Filtered		NO		NO		NO	
Filter Size (in microns)		NAN		NAN		NAN	
Sample ID		B086Q7		B085H0		B086Q8	
Parameter	Units	Conc.	Q	Conc.	Q	Conc.	Q
Chloromethane	UG/L	10.000	U			10.000	U
Bromomethane	UG/L	10.000	U			10.000	U
Vinyl Chloride	UG/L	10.000	U	10.000	U	10.000	U
Chloroethane	UG/L	10.000	U			10.000	U
Methylene Chloride	UG/L	10.000	U	2.600	B	10.000	U
Acetone	UG/L	10.000	U	100.000	U	10.000	U
Carbon Disulfide	UG/L	10.000	U			10.000	U
1,1-Dichloroethene	UG/L	10.000	U			10.000	U
1,1-Dichloroethane	UG/L	10.000	U	5.000	U	10.000	U
1,2-Dichloroethene (total)	UG/L	10.000	U			10.000	U
cis-1,2-Dichloroethylene							
1,2-Dichloroethane	UG/L	10.000	U	5.000	U	10.000	U
trans-1,2-Dichloroethylene	UG/L			5.000	U		
Chloroform	UG/L	10.000	U	1.900	U	6.000	J
2-Butanone	UG/L	10.000	U	100.000	U	10.000	U
1-Butanol	UG/L			1000.000	U		
1,1,1-Trichloroethane	UG/L	10.000	U	5.000	U	10.000	U
Carbon Tetrachloride	UG/L	10.000	U	5.000	U	10.000	U
Bromodichloromethane	UG/L	10.000	U			10.000	U
1,2-Dichloropropane	UG/L	10.000	U			10.000	U
cis-1,3-Dichloropropene	UG/L	10.000	U			10.000	U
Trichloroethene	UG/L	2.000	J	1.400	U	3.000	J
Dibromochloromethane	UG/L	10.000	U			10.000	U
1,1,2-Trichloroethane	UG/L	10.000	U	5.000	U	10.000	U
Benzene	UG/L	10.000	U	5.000	U	10.000	U
trans-1,3-Dichloropropene	UG/L	10.000	U			10.000	U
Bromoform	UG/L	10.000	U			10.000	U
4-Methyl-2-Pentanone	UG/L	10.000	U	50.000	U	10.000	U
2-Hexanone	UG/L	10.000	U			10.000	U
Tetrachloroethene	UG/L	10.000	U	5.000	U	10.000	U
Toluene	UG/L	10.000	U	5.000	U	10.000	U
1,1,2,2-Tetrachloroethane	UG/L	10.000	U			10.000	U
Chlorobenzene	UG/L	10.000	U			10.000	U
Ethyl Benzene	UG/L	10.000	U			10.000	U
Ethyl Cyanide							
Styrene	UG/L	10.000	U			10.000	U
Xylenes (total)	UG/L	10.000	U	5.000	U	10.000	U
Hydrazine							

VOLATILE ORGANIC Analysis Results

Program		CERCLA		CERCLA		CERCLA	
Well ID		399-3-12		399-4-1		399-4-7	
Round		5		5		5	
Date		2-25-93		3-12-93		2-25-93	
Sample Type		SAMPLE		SAMPLE		SAMPLE	
Lab ID		TMA		TMA		TMA	
Filtered		NO		NO		NO	
Filter Size (in microns)		NAN		NAN		NAN	
Sample ID		B086Q9		B086R0		B086R1	
Parameter	Units	Conc.	Q	Conc.	Q	Conc.	Q
Chloromethane	UG/L	10.000	U	10.000	U	10.000	U
Bromomethane	UG/L	10.000	U	10.000	U	10.000	U
Vinyl Chloride	UG/L	10.000	U	10.000	U	10.000	U
Chloroethane	UG/L	10.000	U	10.000	U	10.000	U
Methylene Chloride	UG/L	10.000	U	10.000	U	10.000	U
Acetone	UG/L	10.000	U	10.000	U	10.000	U
Carbon Disulfide	UG/L	10.000	U	10.000	U	10.000	U
1,1-Dichloroethene	UG/L	10.000	U	10.000	U	10.000	U
1,1-Dichloroethane	UG/L	10.000	U	10.000	U	10.000	U
1,2-Dichloroethene (total)	UG/L	10.000	U	10.000	U	10.000	U
cis-1,2-Dichloroethylene							
1,2-Dichloroethane	UG/L	10.000	U	10.000	U	10.000	U
trans-1,2-Dichloroethylene							
Chloroform	UG/L	1.000	U	6.000	J	3.000	U
2-Butanone	UG/L	10.000	U	10.000	U	10.000	U
1-Butanol							
1,1,1-Trichloroethane	UG/L	10.000	U	10.000	U	10.000	U
Carbon Tetrachloride	UG/L	10.000	U	10.000	U	10.000	U
Bromodichloromethane	UG/L	10.000	U	10.000	U	10.000	U
1,2-Dichloropropane	UG/L	10.000	U	10.000	U	10.000	U
cis-1,3-Dichloropropene	UG/L	10.000	U	10.000	U	10.000	U
Trichloroethene	UG/L	3.000	J	4.000	J	3.000	J
Dibromochloromethane	UG/L	10.000	U	10.000	U	10.000	U
1,1,2-Trichloroethane	UG/L	10.000	U	10.000	U	10.000	U
Benzene	UG/L	10.000	U	10.000	U	10.000	U
trans-1,3-Dichloropropene	UG/L	10.000	U	10.000	U	10.000	U
Bromoform	UG/L	10.000	U	10.000	U	10.000	U
4-Methyl-2-Pentanone	UG/L	10.000	U	10.000	U	10.000	U
2-Hexanone	UG/L	10.000	U	10.000	U	10.000	U
Tetrachloroethene	UG/L	10.000	U	10.000	U	10.000	U
Toluene	UG/L	10.000	U	10.000	U	10.000	U
1,1,2,2-Tetrachloroethane	UG/L	10.000	U	10.000	U	10.000	U
Chlorobenzene	UG/L	10.000	U	10.000	U	10.000	U
Ethyl Benzene	UG/L	10.000	U	10.000	U	10.000	U
Ethyl Cyanide							
Styrene	UG/L	10.000	U	10.000	U	10.000	U
Xylenes (total)	UG/L	10.000	U	10.000	U	10.000	U
Hydrazine							

VOLATILE ORGANIC Analysis Results

Program		CERCLA		CERCLA		CERCLA	
Well ID		399-4-10		399-4-11		399-4-12	
Round		5		5		5	
Date		3-3-93		3-9-93		2-25-93	
Sample Type		SAMPLE		SAMPLE		SAMPLE	
Lab ID		TMA		TMA		TMA	
Filtered		NO		NO		NO	
Filter Size (in microns)		NAN		NAN		NAN	
Sample ID		B086R2		B086R3		B086R4	
Parameter	Units	Conc.	Q	Conc.	Q	Conc.	Q
Chloromethane	UG/L	10.000	U	10.000	U	10.000	U
Bromomethane	UG/L	10.000	U	10.000	U	10.000	U
Vinyl Chloride	UG/L	10.000	U	10.000	U	10.000	U
Chloroethane	UG/L	10.000	U	10.000	U	10.000	U
Methylene Chloride	UG/L	10.000	U	10.000	U	10.000	U
Acetone	UG/L	10.000	U	10.000	U	10.000	U
Carbon Disulfide	UG/L	10.000	U	10.000	U	10.000	U
1,1-Dichloroethene	UG/L	10.000	U	10.000	U	10.000	U
1,1-Dichloroethane	UG/L	10.000	U	10.000	U	10.000	U
1,2-Dichloroethene (total)	UG/L	10.000	U	10.000	U	10.000	U
cis-1,2-Dichloroethylene							
1,2-Dichloroethane	UG/L	10.000	U	10.000	U	10.000	U
trans-1,2-Dichloroethylene							
Chloroform	UG/L	3.000	U	4.000	U	8.000	J
2-Butanone	UG/L	10.000	U	10.000	U	10.000	U
1-Butanol							
1,1,1-Trichloroethane	UG/L	10.000	U	10.000	U	10.000	U
Carbon Tetrachloride	UG/L	10.000	U	10.000	U	10.000	U
Bromodichloromethane	UG/L	10.000	U	10.000	U	10.000	U
1,2-Dichloropropane	UG/L	10.000	U	10.000	U	10.000	U
cis-1,3-Dichloropropene	UG/L	10.000	U	10.000	U	10.000	U
Trichloroethene	UG/L	2.000	J	3.000	J	6.000	J
Dibromochloromethane	UG/L	10.000	U	10.000	U	10.000	U
1,1,2-Trichloroethane	UG/L	10.000	U	10.000	U	10.000	U
Benzene	UG/L	10.000	U	10.000	U	10.000	U
trans-1,3-Dichloropropene	UG/L	10.000	U	10.000	U	10.000	U
Bromoform	UG/L	10.000	U	10.000	U	10.000	U
4-Methyl-2-Pentanone	UG/L	10.000	U	10.000	U	10.000	U
2-Hexanone	UG/L	10.000	U	10.000	U	10.000	U
Tetrachloroethene	UG/L	10.000	U	10.000	U	10.000	U
Toluene	UG/L	2.000	U	10.000	U	10.000	U
1,1,2,2-Tetrachloroethane	UG/L	10.000	U	10.000	U	10.000	U
Chlorobenzene	UG/L	10.000	U	10.000	U	10.000	U
Ethyl Benzene	UG/L	10.000	U	10.000	U	10.000	U
Ethyl Cyanide							
Styrene	UG/L	10.000	U	10.000	U	10.000	U
Xylenes (total)	UG/L	10.000	U	10.000	U	10.000	U
Hydrazine							

VOLATILE ORGANIC Analysis Results

Program		CERCLA		CERCLA		CERCLA	
Well ID		399-5-1		399-6-1		399-8-1	
Round		5		5		5	
Date		2-26-93		2-26-93		3-8-93	
Sample Type		SAMPLE		SAMPLE		SAMPLE	
Lab ID		TMA		TMA		TMA	
Filtered		NO		NO		NO	
Filter Size (in microns)		NAN		NAN		NAN	
Sample ID		B086S7		B086R5		B086R8	
Parameter	Units	Conc.	Q	Conc.	Q	Conc.	Q
Chloromethane	UG/L	10.000	U	10.000	U	10.000	U
Bromomethane	UG/L	10.000	U	10.000	U	10.000	U
Vinyl Chloride	UG/L	10.000	U	10.000	U	10.000	U
Chloroethane	UG/L	10.000	U	10.000	U	10.000	U
Methylene Chloride	UG/L	10.000	U	10.000	U	10.000	U
Acetone	UG/L	10.000	U	10.000	U	10.000	U
Carbon Disulfide	UG/L	10.000	U	10.000	U	10.000	U
1,1-Dichloroethene	UG/L	10.000	U	10.000	U	10.000	U
1,1-Dichloroethane	UG/L	10.000	U	10.000	U	10.000	U
1,2-Dichloroethene (total)	UG/L	10.000	U	10.000	U	10.000	U
cis-1,2-Dichloroethylene							
1,2-Dichloroethane	UG/L	10.000	U	10.000	U	10.000	U
trans-1,2-Dichloroethylene							
Chloroform	UG/L	10.000	U	10.000	U	10.000	U
2-Butanone	UG/L	10.000	U	10.000	U	10.000	U
1-Butanol							
1,1,1-Trichloroethane	UG/L	10.000	U	10.000	U	10.000	U
Carbon Tetrachloride	UG/L	10.000	U	10.000	U	10.000	U
Bromodichloromethane	UG/L	10.000	U	10.000	U	10.000	U
1,2-Dichloropropane	UG/L	10.000	U	10.000	U	10.000	U
cis-1,3-Dichloropropene	UG/L	10.000	U	10.000	U	10.000	U
Trichloroethene	UG/L	10.000	U	2.000	J	2.000	J
Dibromochloromethane	UG/L	10.000	U	10.000	U	10.000	U
1,1,2-Trichloroethane	UG/L	10.000	U	10.000	U	10.000	U
Benzene	UG/L	10.000	U	10.000	U	10.000	U
trans-1,3-Dichloropropene	UG/L	10.000	U	10.000	U	10.000	U
Bromoform	UG/L	10.000	U	10.000	U	10.000	U
4-Methyl-2-Pentanone	UG/L	10.000	U	10.000	U	10.000	U
2-Hexanone	UG/L	10.000	U	10.000	U	10.000	U
Tetrachloroethene	UG/L	10.000	U	10.000	U	10.000	U
Toluene	UG/L	10.000	U	10.000	U	10.000	U
1,1,2,2-Tetrachloroethane	UG/L	10.000	U	10.000	U	10.000	U
Chlorobenzene	UG/L	10.000	U	10.000	U	10.000	U
Ethyl Benzene	UG/L	10.000	U	10.000	U	10.000	U
Ethyl Cyanide							
Styrene	UG/L	10.000	U	10.000	U	10.000	U
Xylenes (total)	UG/L	10.000	U	10.000	U	10.000	U
Hydrazine							

VOLATILE ORGANIC Analysis Results

Program		CERCLA		CERCLA		CERCLA	
Well ID		399-8-3		399-8-5A		699-S27-E14	
Round		5		5		5	
Date		3-17-93		2-25-93		2-26-93	
Sample Type		SAMPLE		SAMPLE		SAMPLE	
Lab ID		TMA		TMA		TMA	
Filtered		NO		NO		NO	
Filter Size (in microns)		NAN		NAN		NAN	
Sample ID		B08BF1		B086R7		B086S8	
Parameter	Units	Conc.	Q	Conc.	Q	Conc.	Q
Chloromethane	UG/L	10.000	U	10.000	U	10.000	U
Bromomethane	UG/L	10.000	U	10.000	U	10.000	U
Vinyl Chloride	UG/L	10.000	U	10.000	U	10.000	U
Chloroethane	UG/L	10.000	U	10.000	U	10.000	U
Methylene Chloride	UG/L	10.000	U	10.000	U	10.000	U
Acetone	UG/L	10.000	U	10.000	U	10.000	U
Carbon Disulfide	UG/L	10.000	U	10.000	U	10.000	U
1,1-Dichloroethene	UG/L	10.000	U	10.000	U	10.000	U
1,1-Dichloroethane	UG/L	10.000	U	10.000	U	10.000	U
1,2-Dichloroethene (total)	UG/L	10.000	U	10.000	U	10.000	U
cis-1,2-Dichloroethylene							
1,2-Dichloroethane	UG/L	10.000	U	10.000	U	10.000	U
trans-1,2-Dichloroethylene							
Chloroform	UG/L	10.000	U	10.000	U	10.000	U
2-Butanone	UG/L	10.000	U	10.000	U	10.000	U
1-Butanol							
1,1,1-Trichloroethane	UG/L	10.000	U	10.000	U	10.000	U
Carbon Tetrachloride	UG/L	10.000	U	10.000	U	10.000	U
Bromodichloromethane	UG/L	10.000	U	10.000	U	10.000	U
1,2-Dichloropropane	UG/L	10.000	U	10.000	U	10.000	U
cis-1,3-Dichloropropene	UG/L	10.000	U	10.000	U	10.000	U
Trichloroethene	UG/L	10.000	U	2.000	J	10.000	U
Dibromochloromethane	UG/L	10.000	U	10.000	U	10.000	U
1,1,2-Trichloroethane	UG/L	10.000	U	10.000	U	10.000	U
Benzene	UG/L	10.000	U	10.000	U	10.000	U
trans-1,3-Dichloropropene	UG/L	10.000	U	10.000	U	10.000	U
Bromoform	UG/L	10.000	U	10.000	U	10.000	U
4-Methyl-2-Pentanone	UG/L	10.000	U	10.000	U	10.000	U
2-Hexanone	UG/L	10.000	U	10.000	U	10.000	U
Tetrachloroethene	UG/L	10.000	U	10.000	U	10.000	U
Toluene	UG/L	10.000	U	10.000	U	10.000	U
1,1,2,2-Tetrachloroethane	UG/L	10.000	U	10.000	U	10.000	U
Chlorobenzene	UG/L	10.000	U	10.000	U	10.000	U
Ethyl Benzene	UG/L	10.000	U	10.000	U	10.000	U
Ethyl Cyanide							
Styrene	UG/L	10.000	U	10.000	U	10.000	U
Xylenes (total)	UG/L	10.000	U	10.000	U	10.000	U
Hydrazine							

VOLATILE ORGANIC Analysis Results

Program		CERCLA		CERCLA		CERCLA	
Well ID		699-S28-E12		399-1-5		399-1-7	
Round		5		6		6	
Date		3-12-93		9-24-93		9-16-93	
Sample Type		SAMPLE		SAMPLE		SAMPLE	
Lab ID		TMA		TMA		TMA	
Filtered		NO		NO		NO	
Filter Size (in microns)		NAN		NAN		NAN	
Sample ID		B089B0		B095J0		B095J5	
Parameter	Units	Conc.	Q	Conc.	Q	Conc.	Q
Chloromethane	UG/L	10.000	U	10.000	U	10.000	U
Bromomethane	UG/L	10.000	U	10.000	U	10.000	U
Vinyl Chloride	UG/L	10.000	U	10.000	U	10.000	U
Chloroethane	UG/L	10.000	U	10.000	U	10.000	U
Methylene Chloride	UG/L	10.000	U	10.000	U	10.000	U
Acetone	UG/L	10.000	U	10.000	U	10.000	U
Carbon Disulfide	UG/L	10.000	U	10.000	U	10.000	U
1,1-Dichloroethene	UG/L	10.000	U	10.000	U	10.000	U
1,1-Dichloroethane	UG/L	10.000	U	10.000	U	10.000	U
1,2-Dichloroethene (total)	UG/L	10.000	U	10.000	U	10.000	U
cis-1,2-Dichloroethylene							
1,2-Dichloroethane	UG/L	10.000	U	10.000	U	10.000	U
trans-1,2-Dichloroethylene							
Chloroform	UG/L	10.000	U	10.000	U	11.000	
2-Butanone	UG/L	10.000	U	10.000	U	10.000	U
1-Butanol							
1,1,1-Trichloroethane	UG/L	10.000	U	10.000	U	10.000	U
Carbon Tetrachloride	UG/L	10.000	U	10.000	U	10.000	U
Bromodichloromethane	UG/L	10.000	U	10.000	U	10.000	U
1,2-Dichloropropane	UG/L	10.000	U	10.000	U	10.000	U
cis-1,3-Dichloropropene	UG/L	10.000	U	10.000	U	10.000	U
Trichloroethene	UG/L	1.000	J	10.000	U	1.000	J
Dibromochloromethane	UG/L	10.000	U	10.000	U	10.000	U
1,1,2-Trichloroethane	UG/L	10.000	U	10.000	U	10.000	U
Benzene	UG/L	10.000	U	10.000	U	10.000	U
trans-1,3-Dichloropropene	UG/L	10.000	U	10.000	U	10.000	U
Bromoform	UG/L	10.000	U	10.000	U	10.000	U
4-Methyl-2-Pentanone	UG/L	10.000	U	10.000	U	10.000	U
2-Hexanone	UG/L	10.000	U	10.000	U	10.000	U
Tetrachloroethene	UG/L	10.000	U	10.000	U	10.000	U
Toluene	UG/L	10.000	U	10.000	U	10.000	U
1,1,2,2-Tetrachloroethane	UG/L	10.000	U	10.000	U	10.000	U
Chlorobenzene	UG/L	10.000	U	10.000	U	10.000	U
Ethyl Benzene	UG/L	10.000	U	10.000	U	10.000	U
Ethyl Cyanide							
Styrene	UG/L	10.000	U	10.000	U	10.000	U
Xylenes (total)	UG/L	10.000	U	10.000	U	10.000	U
Hydrazine							

VOLATILE ORGANIC Analysis Results

Program		RCRA		RCRA		RCRA	
Well ID		399-1-10A		399-1-11		399-1-12	
Round		6		6		6	
Date		9-14-93		9-14-93		9-14-93	
Sample Type		SAMPLE		SAMPLE		SAMPLE	
Lab ID		DATA CHEM		DATA CHEM		DATA CHEM	
Filtered		NO		NO		NO	
Filter Size (in microns)		NAN		NAN		NAN	
Sample ID		B09641		B09643		B09645	
Parameter	Units	Conc.	Q	Conc.	Q	Conc.	Q
Chloromethane							
Bromomethane							
Vinyl Chloride	UG/L	0.780	U	0.780	U	0.780	U
Chloroethane							
Methylene Chloride	UG/L	0.610	U	0.610	U	0.610	U
Acetone	UG/L	13.400	U	13.400	U	13.400	U
Carbon Disulfide	UG/L	0.950	U	0.950	U	0.950	U
1,1-Dichloroethene							
1,1-Dichloroethane	UG/L	0.610	U	0.610	U	0.610	U
1,2-Dichloroethene (total)	UG/L	1.200	U	1.200	U	1.200	U
cis-1,2-Dichloroethylene							
1,2-Dichloroethane	UG/L	0.450	U	0.450	U	0.450	U
trans-1,2-Dichloroethylene							
Chloroform	UG/L	0.400	U	0.400	U	0.400	U
2-Butanone	UG/L	4.250	U	4.250	U	4.250	U
1-Butanol	UG/L	13.100	U	13.100	U	13.100	U
1,1,1-Trichloroethane	UG/L	1.400	U	1.400	U	1.000	U
Carbon Tetrachloride	UG/L	0.870	U	0.870	U	0.870	U
Bromodichloromethane							
1,2-Dichloropropane							
cis-1,3-Dichloropropene							
Trichloroethene	UG/L	0.770	U	0.770	U	0.770	U
Dibromochloromethane							
1,1,2-Trichloroethane	UG/L	0.250	U	0.250	U	0.250	U
Benzene	UG/L	0.650	U	0.650	U	0.650	U
trans-1,3-Dichloropropene							
Bromoform							
4-Methyl-2-Pentanone	UG/L	0.850	U	0.850	U	0.850	U
2-Hexanone							
Tetrachloroethene	UG/L	1.100	U	1.100	U	1.100	U
Toluene	UG/L	0.730	U	0.730	U	0.730	U
1,1,2,2-Tetrachloroethane							
Chlorobenzene							
Ethyl Benzene							
Ethyl Cyanide	UG/L	4.340	U	4.340	U	4.340	U
Styrene							
Xylenes (total)	UG/L	1.700	U	1.700	U	1.700	U
Hydrazine							

VOLATILE ORGANIC Analysis Results

Program		RCRA		RCRA		RCRA	
Well ID		399-1-14A		399-1-16A		399-1-16B	
Round		6		6		6	
Date		9-14-93		9-29-93		9-29-93	
Sample Type		SAMPLE		SAMPLE		SAMPLE	
Lab ID		DATA CHEM		DATA CHEM		DATA CHEM	
Filtered		NO		NO		NO	
Filter Size (in microns)		NAN		NAN		NAN	
Sample ID		B09647		B09649		B09651	
Parameter	Units	Conc.	Q	Conc.	Q	Conc.	Q
Chloromethane							
Bromomethane							
Vinyl Chloride	UG/L	0.780	U	0.780	U	0.780	U
Chloroethane							
Methylene Chloride	UG/L	0.610	U	0.610	U	0.610	U
Acetone	UG/L	13.400	U	13.400	U	13.400	U
Carbon Disulfide	UG/L	0.950	U	0.950	U	0.950	U
1,1-Dichloroethene							
1,1-Dichloroethane	UG/L	0.610	U	0.610	U	0.610	U
1,2-Dichloroethene (total)	UG/L	1.200	U	31.000		180.000	
cis-1,2-Dichloroethylene							
1,2-Dichloroethane	UG/L	0.450	U	0.450	U	0.450	U
trans-1,2-Dichloroethylene							
Chloroform	UG/L	0.400	U	4.700	L	0.400	U
2-Butanone	UG/L	4.250	U	4.250	U	4.250	U
1-Butanol	UG/L	13.100	U	13.100	U	13.100	U
1,1,1-Trichloroethane	UG/L	1.100	U	0.640	U	0.640	U
Carbon Tetrachloride	UG/L	0.870	U	0.870	U	0.870	U
Bromodichloromethane							
1,2-Dichloropropane							
cis-1,3-Dichloropropene							
Trichloroethene	UG/L	0.770	U	2.700	L	11.000	
Dibromochloromethane							
1,1,2-Trichloroethane	UG/L	0.250	U	0.250	U	0.250	U
Benzene	UG/L	0.650	U	0.650	U	0.650	U
trans-1,3-Dichloropropene							
Bromoform							
4-Methyl-2-Pentanone	UG/L	0.850	U	0.850	U	0.850	U
2-Hexanone							
Tetrachloroethene	UG/L	1.100	U	1.100	U	1.100	U
Toluene	UG/L	0.730	U	0.730	U	0.730	U
1,1,2,2-Tetrachloroethane							
Chlorobenzene							
Ethyl Benzene							
Ethyl Cyanide	UG/L	4.340	U	4.340	U	4.340	U
Styrene							
Xylenes (total)	UG/L	1.700	U	1.700	U	1.700	U
Hydrazine							

VOLATILE ORGANIC Analysis Results

Program		CERCLA		RCRA		RCRA	
Well ID		399-1-16C		399-1-17A		399-1-17A	
Round		6		6		6	
Date		9-25-93		9-3-93		12-9-93	
Sample Type		SAMPLE		SAMPLE		SAMPLE	
Lab ID		TMA		DATA CHEM		DATA CHEM	
Filtered		NO		NO		NO	
Filter Size (in microns)		NAN		NAN		NAN	
Sample ID		B095K0		B09653		B09MX4	
Parameter	Units	Conc.	Q	Conc.	Q	Conc.	Q
Chloromethane	UG/L	10.000	U				
Bromomethane	UG/L	10.000	U				
Vinyl Chloride	UG/L	10.000	U	1.100	U		
Chloroethane	UG/L	10.000	U				
Methylene Chloride	UG/L	10.000	U	0.300	U		
Acetone	UG/L	10.000	U	4.500	U		
Carbon Disulfide	UG/L	10.000	U	1.800	U		
1,1-Dichloroethene	UG/L	10.000	U				
1,1-Dichloroethane	UG/L	10.000	U	0.400	U		
1,2-Dichloroethene (total)	UG/L	10.000	U	1.200	U	1.200	U
cis-1,2-Dichloroethylene							
1,2-Dichloroethane	UG/L	10.000	U	0.300	U		
trans-1,2-Dichloroethylene							
Chloroform	UG/L	10.000	U	22.000		7.200	B
2-Butanone	UG/L	10.000	U	100.000	U		
1-Butanol	UG/L			17.000	U		
1,1,1-Trichloroethane	UG/L	10.000	U	0.640	U	0.640	UQ
Carbon Tetrachloride	UG/L	10.000	U	0.100	U		
Bromodichloromethane	UG/L	10.000	U				
1,2-Dichloropropane	UG/L	10.000	U				
cis-1,3-Dichloropropene	UG/L	10.000	U				
Trichloroethene	UG/L	10.000	U	0.770	U	0.770	U
Dibromochloromethane	UG/L	10.000	U				
1,1,2-Trichloroethane	UG/L	10.000	U	0.500	U		
Benzene	UG/L	10.000	U	0.200	U		
trans-1,3-Dichloropropene	UG/L	10.000	U				
Bromoform	UG/L	10.000	U				
4-Methyl-2-Pentanone	UG/L	10.000	U	0.600	U		
2-Hexanone	UG/L	10.000	U				
Tetrachloroethene	UG/L	10.000	U	2.600	U		
Toluene	UG/L	10.000	U	0.300	U		
1,1,2,2-Tetrachloroethane	UG/L	10.000	U				
Chlorobenzene	UG/L	10.000	U				
Ethyl Benzene	UG/L	10.000	U				
Ethyl Cyanide	UG/L			10.000	U		
Styrene	UG/L	10.000	U				
Xylenes (total)	UG/L	10.000	U	0.500	U		
Hydrazine							

VOLATILE ORGANIC Analysis Results

Program		RCRA		RCRA		RCRA	
Well ID		399-1-17A		399-1-17B		399-1-18A	
Round		6		6		6	
Date		12-9-93		9-7-93		9-7-93	
Sample Type		SAMPLE		SAMPLE		SAMPLE	
Lab ID		DATA CHEM		DATA CHEM		DATA CHEM	
Filtered		NO		NO		NO	
Filter Size (in microns)		NAN		NAN		NAN	
Sample ID		B09MX5		B09655		B09657	
Parameter	Units	Conc.	Q	Conc.	Q	Conc.	Q
Chloromethane							
Bromomethane							
Vinyl Chloride	UG/L			0.780	U	0.780	U
Chloroethane							
Methylene Chloride	UG/L			0.610	U	0.610	U
Acetone	UG/L			13.400	U	13.400	U
Carbon Disulfide	UG/L			0.950	U	0.950	U
1,1-Dichloroethene							
1,1-Dichloroethane	UG/L			0.610	U	0.610	U
1,2-Dichloroethene (total)	UG/L	1.200	U	5.100		1.200	U
cis-1,2-Dichloroethylene							
1,2-Dichloroethane	UG/L			0.450	U	0.450	U
trans-1,2-Dichloroethylene							
Chloroform	UG/L	7.200	B	0.400	U	0.400	U
2-Butanone	UG/L			4.250	U	4.250	U
1-Butanol	UG/L			13.100	U	13.100	U
1,1,1-Trichloroethane	UG/L	0.640	UQ	2.300	U	0.640	U
Carbon Tetrachloride	UG/L			0.870	U	0.870	U
Bromodichloromethane							
1,2-Dichloropropane							
cis-1,3-Dichloropropene							
Trichloroethene	UG/L	0.770	U	0.770	U	0.770	U
Dibromochloromethane							
1,1,2-Trichloroethane	UG/L			0.250	U	0.250	U
Benzene	UG/L			0.650	U	0.650	U
trans-1,3-Dichloropropene							
Bromoform							
4-Methyl-2-Pentanone	UG/L			0.850	U	0.850	U
2-Hexanone							
Tetrachloroethene	UG/L			1.100	U	1.100	U
Toluene	UG/L			0.730	U	0.730	U
1,1,2,2-Tetrachloroethane							
Chlorobenzene							
Ethyl Benzene							
Ethyl Cyanide	UG/L			4.340	U	4.340	U
Styrene							
Xylenes (total)	UG/L			1.700	U	1.700	U
Hydrazine							

VOLATILE ORGANIC Analysis Results

Program		CERCLA		RCRA		CERCLA	
Well ID		399-1-21A		399-2-1		399-2-2	
Round		6		6		6	
Date		9-24-93		9-16-93		9-21-93	
Sample Type		SAMPLE		SAMPLE		SAMPLE	
Lab ID		TMA		DATA CHEM		TMA	
Filtered		NO		NO		NO	
Filter Size (in microns)		NAN		NAN		NAN	
Sample ID		B095K1		B09663		B095K2	
Parameter	Units	Conc.	Q	Conc.	Q	Conc.	Q
Chloromethane	UG/L	10.000	U			10.000	U
Bromomethane	UG/L	10.000	U			10.000	U
Vinyl Chloride	UG/L	10.000	U	0.780	U	10.000	U
Chloroethane	UG/L	10.000	U			10.000	U
Methylene Chloride	UG/L	10.000	U	0.610	U	10.000	U
Acetone	UG/L	10.000	U	13.400	U	10.000	U
Carbon Disulfide	UG/L	10.000	U	0.950	U	10.000	U
1,1-Dichloroethene	UG/L	10.000	U			10.000	U
1,1-Dichloroethane	UG/L	10.000	U	0.610	U	10.000	U
1,2-Dichloroethene (total)	UG/L	10.000	U	1.200	U	10.000	U
cis-1,2-Dichloroethylene							
1,2-Dichloroethane	UG/L	10.000	U	0.450	U	10.000	U
trans-1,2-Dichloroethylene							
Chloroform	UG/L	2.000	J	5.300		8.000	J
2-Butanone	UG/L	10.000	U	4.250	U	10.000	U
1-Butanol	UG/L			13.100	U		
1,1,1-Trichloroethane	UG/L	10.000	U	0.640	U	10.000	U
Carbon Tetrachloride	UG/L	10.000	U	0.870	U	10.000	U
Bromodichloromethane	UG/L	10.000	U			10.000	U
1,2-Dichloropropane	UG/L	10.000	U			10.000	U
cis-1,3-Dichloropropene	UG/L	10.000	U			10.000	U
Trichloroethene	UG/L	1.000	J	1.700	L	10.000	U
Dibromochloromethane	UG/L	10.000	U			10.000	U
1,1,2-Trichloroethane	UG/L	10.000	U	0.250	U	10.000	U
Benzene	UG/L	10.000	U	0.650	U	10.000	U
trans-1,3-Dichloropropene	UG/L	10.000	U			10.000	U
Bromoform	UG/L	10.000	U			10.000	U
4-Methyl-2-Pentanone	UG/L	10.000	U	0.850	U	10.000	U
2-Hexanone	UG/L	10.000	U			10.000	U
Tetrachloroethene	UG/L	10.000	U	1.100	U	10.000	U
Toluene	UG/L	10.000	U	0.730	U	10.000	U
1,1,2,2-Tetrachloroethane	UG/L	10.000	U			10.000	U
Chlorobenzene	UG/L	10.000	U			10.000	U
Ethyl Benzene	UG/L	10.000	U			10.000	U
Ethyl Cyanide	UG/L			4.340	U		
Styrene	UG/L	10.000	U			10.000	U
Xylenes (total)	UG/L	10.000	U	1.700	U	10.000	U
Hydrazine							

VOLATILE ORGANIC Analysis Results

Program		CERCLA		RCRA		CERCLA	
Well ID		399-3-2		399-3-10		399-3-11	
Round		6		6		6	
Date		9-13-93		9-3-93		9-22-93	
Sample Type		SAMPLE		SAMPLE		SAMPLE	
Lab ID		TMA		DATA CHEM		TMA	
Filtered		NO		NO		NO	
Filter Size (in microns)		NAN		NAN		NAN	
Sample ID		B095K6		B09659		B095K7	
Parameter	Units	Conc.	Q	Conc.	Q	Conc.	Q
Chloromethane	UG/L	10.000	U			10.000	U
Bromomethane	UG/L	10.000	U			10.000	U
Vinyl Chloride	UG/L	10.000	U	1.100	U	10.000	U
Chloroethane	UG/L	10.000	U			10.000	U
Methylene Chloride	UG/L	10.000	U	0.300	U	10.000	U
Acetone	UG/L	10.000	U	4.500	U	10.000	U
Carbon Disulfide	UG/L	10.000	U	1.800	U	10.000	U
1,1-Dichloroethene	UG/L	10.000	U			10.000	U
1,1-Dichloroethane	UG/L	10.000	U	0.400	U	10.000	U
1,2-Dichloroethene (total)	UG/L	10.000	U	1.200	U	10.000	U
cis-1,2-Dichloroethylene							
1,2-Dichloroethane	UG/L	10.000	U	0.300	U	10.000	U
trans-1,2-Dichloroethylene							
Chloroform	UG/L	10.000	U	3.000	L	12.000	
2-Butanone	UG/L	10.000	U	100.000	U	10.000	U
1-Butanol	UG/L			17.000	U		
1,1,1-Trichloroethane	UG/L	10.000	U	0.640	U	10.000	U
Carbon Tetrachloride	UG/L	10.000	U	0.100	U	10.000	U
Bromodichloromethane	UG/L	10.000	U			10.000	U
1,2-Dichloropropane	UG/L	10.000	U			10.000	U
cis-1,3-Dichloropropene	UG/L	10.000	U			10.000	U
Trichloroethene	UG/L	2.000	J	1.300	L	2.000	J
Dibromochloromethane	UG/L	10.000	U			10.000	U
1,1,2-Trichloroethane	UG/L	10.000	U	0.500	U	10.000	U
Benzene	UG/L	10.000	U	0.200	U	10.000	U
trans-1,3-Dichloropropene	UG/L	10.000	U			10.000	U
Bromoform	UG/L	10.000	U			10.000	U
4-Methyl-2-Pentanone	UG/L	10.000	U	0.600	U	10.000	U
2-Hexanone	UG/L	10.000	U			10.000	U
Tetrachloroethene	UG/L	10.000	U	2.600	U	10.000	U
Toluene	UG/L	10.000	U	0.300	U	10.000	U
1,1,2,2-Tetrachloroethane	UG/L	10.000	U			10.000	U
Chlorobenzene	UG/L	10.000	U			10.000	U
Ethyl Benzene	UG/L	10.000	U			10.000	U
Ethyl Cyanide	UG/L			10.000	U		
Styrene	UG/L	10.000	U			10.000	U
Xylenes (total)	UG/L	10.000	U	0.500	U	10.000	U
Hydrazine							

VOLATILE ORGANIC Analysis Results

Program		CERCLA		CERCLA		CERCLA	
Well ID		399-3-12		399-4-7		399-4-10	
Round		6		6		6	
Date		9-24-93		9-17-93		9-22-93	
Sample Type		SAMPLE		SAMPLE		SAMPLE	
Lab ID		TMA		TMA		TMA	
Filtered		NO		NO		NO	
Filter Size (in microns)		NAN		NAN		NAN	
Sample ID		B095K9		B095L0		B095L4	
Parameter	Units	Conc.	Q	Conc.	Q	Conc.	Q
Chloromethane	UG/L	10.000	U	10.000	U	10.000	U
Bromomethane	UG/L	10.000	U	10.000	U	10.000	U
Vinyl Chloride	UG/L	10.000	U	10.000	U	10.000	U
Chloroethane	UG/L	10.000	U	10.000	U	10.000	U
Methylene Chloride	UG/L	10.000	U	8.000	J	10.000	U
Acetone	UG/L	10.000	U	10.000	U	10.000	U
Carbon Disulfide	UG/L	10.000	U	10.000	U	10.000	U
1,1-Dichloroethene	UG/L	10.000	U	10.000	U	10.000	U
1,1-Dichloroethane	UG/L	10.000	U	10.000	U	10.000	U
1,2-Dichloroethene (total)	UG/L	10.000	U	10.000	U	10.000	U
cis-1,2-Dichloroethylene							
1,2-Dichloroethane	UG/L	10.000	U	10.000	U	10.000	U
trans-1,2-Dichloroethylene							
Chloroform	UG/L	1.000	J	10.000		2.000	J
2-Butanone	UG/L	10.000	U	10.000	U	10.000	U
1-Butanol							
1,1,1-Trichloroethane	UG/L	10.000	U	10.000	U	10.000	U
Carbon Tetrachloride	UG/L	10.000	U	10.000	U	10.000	U
Bromodichloromethane	UG/L	10.000	U	10.000	U	10.000	U
1,2-Dichloropropane	UG/L	10.000	U	10.000	U	10.000	U
cis-1,3-Dichloropropene	UG/L	10.000	U	10.000	U	10.000	U
Trichloroethene	UG/L	4.000	J	4.000	J	2.000	J
Dibromochloromethane	UG/L	10.000	U	10.000	U	10.000	U
1,1,2-Trichloroethane	UG/L	10.000	U	10.000	U	10.000	U
Benzene	UG/L	10.000	U	10.000	U	10.000	U
trans-1,3-Dichloropropene	UG/L	10.000	U	10.000	U	10.000	U
Bromoform	UG/L	10.000	U	10.000	U	10.000	U
4-Methyl-2-Pentanone	UG/L	10.000	U	10.000	U	10.000	U
2-Hexanone	UG/L	10.000	U	10.000	U	10.000	U
Tetrachloroethene	UG/L	10.000	U	10.000	U	10.000	U
Toluene	UG/L	10.000	U	10.000	U	10.000	U
1,1,2,2-Tetrachloroethane	UG/L	10.000	U	10.000	U	10.000	U
Chlorobenzene	UG/L	10.000	U	10.000	U	10.000	U
Ethyl Benzene	UG/L	10.000	U	10.000	U	10.000	U
Ethyl Cyanide							
Styrene	UG/L	10.000	U	10.000	U	10.000	U
Xylenes (total)	UG/L	10.000	U	10.000	U	10.000	U
Hydrazine							

VOLATILE ORGANIC Analysis Results

Program		CERCLA		CERCLA		CERCLA	
Well ID		399-4-12		399-1-5		399-1-7	
Round		6		7		7	
Date		9-17-93		6-24-94		6-23-94	
Sample Type		SAMPLE		SAMPLE		SAMPLE	
Lab ID		TMA		IT		IT	
Filtered		NO		NO		NO	
Filter Size (in microns)		NAN		NAN		NAN	
Sample ID		B095L9		B0BZJ2		B0BZJ8	
Parameter	Units	Conc.	Q	Conc.	Q	Conc.	Q
Chloromethane	UG/L	10.000	U	10.000	U	10.000	U
Bromomethane	UG/L	10.000	U	10.000	U	10.000	UJ
Vinyl Chloride	UG/L	10.000	U	10.000	U	10.000	U
Chloroethane	UG/L	10.000	U	10.000	U	10.000	U
Methylene Chloride	UG/L	10.000	U	10.000	U	10.000	U
Acetone	UG/L	10.000	U	10.000	U	10.000	U
Carbon Disulfide	UG/L	10.000	U	10.000	U	10.000	U
1,1-Dichloroethene	UG/L	10.000	U	10.000	U	10.000	U
1,1-Dichloroethane	UG/L	10.000	U	10.000	U	10.000	U
1,2-Dichloroethene (total)	UG/L	10.000	U	10.000	U	10.000	U
cis-1,2-Dichloroethylene							
1,2-Dichloroethane	UG/L	10.000	U	10.000	U	10.000	U
trans-1,2-Dichloroethylene							
Chloroform	UG/L	5.000	J	10.000	U	6.000	U
2-Butanone	UG/L	10.000	U	10.000	U	10.000	U
1-Butanol							
1,1,1-Trichloroethane	UG/L	10.000	U	10.000	UJ	10.000	U
Carbon Tetrachloride	UG/L	10.000	U	10.000	UJ	10.000	U
Bromodichloromethane	UG/L	10.000	U	10.000	UJ	10.000	U
1,2-Dichloropropane	UG/L	10.000	U	10.000	U	10.000	U
cis-1,3-Dichloropropene	UG/L	10.000	U	10.000	U	10.000	U
Trichloroethene	UG/L	4.000	J	10.000	UJ	4.000	J
Dibromochloromethane	UG/L	10.000	U	10.000	UJ	10.000	U
1,1,2-Trichloroethane	UG/L	10.000	U	10.000	UJ	10.000	U
Benzene	UG/L	10.000	U	10.000	U	10.000	U
trans-1,3-Dichloropropene	UG/L	10.000	U	10.000	U	10.000	U
Bromoform	UG/L	10.000	U	10.000	U	10.000	U
4-Methyl-2-Pentanone	UG/L	10.000	U	10.000	U	10.000	U
2-Hexanone	UG/L	10.000	U	10.000	U	10.000	U
Tetrachloroethene	UG/L	10.000	U	10.000	UJ	10.000	U
Toluene	UG/L	10.000	U	10.000	UJ	10.000	UJ
1,1,2,2-Tetrachloroethane	UG/L	10.000	U	10.000	UJ	10.000	U
Chlorobenzene	UG/L	10.000	U	10.000	U	10.000	U
Ethyl Benzene	UG/L	10.000	U	10.000	UJ	10.000	UJ
Ethyl Cyanide							
Styrene	UG/L	10.000	U	10.000	UJ	10.000	UJ
Xylenes (total)	UG/L	10.000	U	10.000	UJ	10.000	UJ
Hydrazine							

VOLATILE ORGANIC Analysis Results

Program		RCRA		RCRA		RCRA	
Well ID		399-1-10A		399-1-11		399-1-12	
Round		7		7		7	
Date		6-23-94		6-22-94		6-22-94	
Sample Type		SAMPLE		SAMPLE		SAMPLE	
Lab ID		DATA CHEM		DATA CHEM		DATA CHEM	
Filtered		NO		NO		NO	
Filter Size (in microns)		NAN		NAN		NAN	
Sample ID		BOBYJ9		BOBYK1		BOBYK3	
Parameter	Units	Conc.	Q	Conc.	Q	Conc.	Q
Chloromethane							
Bromomethane							
Vinyl Chloride	UG/L	0.150	U	0.150	U	0.150	U
Chloroethane							
Methylene Chloride	UG/L	0.082	U	0.082	U	0.082	U
Acetone							
Carbon Disulfide							
1,1-Dichloroethene							
1,1-Dichloroethane	UG/L	0.080	U	0.080	U	0.080	U
1,2-Dichloroethene (total)							
cis-1,2-Dichloroethylene	UG/L	0.045	U	0.045	U	0.045	U
1,2-Dichloroethane	UG/L	0.055	U	0.055	U	0.055	U
trans-1,2-Dichloroethylene	UG/L	0.067	U	0.067	U	0.067	U
Chloroform	UG/L	0.050	U	0.050	U	0.050	U
2-Butanone							
1-Butanol							
1,1,1-Trichloroethane	UG/L	0.220	U	0.220	U	0.220	U
Carbon Tetrachloride	UG/L	0.320	U	0.320	U	0.320	U
Bromodichloromethane							
1,2-Dichloropropane							
cis-1,3-Dichloropropene							
Trichloroethene	UG/L	0.043	U	0.043	U	0.043	U
Dibromochloromethane							
1,1,2-Trichloroethane	UG/L	0.062	U	0.062	U	0.062	U
Benzene	UG/L	0.240	U	0.240	U	0.240	U
trans-1,3-Dichloropropene							
Bromoform							
4-Methyl-2-Pentanone							
2-Hexanone							
Tetrachloroethene	UG/L	0.080	U	0.410	L	0.600	
Toluene	UG/L	0.077	U	0.077	U	0.077	U
1,1,2,2-Tetrachloroethane							
Chlorobenzene							
Ethyl Benzene	UG/L	0.043	U	0.043	U	0.043	U
Ethyl Cyanide							
Styrene							
Xylenes (total)	UG/L	0.200	U	0.200	U	0.200	U
Hydrazine							

VOLATILE ORGANIC Analysis Results

Program		RCRA		RCRA		RCRA	
Well ID		399-1-14A		399-1-16A		399-1-16B	
Round		7		7		7	
Date		6-22-94		6-23-94		6-22-94	
Sample Type		SAMPLE		SAMPLE		SAMPLE	
Lab ID		DATA CHEM		DATA CHEM		DATA CHEM	
Filtered		NO		NO		NO	
Filter Size (in microns)		NAN		NAN		NAN	
Sample ID		B0BYK5		B0BYK7		B0BYK9	
Parameter	Units	Conc.	Q	Conc.	Q	Conc.	Q
Chloromethane							
Bromomethane							
Vinyl Chloride	UG/L	0.150	U	0.150	U	0.150	U
Chloroethane							
Methylene Chloride	UG/L	0.082	U	0.082	U	0.082	U
Acetone							
Carbon Disulfide							
1,1-Dichloroethene							
1,1-Dichloroethane	UG/L	0.080	U	0.080	U	0.080	U
1,2-Dichloroethene (total)							
cis-1,2-Dichloroethylene	UG/L	0.045	U	0.045	U	130.000	D
1,2-Dichloroethane	UG/L	0.055	U	0.055	U	0.055	U
trans-1,2-Dichloroethylene	UG/L	0.067	U	0.067	U	0.067	U
Chloroform	UG/L	0.050	U	0.050	U	0.050	U
2-Butanone							
1-Butanol							
1,1,1-Trichloroethane	UG/L	0.220	U	0.220	U	0.220	U
Carbon Tetrachloride	UG/L	0.320	U	0.320	U	0.320	U
Bromodichloromethane							
1,2-Dichloropropane							
cis-1,3-Dichloropropene							
Trichloroethene	UG/L	0.043	U	0.100	L	5.400	
Dibromochloromethane							
1,1,2-Trichloroethane	UG/L	0.062	U	0.062	U	0.062	U
Benzene	UG/L	0.240	U	0.240	U	0.240	U
trans-1,3-Dichloropropene							
Bromoform							
4-Methyl-2-Pentanone							
2-Hexanone							
Tetrachloroethene	UG/L	0.740		0.088	L	0.080	U
Toluene	UG/L	0.077	U	0.077	U	0.077	U
1,1,2,2-Tetrachloroethane							
Chlorobenzene							
Ethyl Benzene	UG/L	0.043	U	0.043	U	0.084	L
Ethyl Cyanide							
Styrene							
Xylenes (total)	UG/L	0.200	U	0.200	U	0.200	U
Hydrazine							

VOLATILE ORGANIC Analysis Results

Program		CERCLA		RCRA		RCRA	
Well ID		399-1-16C		399-1-17A		399-1-17A	
Round		7		7		7	
Date		6-24-94		4-18-94		6-22-94	
Sample Type		SAMPLE		SAMPLE		SAMPLE	
Lab ID		IT		DATA CHEM		DATA CHEM	
Filtered		NO		NO		NO	
Filter Size (in microns)		NAN		NAN		NAN	
Sample ID		B0BZK0		B0BQM6		B0BYL1	
Parameter	Units	Conc.	Q	Conc.	Q	Conc.	Q
Chloromethane	UG/L	10.000	U				
Bromomethane	UG/L	10.000	U				
Vinyl Chloride	UG/L	10.000	U			0.150	U
Chloroethane	UG/L	10.000	U				
Methylene Chloride	UG/L	10.000	U			0.082	U
Acetone	UG/L	10.000	U				
Carbon Disulfide	UG/L	10.000	U				
1,1-Dichloroethene	UG/L	10.000	U				
1,1-Dichloroethane	UG/L	10.000	U			0.080	U
1,2-Dichloroethene (total)	UG/L	10.000	U				
cis-1,2-Dichloroethylene	UG/L			0.050	U	0.045	U
1,2-Dichloroethane	UG/L	10.000	U			0.055	U
trans-1,2-Dichloroethylene	UG/L					0.067	U
Chloroform	UG/L	10.000	U	8.600	B	7.600	
2-Butanone	UG/L	11.000					
1-Butanol							
1,1,1-Trichloroethane	UG/L	10.000	UJ			0.220	U
Carbon Tetrachloride	UG/L	10.000	UJ			0.320	U
Bromodichloromethane	UG/L	10.000	UJ				
1,2-Dichloropropane	UG/L	10.000	U				
cis-1,3-Dichloropropene	UG/L	10.000	U				
Trichloroethene	UG/L	10.000	UJ	0.040	U	0.076	L
Dibromochloromethane	UG/L	10.000	UJ				
1,1,2-Trichloroethane	UG/L	10.000	UJ			0.062	U
Benzene	UG/L	10.000	U			0.240	U
trans-1,3-Dichloropropene	UG/L	10.000	U				
Bromoform	UG/L	10.000	U				
4-Methyl-2-Pentanone	UG/L	10.000	U				
2-Hexanone	UG/L	10.000	U				
Tetrachloroethene	UG/L	10.000	UJ	0.080	U	0.510	
Toluene	UG/L	10.000	UJ			0.077	U
1,1,2,2-Tetrachloroethane	UG/L	10.000	UJ				
Chlorobenzene	UG/L	10.000	U				
Ethyl Benzene	UG/L	10.000	UJ	0.040	U	0.043	U
Ethyl Cyanide							
Styrene	UG/L	10.000	UJ				
Xylenes (total)	UG/L	10.000	UJ			0.200	U
Hydrazine							

VOLATILE ORGANIC Analysis Results

Program		RCRA		RCRA		CERCLA	
Well ID		399-1-17B		399-1-18A		399-1-21A	
Round		7		7		7	
Date		6-22-94		6-22-94		6-24-94	
Sample Type		SAMPLE		SAMPLE		SAMPLE	
Lab ID		DATA CHEM		DATA CHEM		IT	
Filtered		NO		NO		NO	
Filter Size (in microns)		NAN		NAN		NAN	
Sample ID		B0BYL6		B0BYL8		B0BZK2	
Parameter	Units	Conc.	Q	Conc.	Q	Conc.	Q
Chloromethane	UG/L					10.000	U
Bromomethane	UG/L					10.000	U
Vinyl Chloride	UG/L	0.150	U	0.150	U	10.000	U
Chloroethane	UG/L					10.000	U
Methylene Chloride	UG/L	0.082	U	0.082	U	10.000	U
Acetone	UG/L					10.000	U
Carbon Disulfide	UG/L					10.000	U
1,1-Dichloroethene	UG/L					10.000	U
1,1-Dichloroethane	UG/L	0.080	U	0.080	U	10.000	U
1,2-Dichloroethene (total)	UG/L					10.000	U
cis-1,2-Dichloroethylene	UG/L	1.500		0.045	U		
1,2-Dichloroethane	UG/L	0.055	U	0.055	U	10.000	U
trans-1,2-Dichloroethylene	UG/L	0.067	U	0.067	U		
Chloroform	UG/L	0.050	U	0.050	U	7.000	U
2-Butanone	UG/L					10.000	U
1-Butanol							
1,1,1-Trichloroethane	UG/L	0.220	U	0.220	U	10.000	UJ
Carbon Tetrachloride	UG/L	0.320	U	0.320	U	10.000	UJ
Bromodichloromethane	UG/L					10.000	UJ
1,2-Dichloropropane	UG/L					10.000	U
cis-1,3-Dichloropropene	UG/L					10.000	U
Trichloroethene	UG/L	0.043	U	0.043	U	10.000	UJ
Dibromochloromethane	UG/L					10.000	UJ
1,1,2-Trichloroethane	UG/L	0.062	U	0.062	U	10.000	UJ
Benzene	UG/L	0.240	U	0.240	U	10.000	U
trans-1,3-Dichloropropene	UG/L					10.000	U
Bromoform	UG/L					10.000	U
4-Methyl-2-Pentanone	UG/L					10.000	U
2-Hexanone	UG/L					10.000	U
Tetrachloroethene	UG/L	0.080	U	0.080	U	10.000	UJ
Toluene	UG/L	0.077	U	0.077	U	10.000	UJ
1,1,2,2-Tetrachloroethane	UG/L					10.000	UJ
Chlorobenzene	UG/L					10.000	U
Ethyl Benzene	UG/L	0.043	U	0.043	U	10.000	UJ
Ethyl Cyanide							
Styrene	UG/L					10.000	UJ
Xylenes (total)	UG/L	0.200	U	0.200	U	10.000	UJ
Hydrazine							

VOLATILE ORGANIC Analysis Results

Program		RCRA		CERCLA		CERCLA	
Well ID		399-2-1		399-2-2		399-3-2	
Round		7		7		7	
Date		6-23-94		6-23-94		6-22-94	
Sample Type		SAMPLE		SAMPLE		SAMPLE	
Lab ID		DATA CHEM		IT		IT	
Filtered		NO		NO		NO	
Filter Size (in microns)		NAN		NAN		NAN	
Sample ID		BOBYM0		BOBZK4		BOBZK8	
Parameter	Units	Conc.	Q	Conc.	Q	Conc.	Q
Chloromethane	UG/L			10.000	U	10.000	U
Bromomethane	UG/L			10.000	U	10.000	U
Vinyl Chloride	UG/L	0.150	U	10.000	U	10.000	U
Chloroethane	UG/L			10.000	U	10.000	U
Methylene Chloride	UG/L	0.082	U	10.000	U	10.000	U
Acetone	UG/L			10.000	U	10.000	U
Carbon Disulfide	UG/L			10.000	U	10.000	U
1,1-Dichloroethene	UG/L			10.000	U	10.000	U
1,1-Dichloroethane	UG/L	0.080	U	10.000	U	10.000	U
1,2-Dichloroethene (total)	UG/L			10.000	U	10.000	U
cis-1,2-Dichloroethylene	UG/L	0.045	U				
1,2-Dichloroethane	UG/L	0.055	U	10.000	U	10.000	U
trans-1,2-Dichloroethylene	UG/L	0.067	U				
Chloroform	UG/L	0.850		4.000	U	10.000	U
2-Butanone	UG/L			10.000	U	10.000	U
1-Butanol							
1,1,1-Trichloroethane	UG/L	0.220	U	10.000	UJ	10.000	U
Carbon Tetrachloride	UG/L	0.320	U	10.000	UJ	10.000	U
Bromodichloromethane	UG/L			10.000	UJ	10.000	U
1,2-Dichloropropane	UG/L			10.000	U	10.000	U
cis-1,3-Dichloropropene	UG/L			10.000	U	10.000	U
Trichloroethene	UG/L	0.930	L	7.000	J	10.000	U
Dibromochloromethane	UG/L			10.000	UJ	10.000	U
1,1,2-Trichloroethane	UG/L	0.062	U	10.000	UJ	10.000	U
Benzene	UG/L	0.240	U	10.000	U	10.000	U
trans-1,3-Dichloropropene	UG/L			10.000	U	10.000	U
Bromoform	UG/L			10.000	U	10.000	U
4-Methyl-2-Pentanone	UG/L			10.000	U	10.000	U
2-Hexanone	UG/L			10.000	U	10.000	U
Tetrachloroethene	UG/L	0.080	U	10.000	UJ	10.000	U
Toluene	UG/L	0.077	U	10.000	UJ	10.000	UJ
1,1,2,2-Tetrachloroethane	UG/L			10.000	UJ	10.000	U
Chlorobenzene	UG/L			10.000	U	10.000	U
Ethyl Benzene	UG/L	0.043	U	10.000	UJ	10.000	UJ
Ethyl Cyanide							
Styrene	UG/L			10.000	UJ	10.000	UJ
Xylenes (total)	UG/L	0.200	U	10.000	UJ	10.000	UJ
Hydrazine							

VOLATILE ORGANIC Analysis Results

Program		RCRA		CERCLA		CERCLA	
Well ID		399-3-10		399-3-11		399-3-12	
Round		7		7		7	
Date		6-23-94		6-22-94		6-22-94	
Sample Type		SAMPLE		SAMPLE		SAMPLE	
Lab ID		DATA CHEM		IT		IT	
Filtered		NO		NO		NO	
Filter Size (in microns)		NAN		NAN		NAN	
Sample ID		BOBYM2		BOBZL0		BOBZL4	
Parameter	Units	Conc.	Q	Conc.	Q	Conc.	Q
Chloromethane	UG/L			10.000	U	10.000	U
Bromomethane	UG/L			10.000	U	10.000	UJ
Vinyl Chloride	UG/L	0.150	U	10.000	U	10.000	U
Chloroethane	UG/L			10.000	U	10.000	U
Methylene Chloride	UG/L	0.082	U	10.000	U	10.000	U
Acetone	UG/L			10.000	U	10.000	U
Carbon Disulfide	UG/L			10.000	U	10.000	U
1,1-Dichloroethene	UG/L			10.000	U	10.000	U
1,1-Dichloroethane	UG/L	0.080	U	10.000	U	10.000	U
1,2-Dichloroethene (total)	UG/L			10.000	U	10.000	U
cis-1,2-Dichloroethylene	UG/L	0.045	U				
1,2-Dichloroethane	UG/L	0.055	U	10.000	U	10.000	U
trans-1,2-Dichloroethylene	UG/L	0.067	U				
Chloroform	UG/L	0.990		2.000	U	2.000	U
2-Butanone	UG/L			10.000	U	10.000	U
1-Butanol							
1,1,1-Trichloroethane	UG/L	0.220	U	10.000	U	10.000	U
Carbon Tetrachloride	UG/L	0.320	U	10.000	U	10.000	U
Bromodichloromethane	UG/L			10.000	U	10.000	U
1,2-Dichloropropane	UG/L			10.000	U	10.000	U
cis-1,3-Dichloropropene	UG/L			10.000	U	10.000	U
Trichloroethene	UG/L	0.740	L	3.000	J	2.000	J
Dibromochloromethane	UG/L			10.000	U	10.000	U
1,1,2-Trichloroethane	UG/L	0.062	U	10.000	U	10.000	U
Benzene	UG/L	0.240	U	10.000	U	10.000	U
trans-1,3-Dichloropropene	UG/L			10.000	U	10.000	U
Bromoform	UG/L			10.000	U	10.000	U
4-Methyl-2-Pentanone	UG/L			10.000	U	10.000	U
2-Hexanone	UG/L			10.000	U	10.000	U
Tetrachloroethene	UG/L	0.080	U	10.000	U	10.000	U
Toluene	UG/L	0.077	U	10.000	UJ	10.000	UJ
1,1,2,2-Tetrachloroethane	UG/L			10.000	U	10.000	U
Chlorobenzene	UG/L			10.000	U	10.000	U
Ethyl Benzene	UG/L	0.043	U	10.000	UJ	10.000	UJ
Ethyl Cyanide							
Styrene	UG/L			10.000	UJ	10.000	UJ
Xylenes (total)	UG/L	0.200	U	10.000	UJ	10.000	UJ
Hydrazine							

VOLATILE ORGANIC Analysis Results

Program		CERCLA		CERCLA		CERCLA	
Well ID		399-4-7		399-4-10		399-4-12	
Round		7		7		7	
Date		6-23-94		6-23-94		6-22-94	
Sample Type		SAMPLE		SAMPLE		SAMPLE	
Lab ID		IT		IT		IT	
Filtered		NO		NO		NO	
Filter Size (in microns)		NAN		NAN		NAN	
Sample ID		B0BZL6		B0BZM0		B0BZM4	
Parameter	Units	Conc.	Q	Conc.	Q	Conc.	Q
Chloromethane	UG/L	10.000	U	10.000	U	10.000	U
Bromomethane	UG/L	10.000	U	10.000	U	10.000	UJ
Vinyl Chloride	UG/L	10.000	U	10.000	U	10.000	U
Chloroethane	UG/L	10.000	U	10.000	U	10.000	U
Methylene Chloride	UG/L	10.000	U	10.000	U	10.000	U
Acetone	UG/L	10.000	U	10.000	U	10.000	U
Carbon Disulfide	UG/L	10.000	U	10.000	U	10.000	U
1,1-Dichloroethene	UG/L	10.000	U	10.000	U	10.000	U
1,1-Dichloroethane	UG/L	10.000	U	10.000	U	10.000	U
1,2-Dichloroethene (total)	UG/L	10.000	U	10.000	U	10.000	U
cis-1,2-Dichloroethylene							
1,2-Dichloroethane	UG/L	10.000	U	10.000	U	10.000	U
trans-1,2-Dichloroethylene							
Chloroform	UG/L	3.000	U	4.000	U	7.000	U
2-Butanone	UG/L	10.000	U	10.000	U	10.000	U
1-Butanol							
1,1,1-Trichloroethane	UG/L	10.000	UJ	10.000	UJ	10.000	U
Carbon Tetrachloride	UG/L	10.000	UJ	10.000	UJ	10.000	U
Bromodichloromethane	UG/L	10.000	UJ	10.000	UJ	10.000	U
1,2-Dichloropropane	UG/L	10.000	U	10.000	U	10.000	U
cis-1,3-Dichloropropene	UG/L	10.000	U	10.000	U	10.000	U
Trichloroethene	UG/L	2.000	J	10.000	UJ	7.000	J
Dibromochloromethane	UG/L	10.000	UJ	10.000	UJ	10.000	U
1,1,2-Trichloroethane	UG/L	10.000	UJ	10.000	UJ	10.000	U
Benzene	UG/L	10.000	U	10.000	U	10.000	U
trans-1,3-Dichloropropene	UG/L	10.000	U	10.000	U	10.000	U
Bromoform	UG/L	10.000	U	10.000	U	10.000	U
4-Methyl-2-Pentanone	UG/L	10.000	U	10.000	U	10.000	U
2-Hexanone	UG/L	10.000	U	10.000	U	10.000	U
Tetrachloroethene	UG/L	10.000	UJ	10.000	UJ	10.000	U
Toluene	UG/L	10.000	UJ	10.000	UJ	10.000	UJ
1,1,2,2-Tetrachloroethane	UG/L	10.000	UJ	10.000	UJ	10.000	U
Chlorobenzene	UG/L	10.000	U	10.000	U	10.000	U
Ethyl Benzene	UG/L	10.000	UJ	10.000	UJ	10.000	UJ
Ethyl Cyanide							
Styrene	UG/L	10.000	UJ	10.000	UJ	10.000	UJ
Xylenes (total)	UG/L	10.000	UJ	10.000	UJ	10.000	UJ
Hydrazine							

APPENDIX C

URANIUM DATA TRENDS

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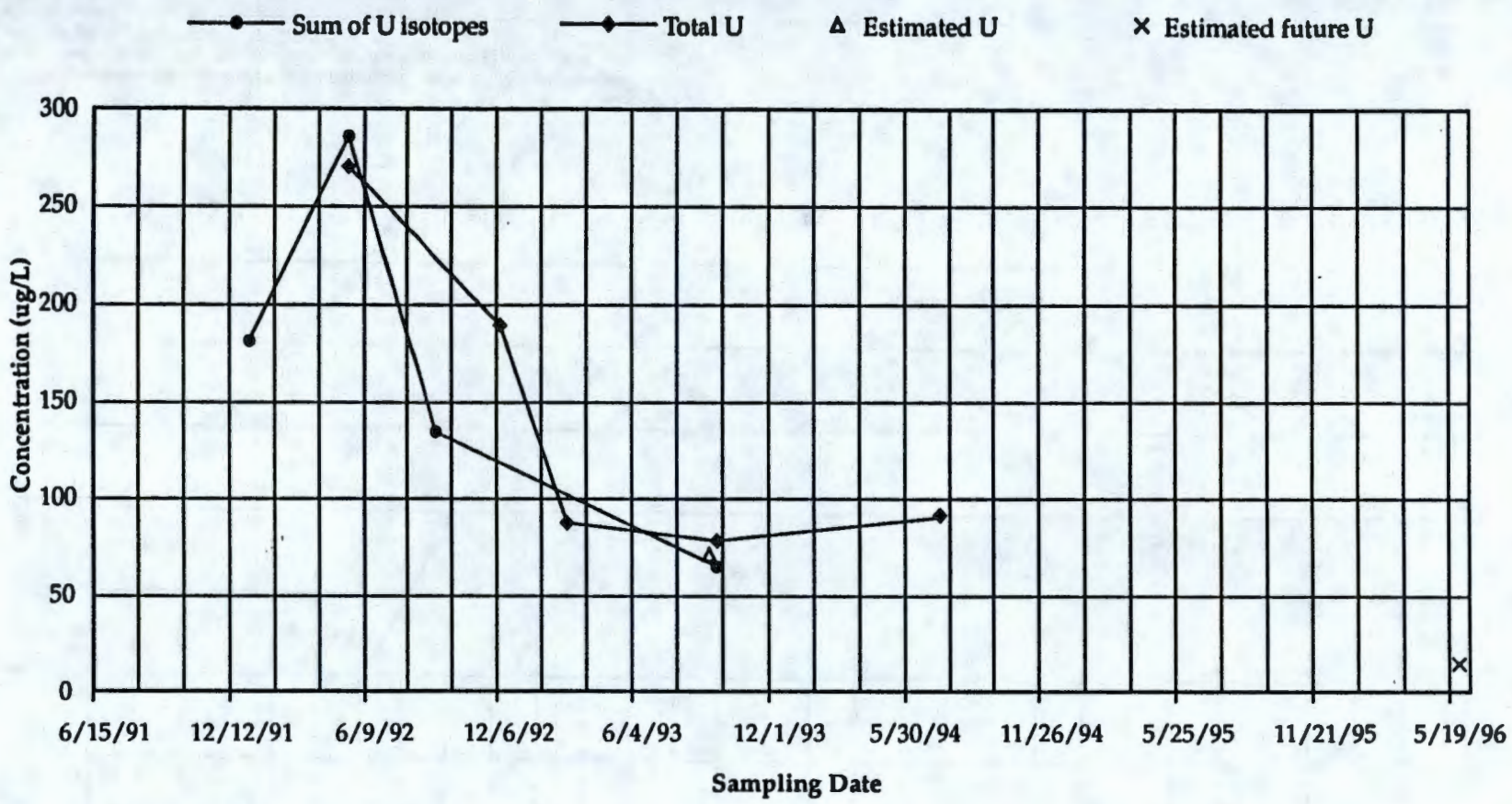
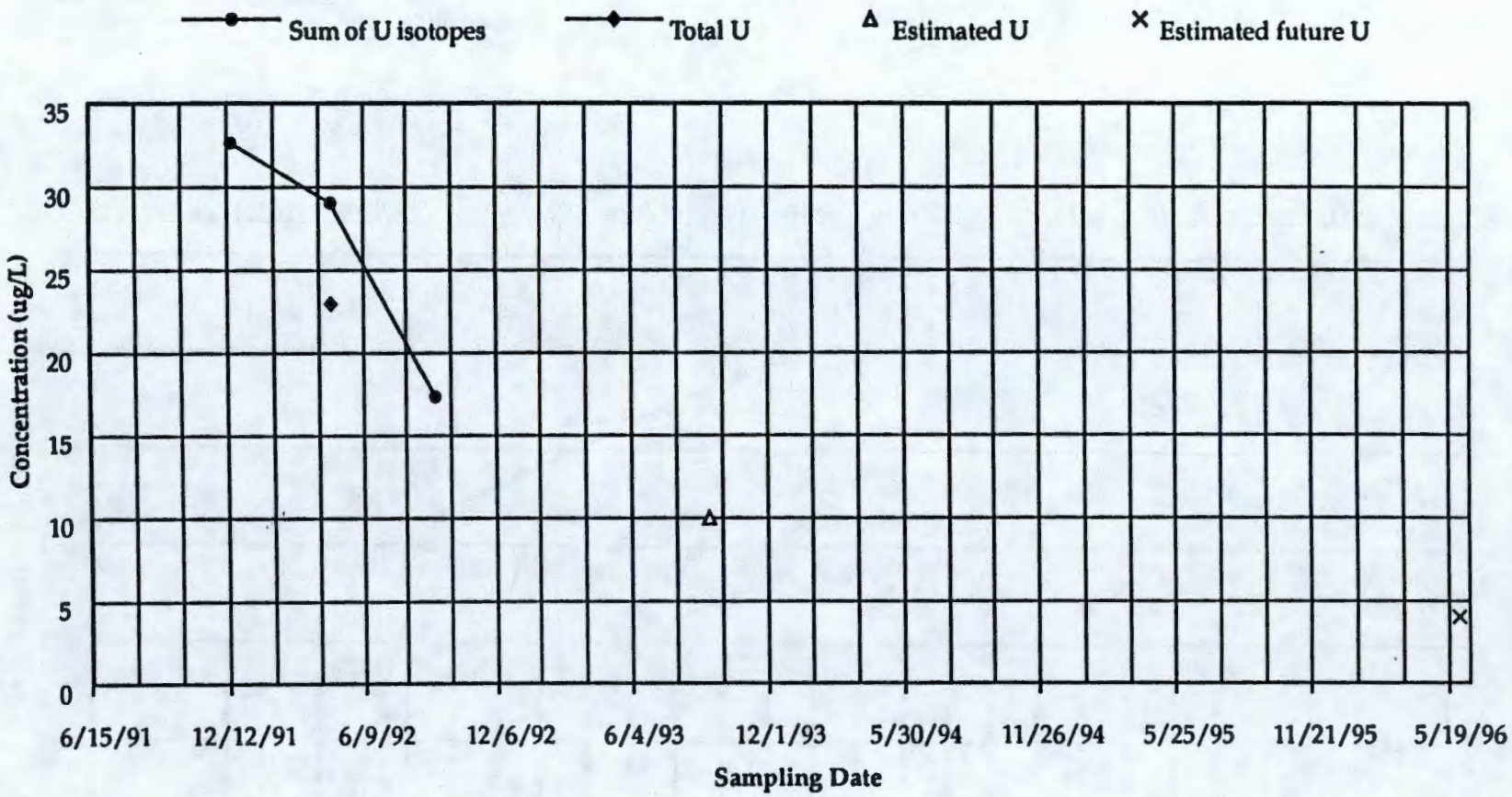
9513333.1507



Note: The estimated values shown are interpreted values based on the data collected and any apparent trends. These values are used to create the conceptual plume maps shown in Chapter 4.

923 E426/53155/10-4-94

Figure C-1. Uranium Concentration Trends at Well 399-1-5.

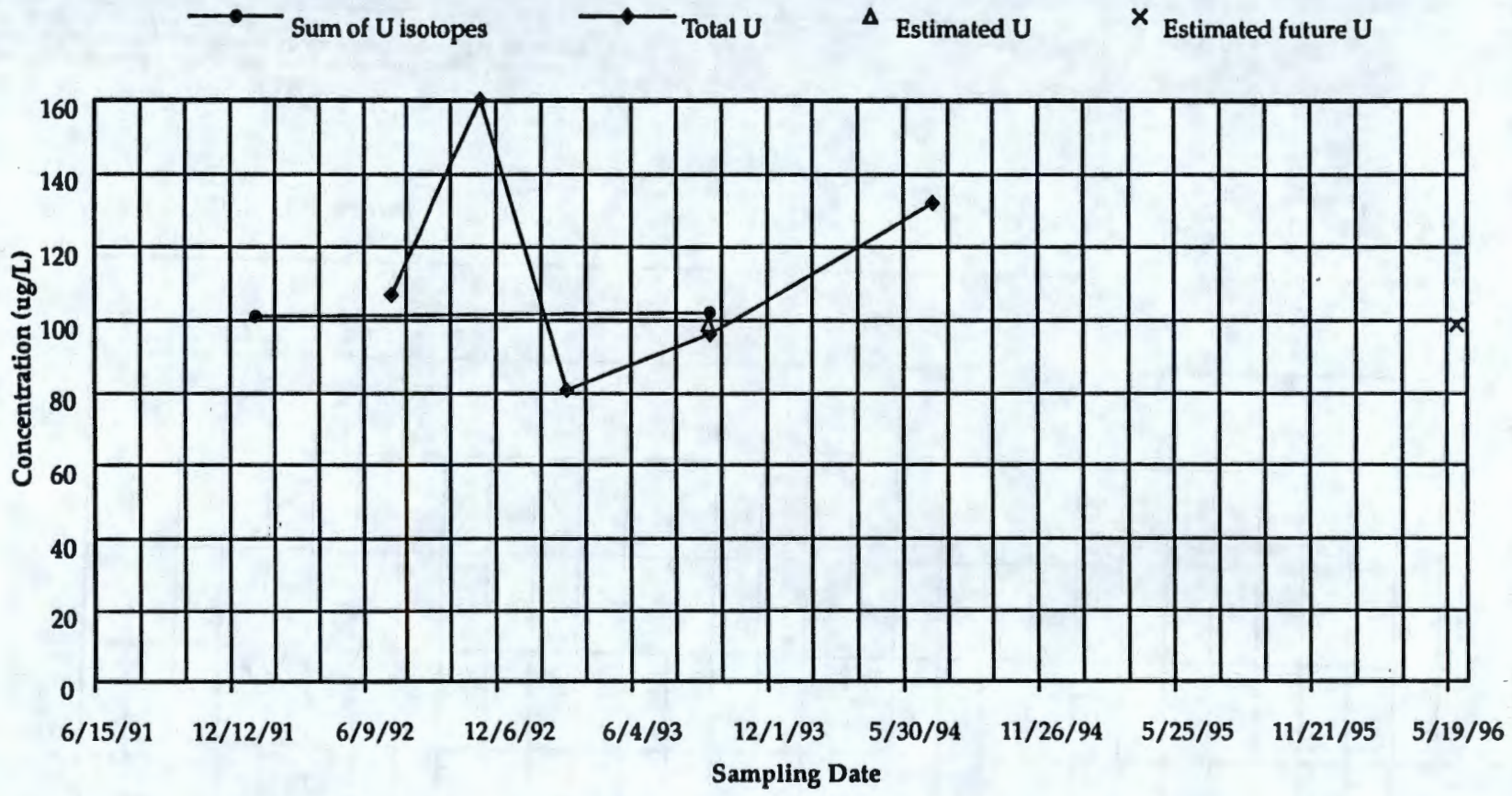


Note: The estimated values shown are interpreted values based on the data collected and any apparent trends. These values are used to create the conceptual plume maps shown in Chapter 4.

923 E426/53156/10-4-94

Figure C-2. Uranium Concentration Trends at Well 399-1-6.

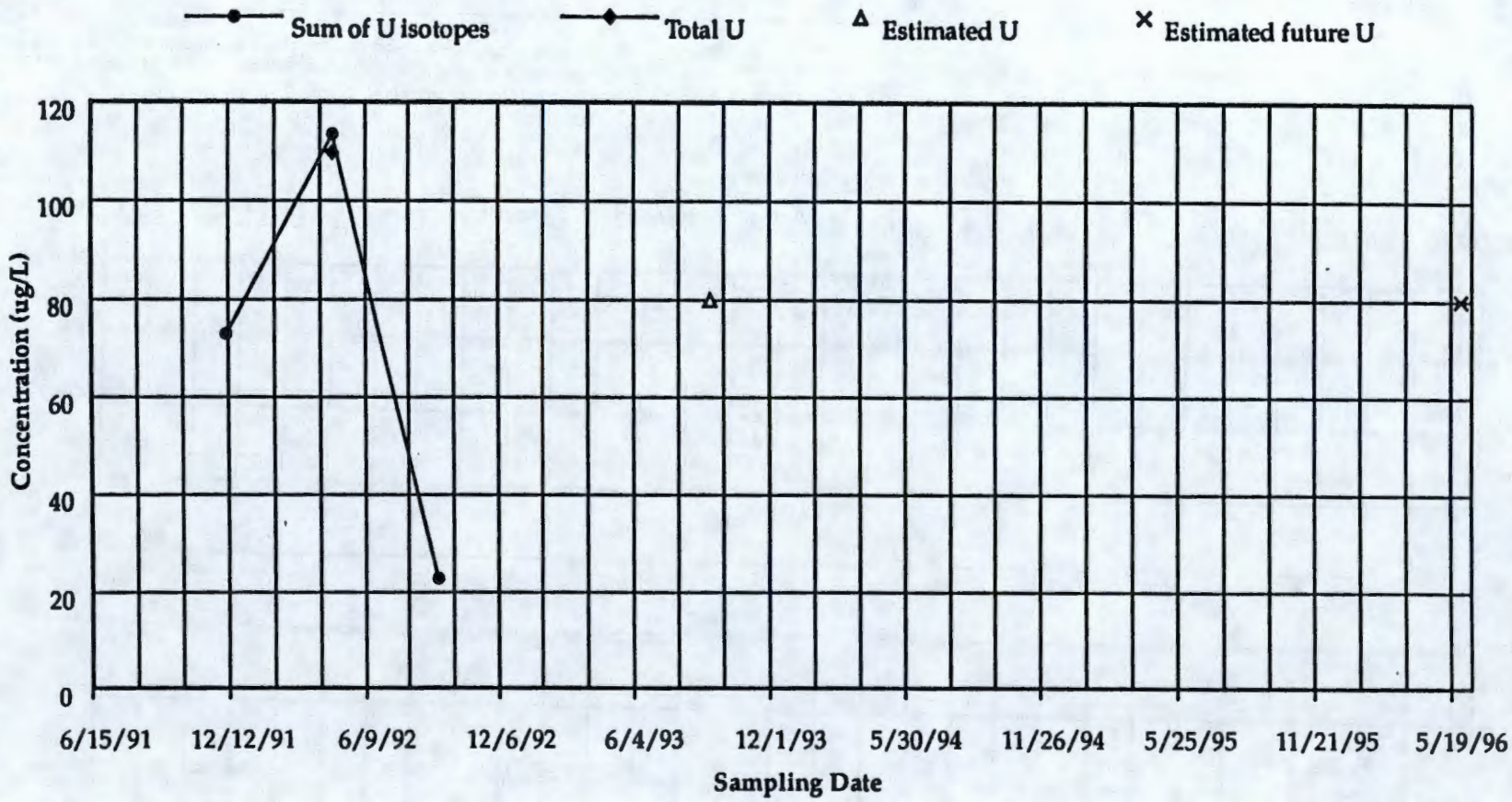
9513333.1508



Note: The estimated values shown are interpreted values based on the data collected and any apparent trends. These values are used to create the conceptual plume maps shown in Chapter 4.

923 E426/53157/10-4-94

Figure C-3. Uranium Concentration Trends at Well 399-1-7.

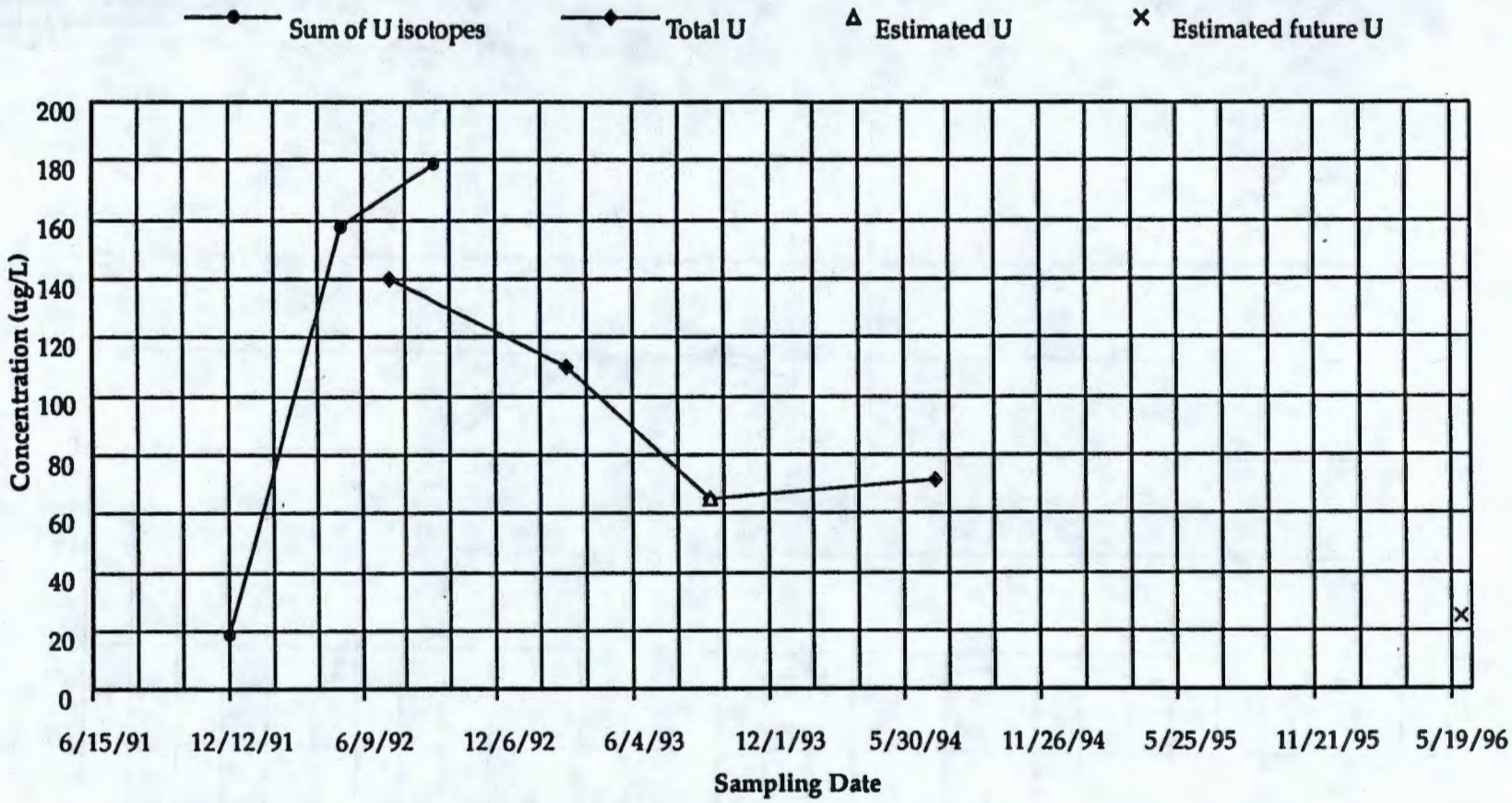


Note: The estimated values shown are interpreted values based on the data collected and any apparent trends. These values are used to create the conceptual plume maps shown in Chapter 4.

923 E426/53158/10-4-94

Figure C-4. Uranium Concentration Trends at Well 399-1-8.

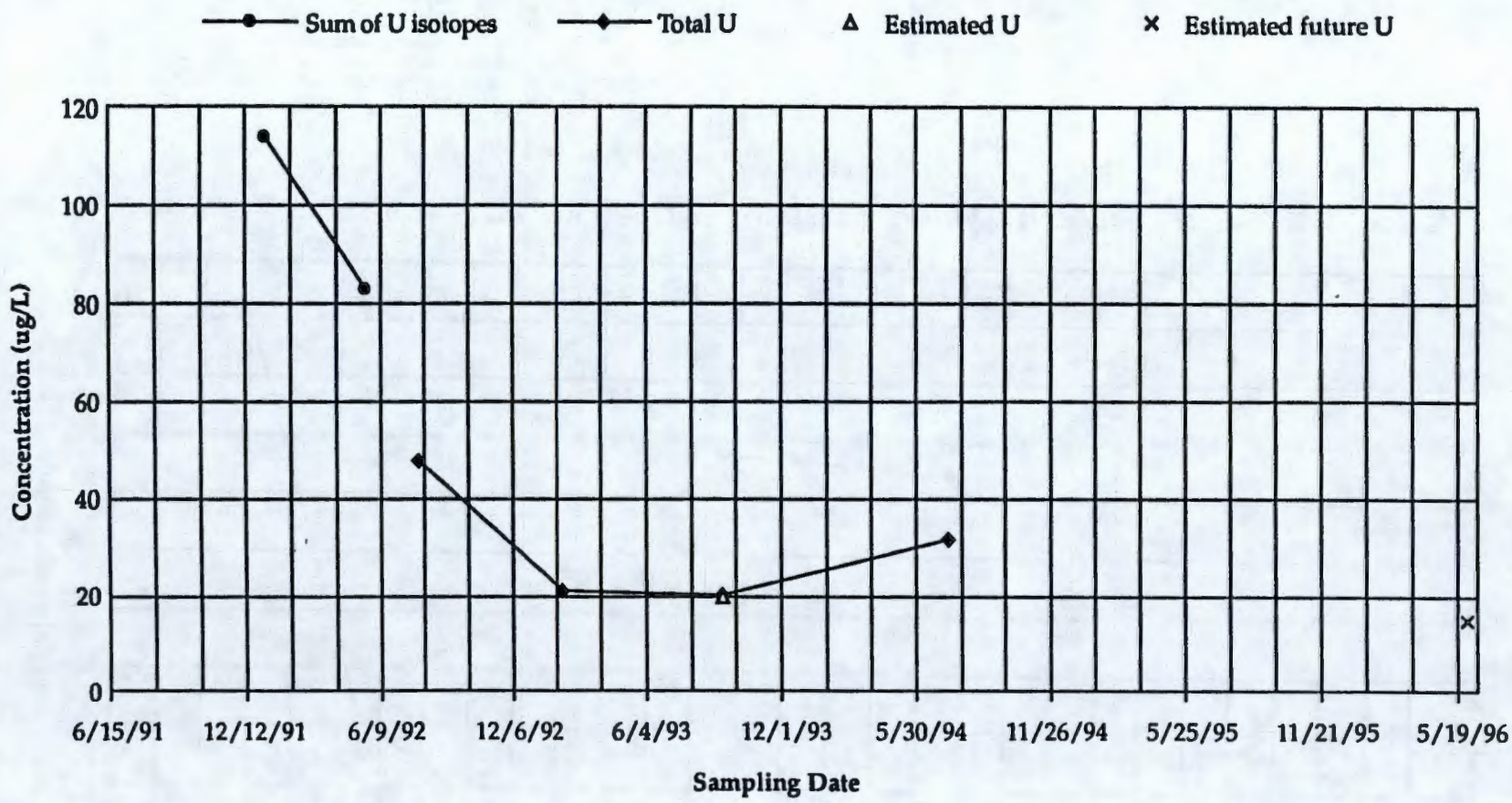
9513333.1509



Note: The estimated values shown are interpreted values based on the data collected and any apparent trends. These values are used to create the conceptual plume maps shown in Chapter 4.

923 E426/53148/10-4-94

Figure C-5. Uranium Concentration Trends at Well 399-1-10A.

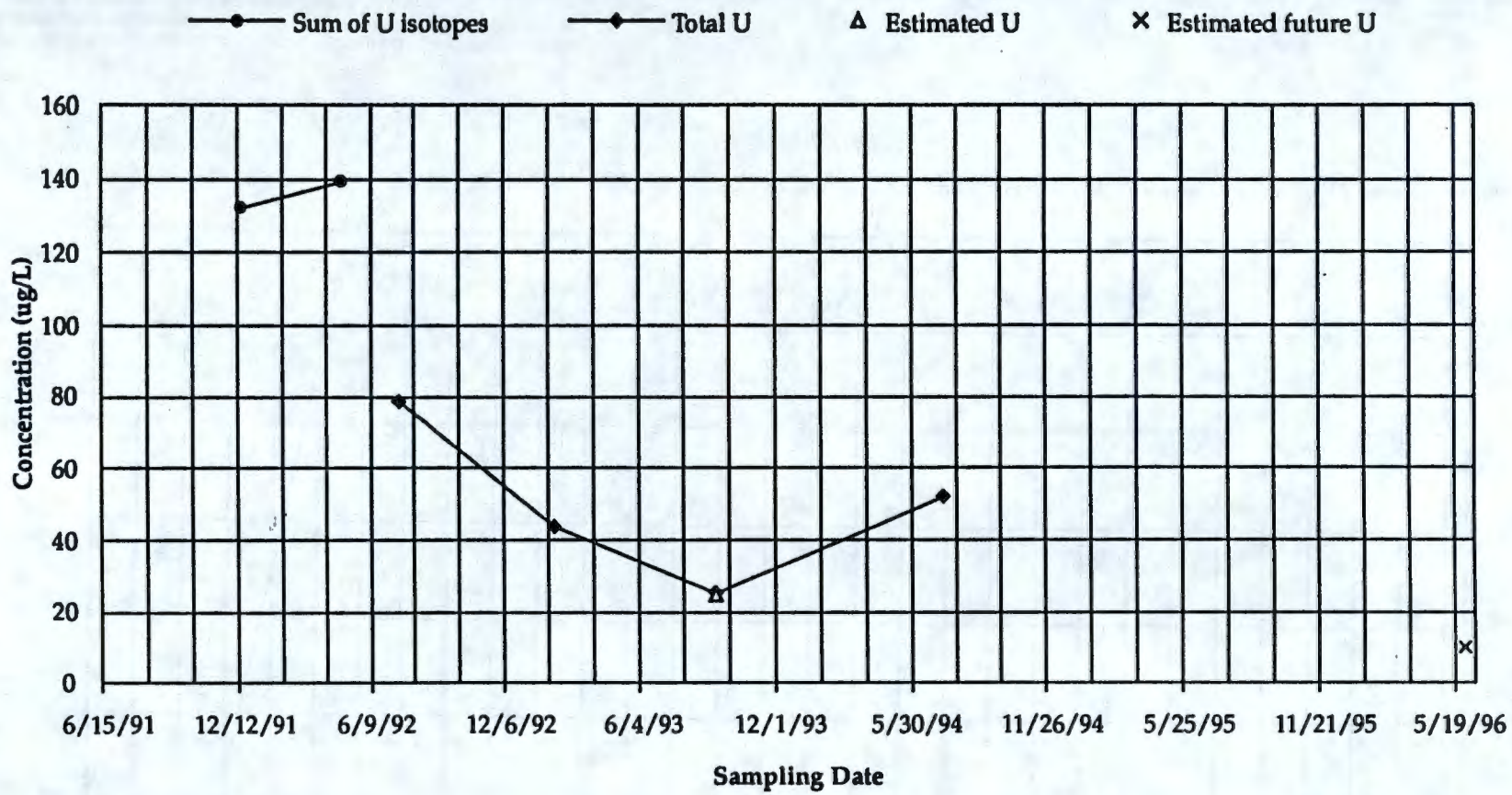


Note: The estimated values shown are interpreted values based on the data collected and any apparent trends. These values are used to create the conceptual plume maps shown in Chapter 4.

923 E426/53149/10-4-94

Figure C-6. Uranium Concentration Trends at Well 399-1-11.

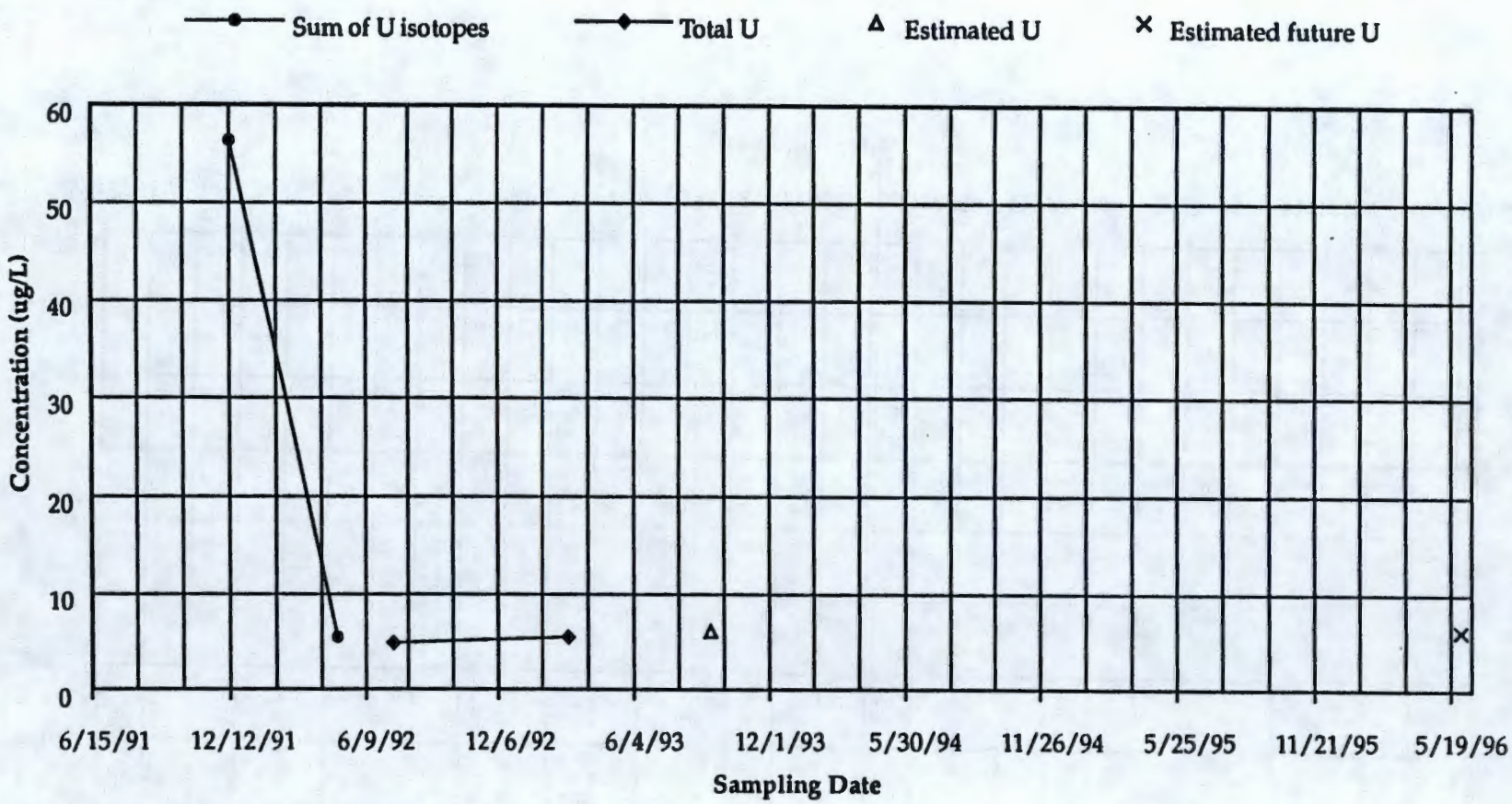
9513333.1510



Note: The estimated values shown are interpreted values based on the data collected and any apparent trends. These values are used to create the conceptual plume maps shown in Chapter 4.

923 E426/53150/10-4-94

Figure C-7. Uranium Concentration Trends at Well 399-1-12.

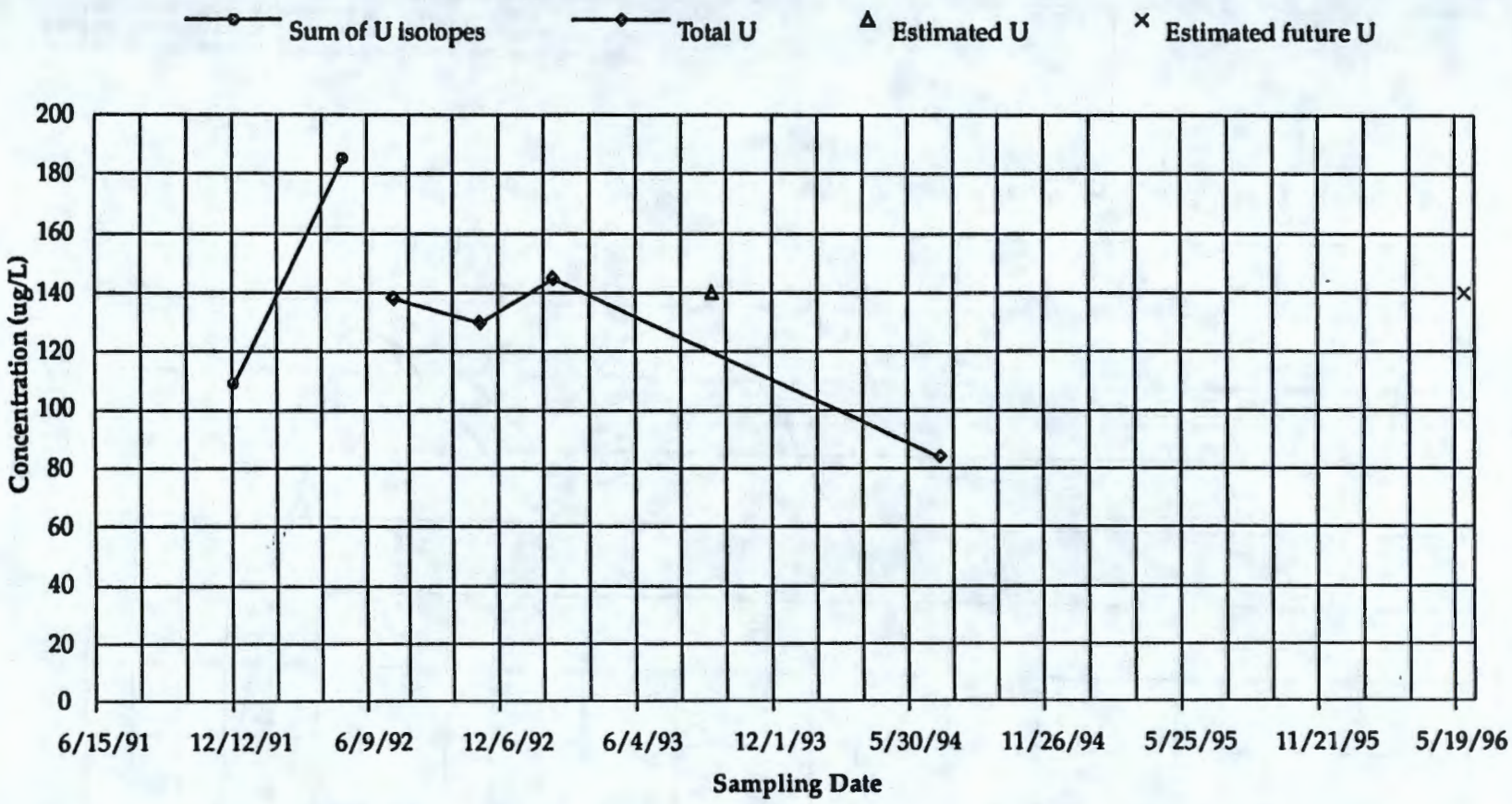


Note: The estimated values shown are interpreted values based on the data collected and any apparent trend. These values are used to create the conceptual plume maps shown in Chapter 4.

923 E426/53151/10-4-94

Figure C-8. Uranium Concentration Trends at Well 399-1-15.

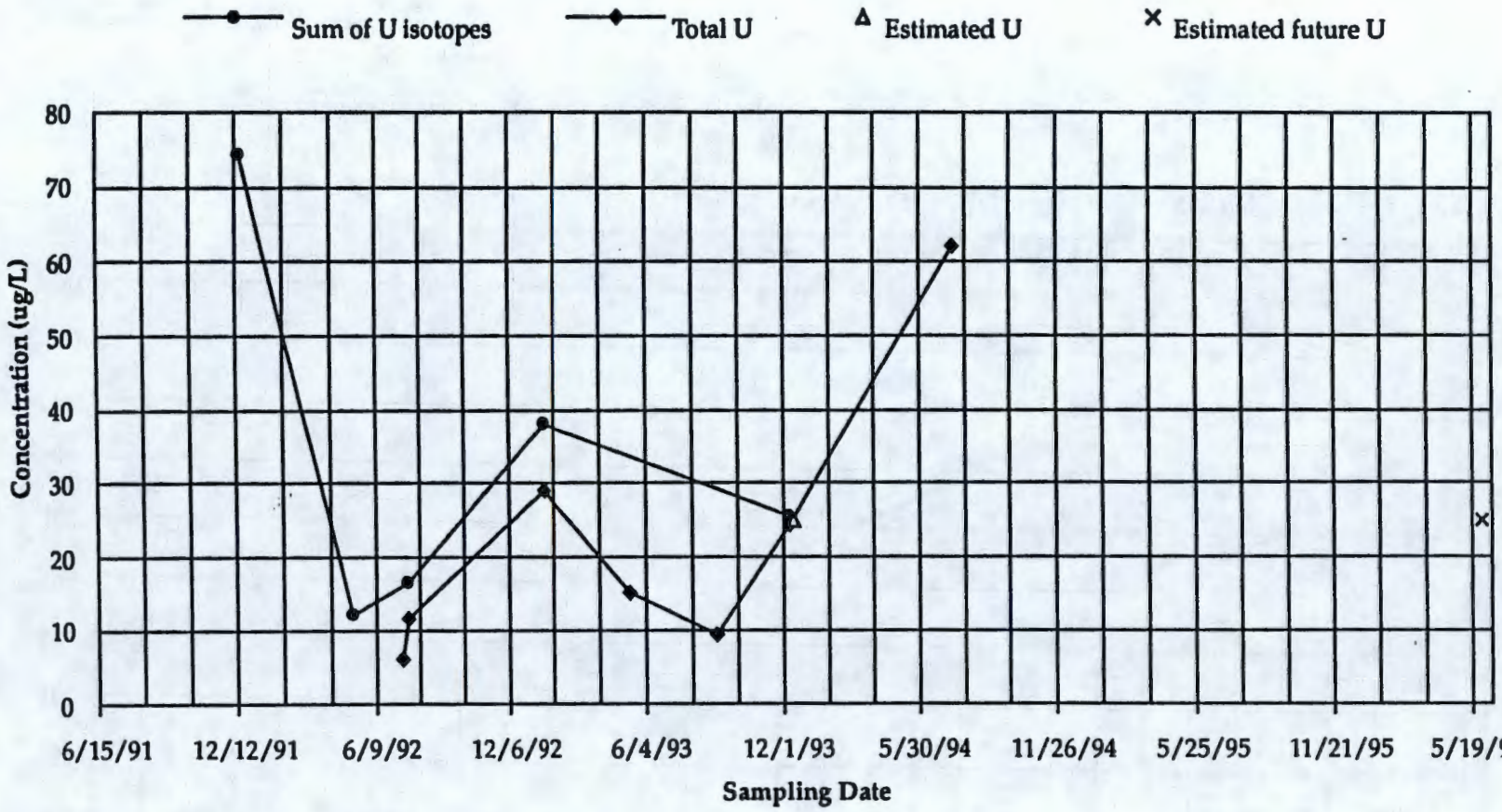
9513333.1511



Note: The estimated values shown are interpreted values based on the data collected and any apparent trends. These values are used to create the conceptual plume maps shown in Chapter 4.

923 E426/53152/10-5-94

Figure C-9. Uranium Concentration Trends at Well 399-1-16A.

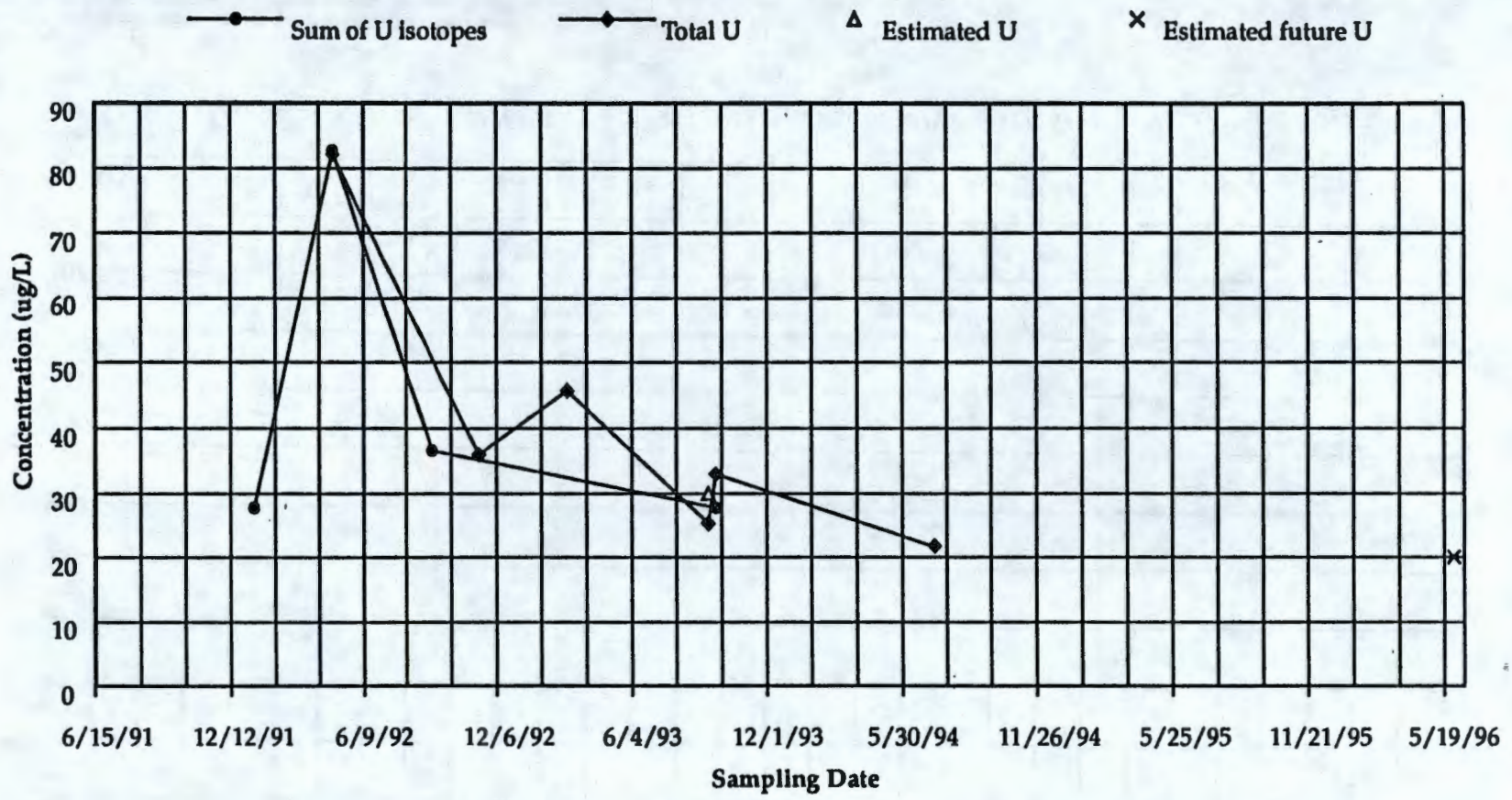


Note: The estimated values shown are interpreted values based on the data collected and any apparent trends. These values are used to create the conceptual plume maps shown in Chapter 4.

923 E426/53153/10-4-94

Figure C-10. Uranium Concentration Trends at Well 399-1-17A.

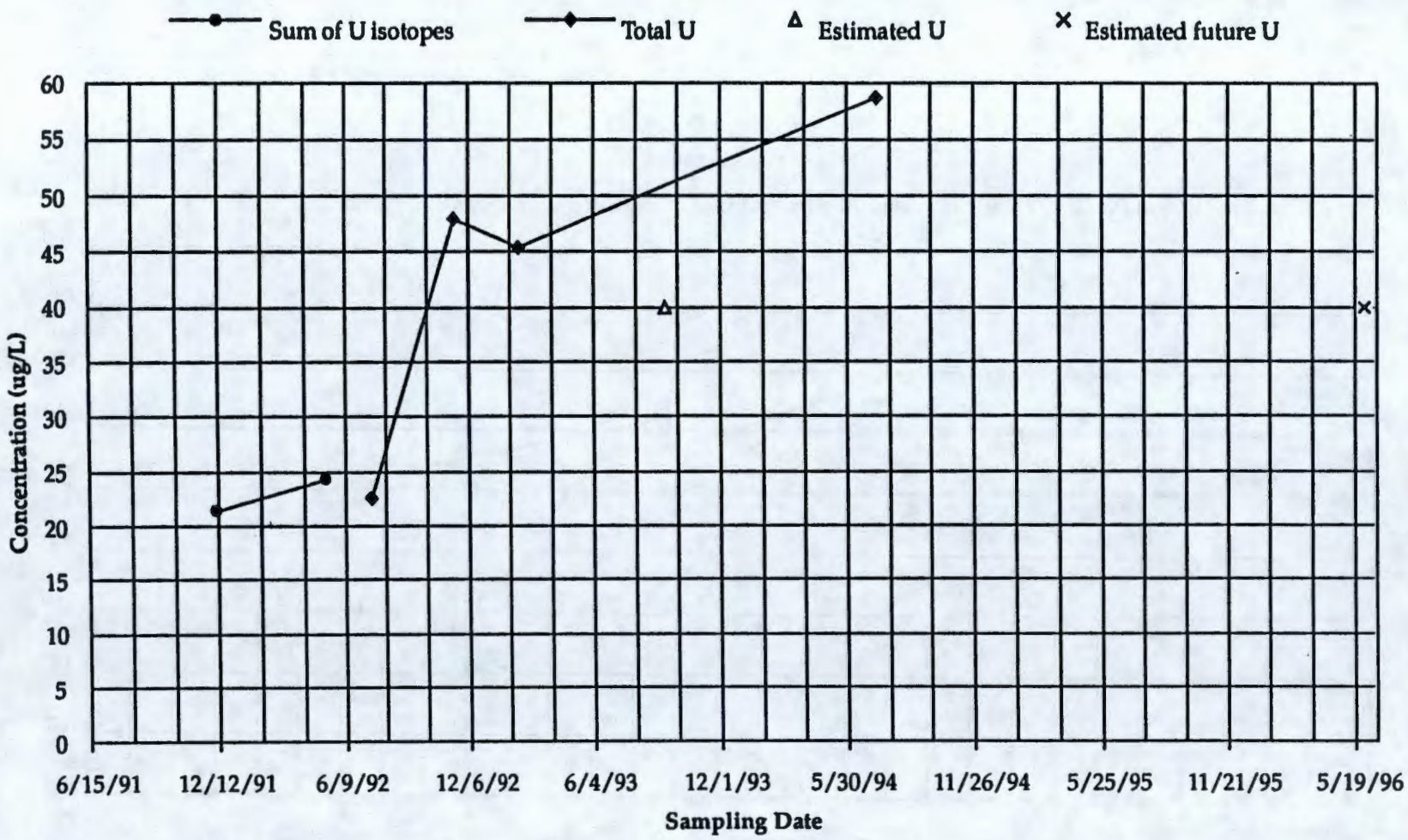
9513333.1512



Note: The estimated values shown are interpreted values based on the data collected and any apparent trends. These values are used to create the conceptual plume maps shown in Chapter 4.

923 E426/53154/10-4-94

Figure C-11. Uranium Concentration Trends at Well 399-1-21A.

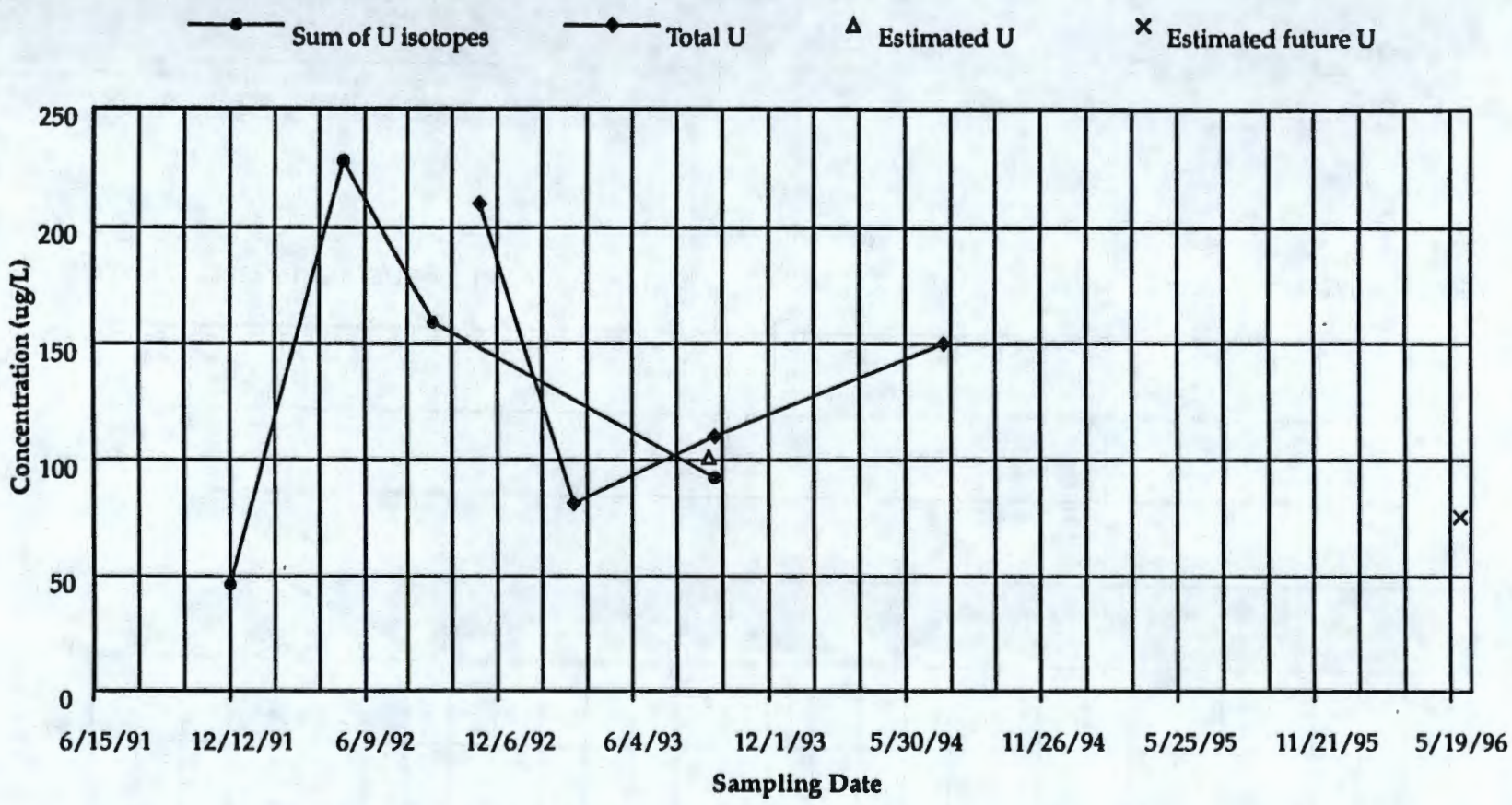


Note: The estimated values shown are interpreted values based on the data collected and any apparent trend. These values are used to create the conceptual plume maps shown in Chapter 4.

923 E426/53159/10-7-94

Figure C-12. Uranium Concentration Trends at Well 399-2-1.

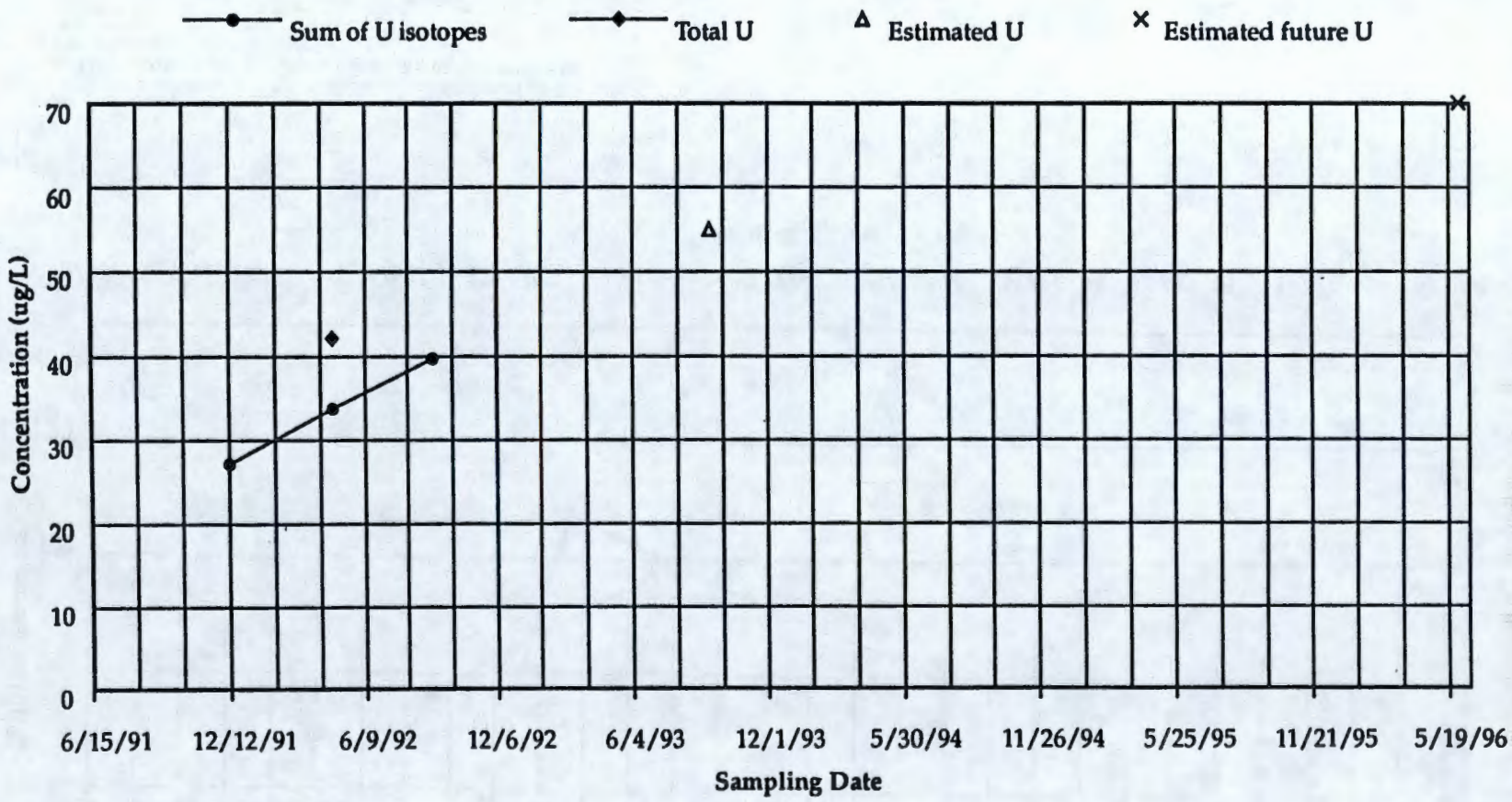
9513333.1513



Note: The estimated values shown are interpreted values based on the data collected and any apparent trends. These values are used to create the conceptual plume maps shown in Chapter 4.

923 E426/53160/10-4-94

Figure C-13. Uranium Concentration Trends at Well 399-2-2.



Note: The estimated values shown are interpreted values based on the data collected and any apparent trends. These values are used to create the conceptual plume maps shown in Chapter 4.

923 E426/53161/10-4-94

Figure C-14. Uranium Concentration Trends at Well 399-2-3.

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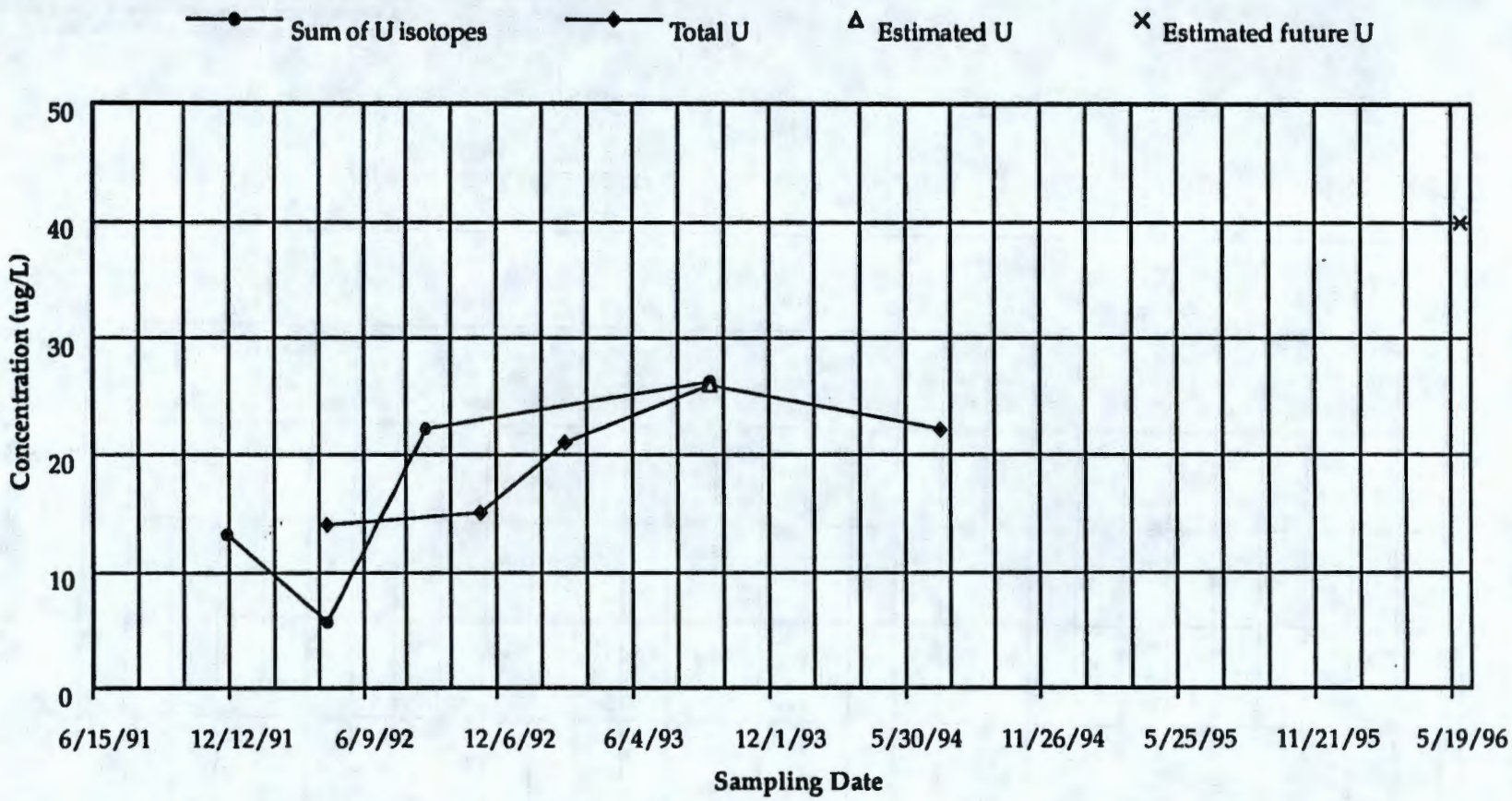
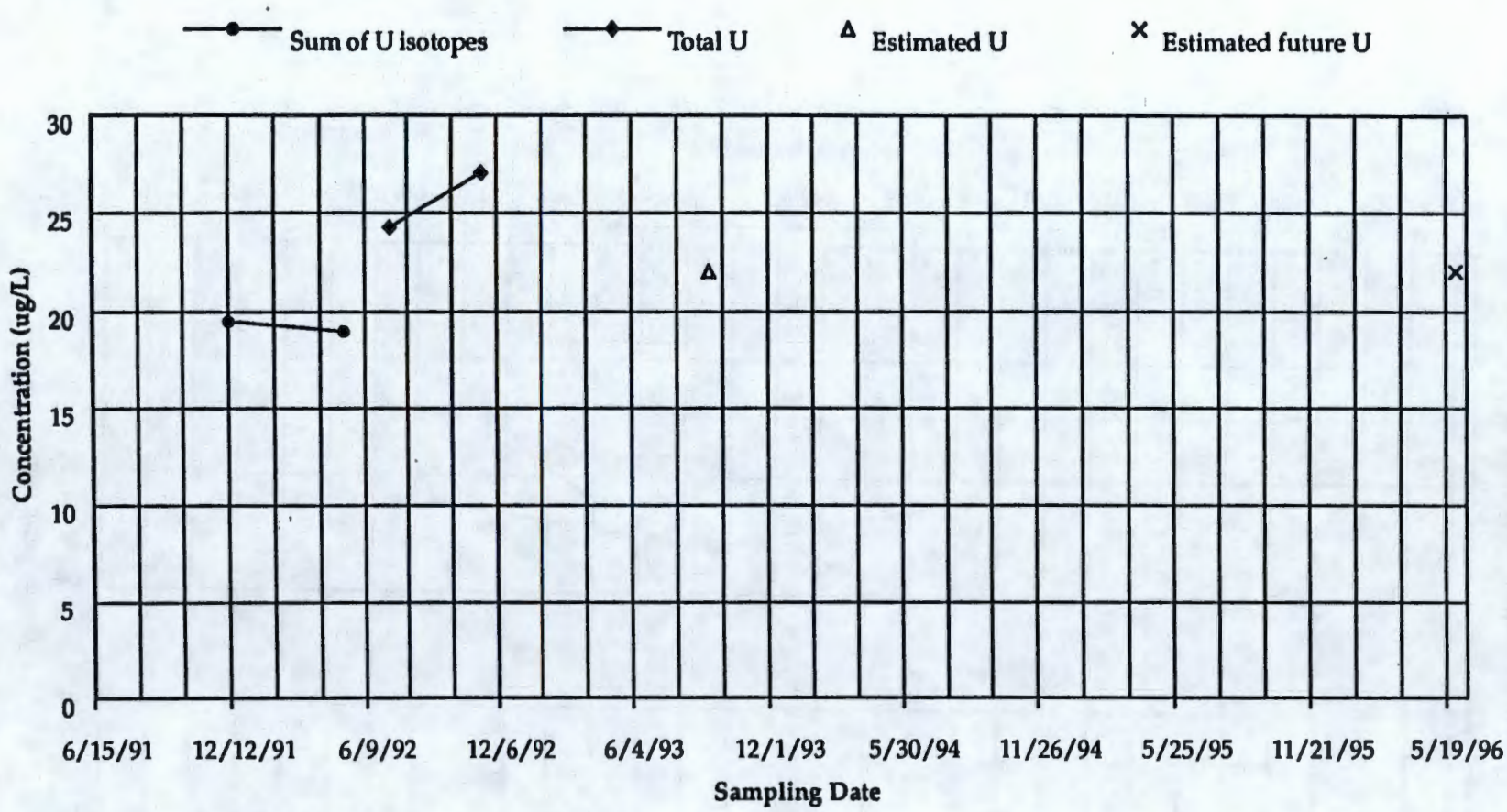


Note: The estimated values shown are interpreted values based on the data collected and any apparent trends. These values are used to create the conceptual plume maps shown in Chapter 4.

923 E426/53165/10-4-94

Figure C-15. Uranium Concentration Trends at Well 399-3-2.



Note: The estimated values shown are interpreted values based on the data collected and any apparent trends. These values are used to create the conceptual plume maps shown in Chapter 4.

923 E426/53166/10-4-94

Figure C-16. Uranium Concentration Trends at Well 399-3-9.

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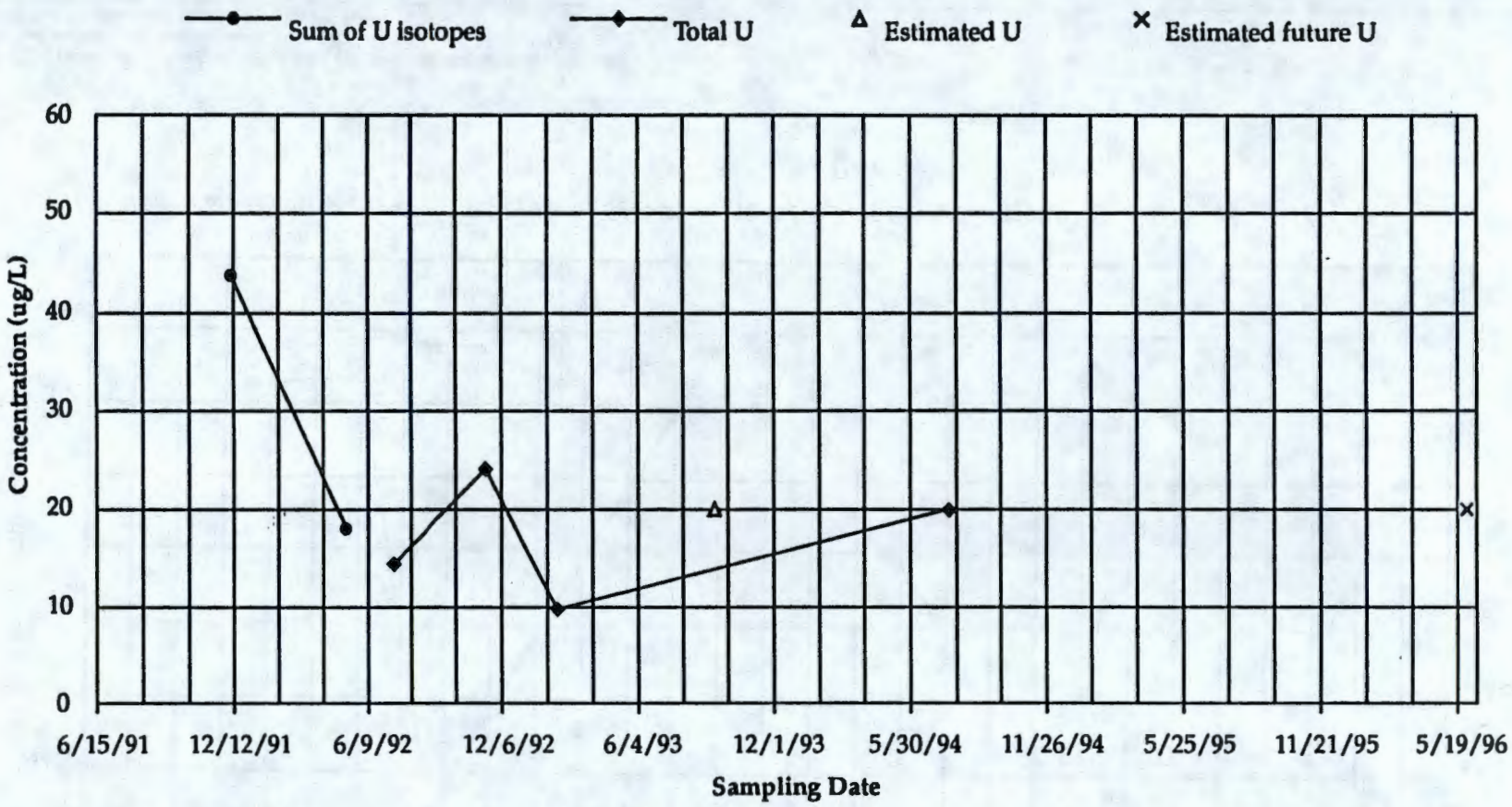
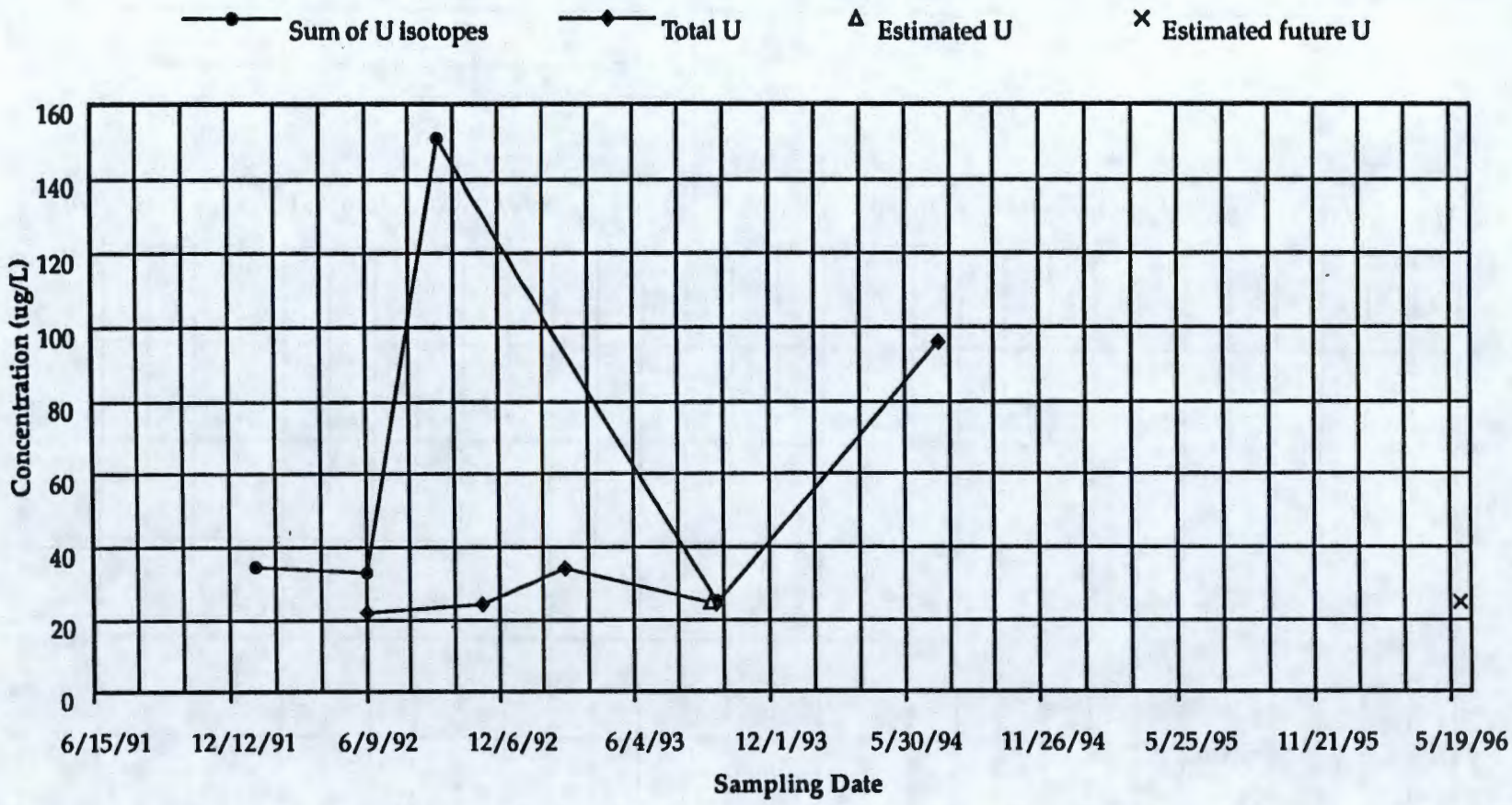


Note: The estimated values shown are interpreted values based on the data collected and any apparent trends. These values are used to create the conceptual plume maps shown in Chapter 4.

923 E426/53162/10-4-94

Figure C-17. Uranium Concentration Trends at Well 399-3-10.



Note: The estimated values shown are interpreted values based on the data collected and any apparent trends. These values are used to create the conceptual plume maps shown in Chapter 4.

923 E426/53163/10-4-94

Figure C-18. Uranium Concentration Trends at Well 399-3-11.

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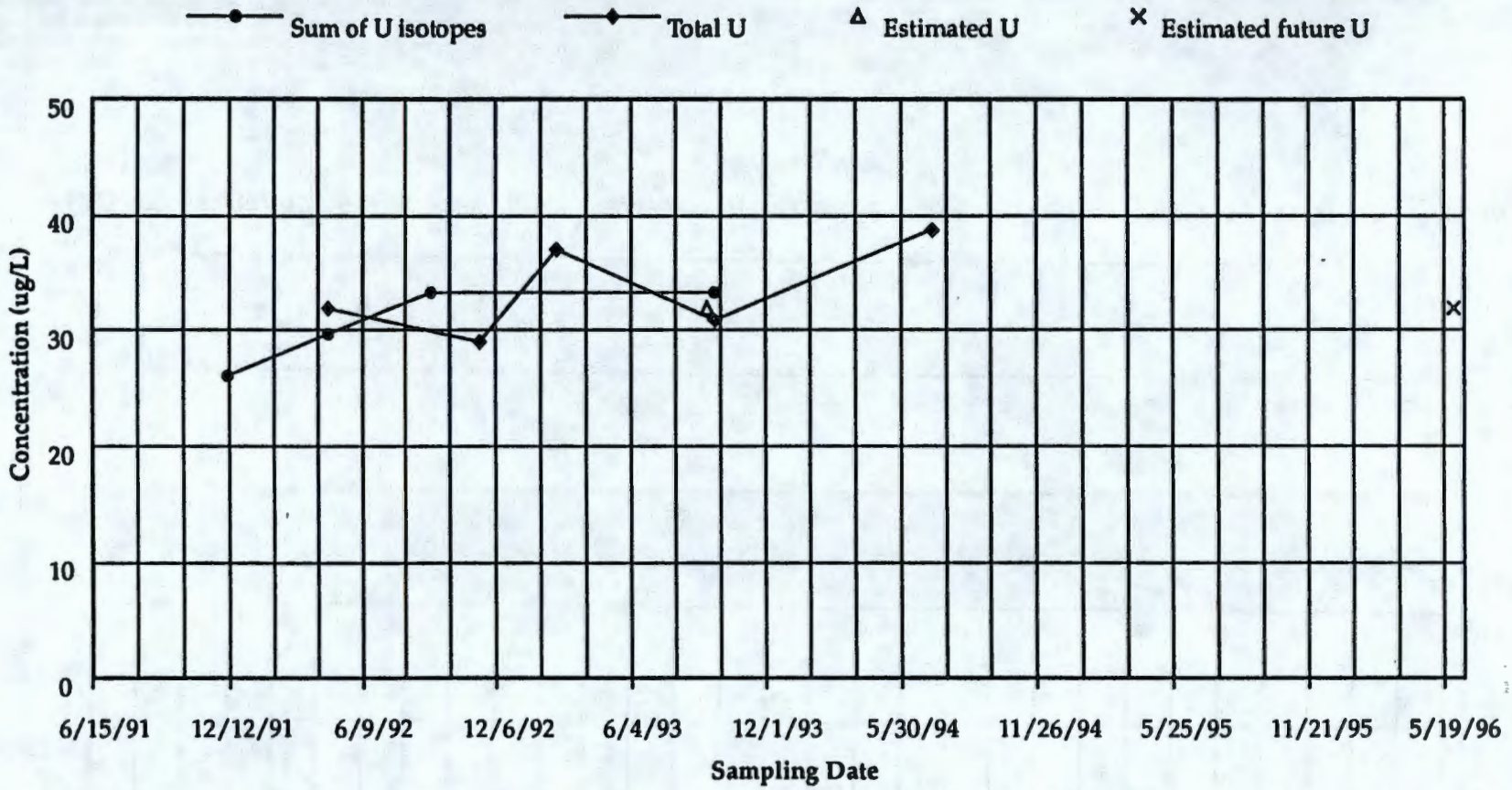
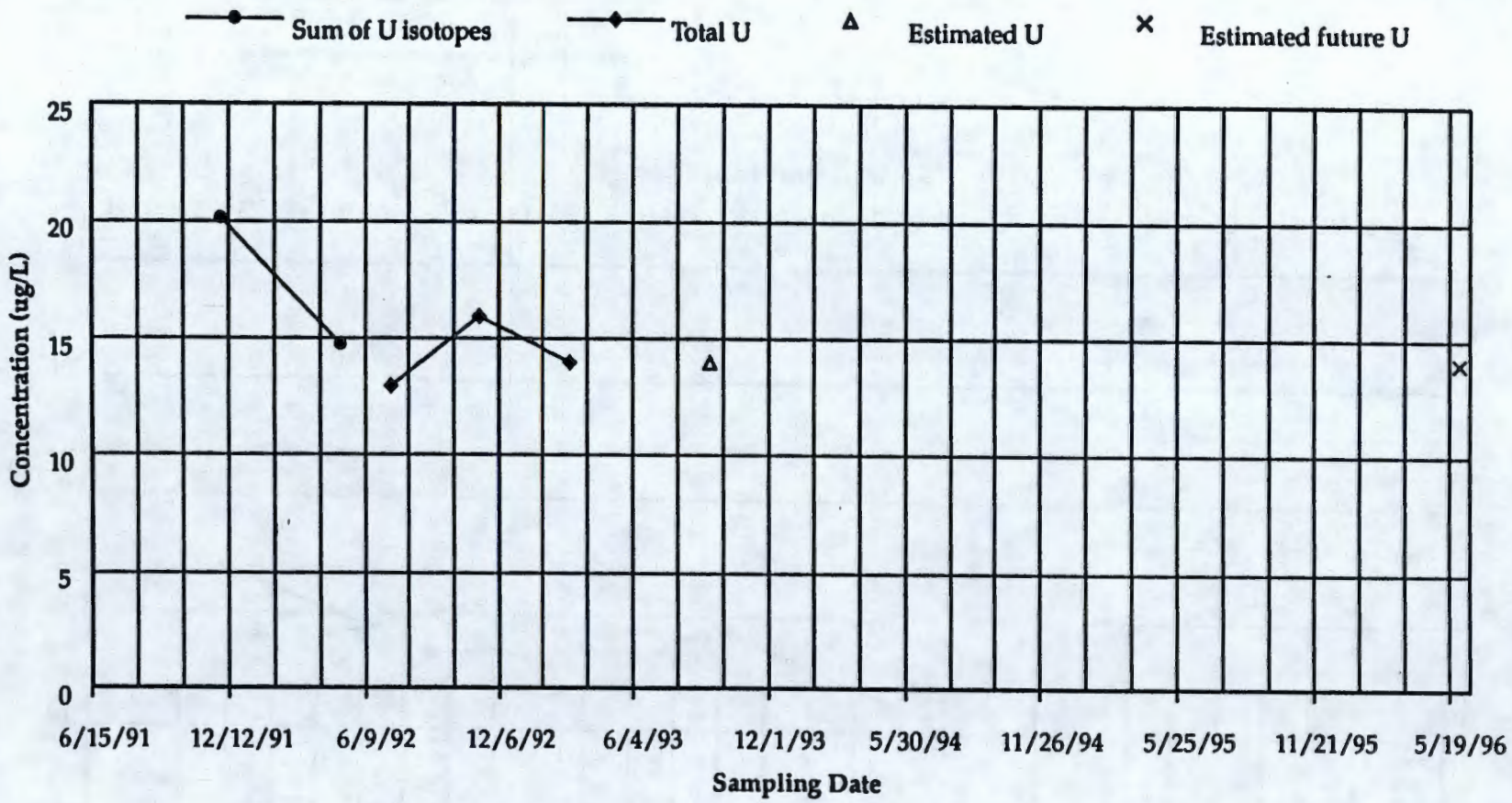


Note: The estimated values shown are interpreted values based on the data collected and any apparent trends. These values are used to create the conceptual plume maps shown in Chapter 4.

923 E426/53164/10-4-94

Figure C-19. Uranium Concentration Trends at Well 399-3-12.



Note: The estimated values shown are interpreted values based on the data collected and any apparent trends. These values are used to create the conceptual plume maps shown in Chapter 4.

923 E426/53167/10-4-94

Figure C-20. Uranium Concentration Trends at Well 399-4-1.

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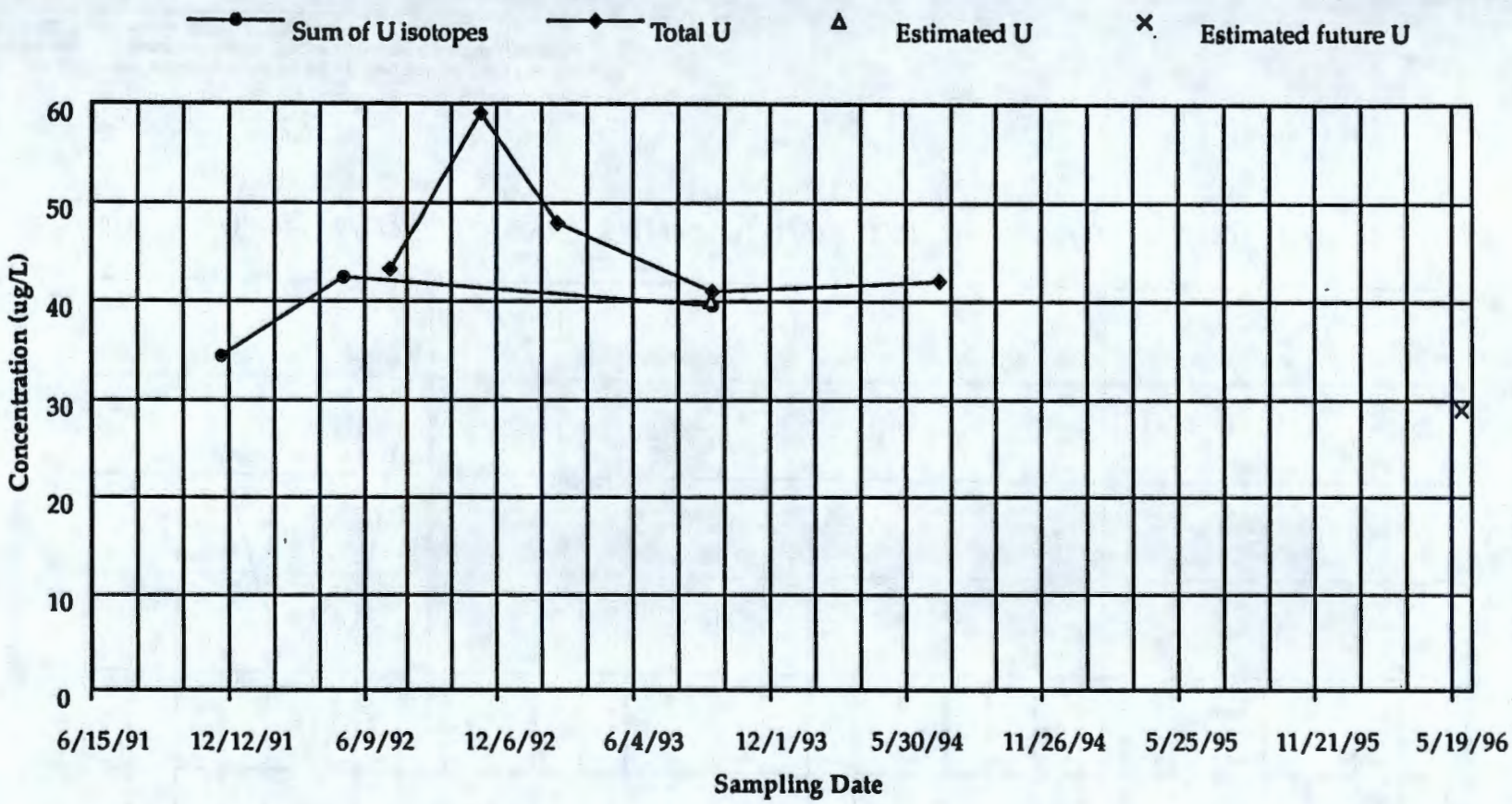
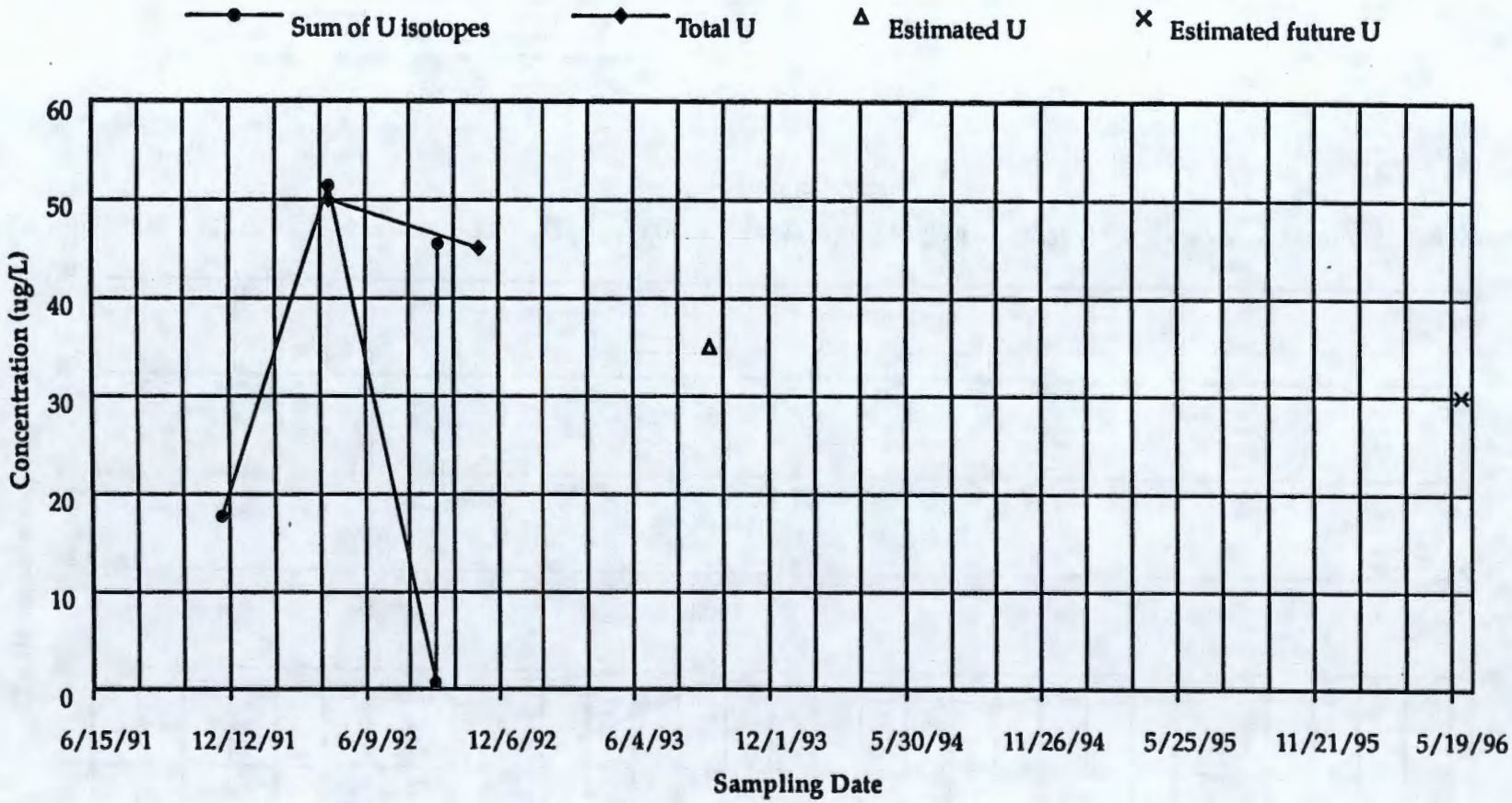


Note: The estimated values shown are interpreted values based on the data collected and any apparent trends. These values are used to create the conceptual plume maps shown in Chapter 4.

923 E426/53168/10-4-94

Figure C-21. Uranium Concentration Trends at Well 399-4-7.

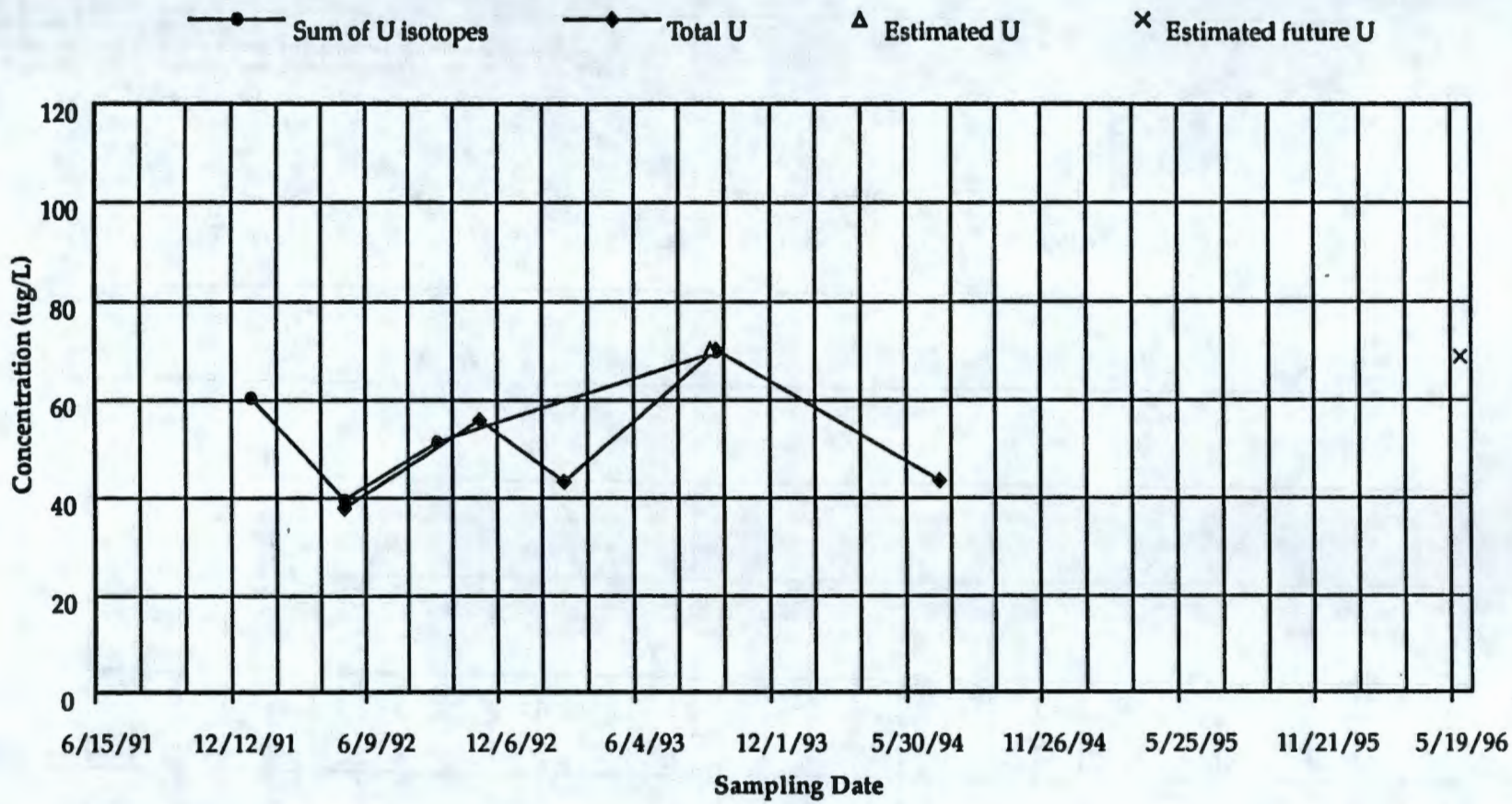


Note: The estimated values shown are interpreted values based on the data collected and any apparent trends. These values are used to create the conceptual plume maps shown in Chapter 4.

923 E426/53169/10-4-94

Figure C-22. Uranium Concentration Trends at Well 399-4-9.

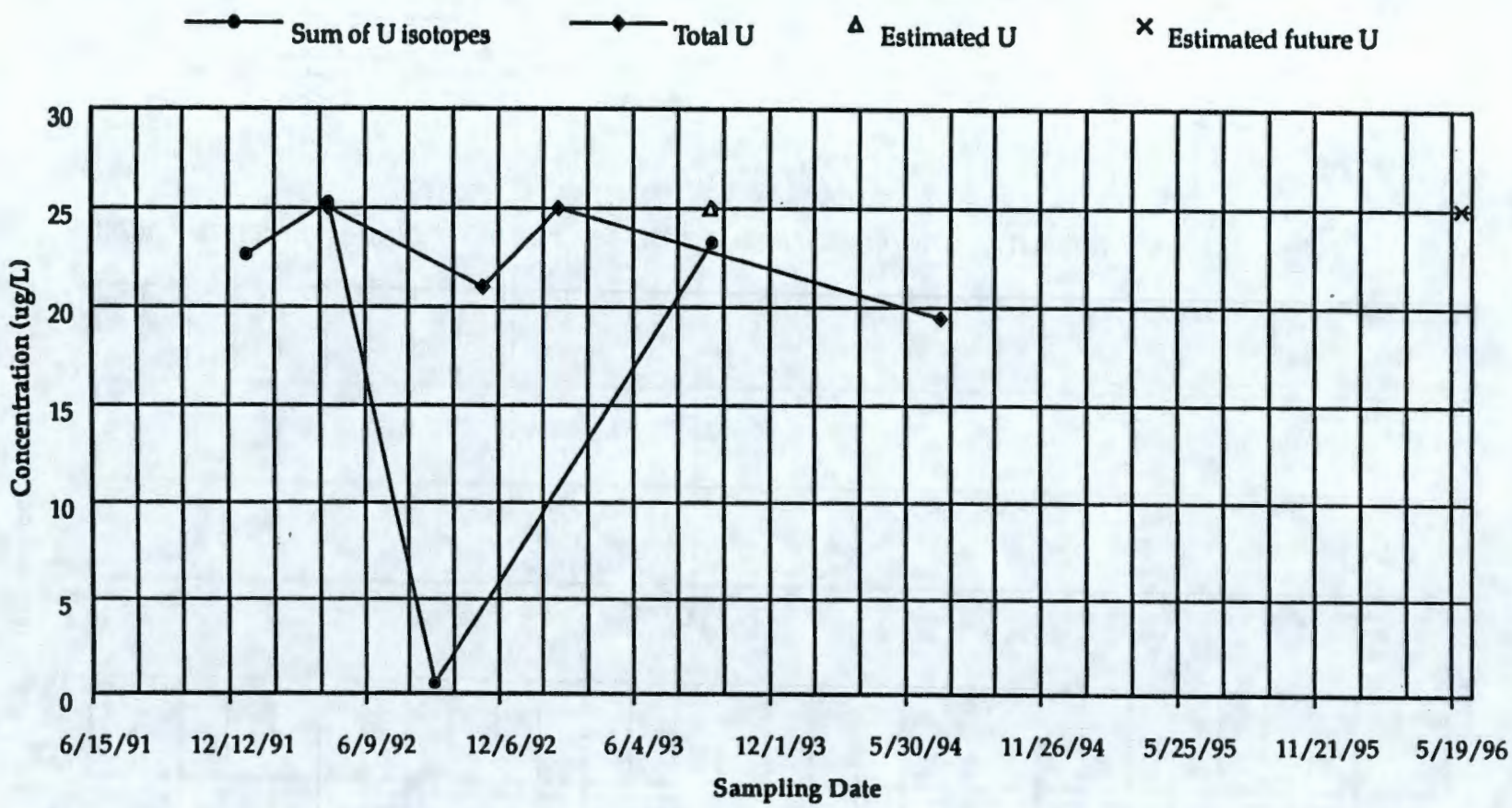
9513333.1518



Note: The estimated values shown are interpreted values based on the data collectedand any apparent trends. These values are used to create the conceptual plume maps shown in Chapter 4.

923 E426/53170/10-4-94

Figure C-23. Uranium Concentration Trends at Well 399-4-10.



Note: The estimated values shown are interpreted values based on the data collected and any apparent trends. These values are used to create the conceptual plume maps shown in Chapter 4.

923 E426/53171/10-4-94

Figure C-24. Uranium Concentration Trends at Well 399-4-12.

APPENDIX D

URANIUM PLUME MAPS

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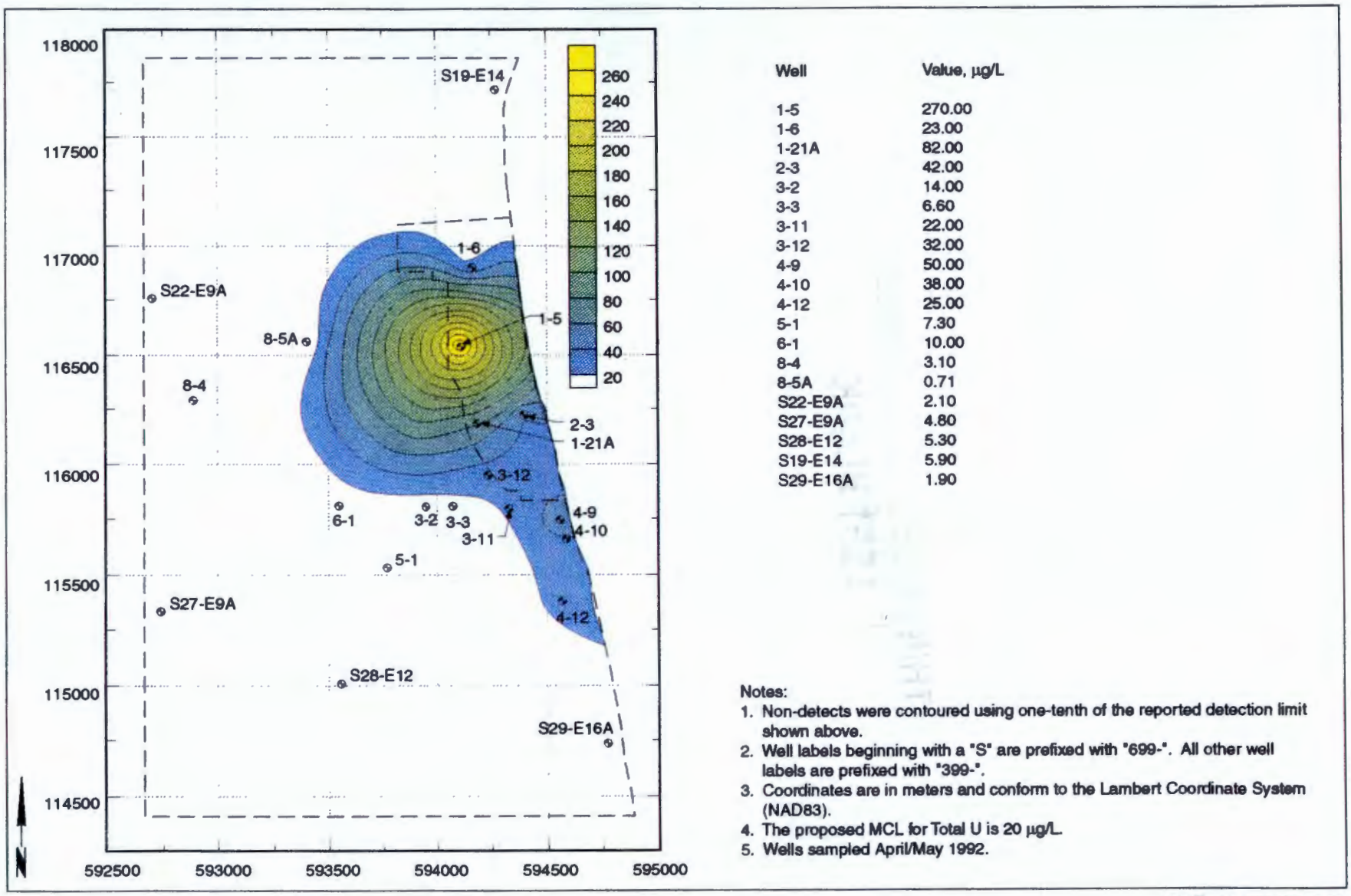

Well	Value, µg/L
1-5	270.00
1-6	23.00
1-21A	82.00
2-3	42.00
3-2	14.00
3-3	6.60
3-11	22.00
3-12	32.00
4-9	50.00
4-10	38.00
4-12	25.00
5-1	7.30
6-1	10.00
8-4	3.10
8-5A	0.71
S22-E9A	2.10
S27-E9A	4.80
S28-E12	5.30
S19-E14	5.90
S29-E16A	1.90

Notes:
1. Non-detects were contoured using one-tenth of the reported detection limit shown above.
2. Well labels beginning with a "S" are prefixed with "699-". All other well labels are prefixed with "399-".
3. Coordinates are in meters and conform to the Lambert Coordinate System (NAD83).
4. The proposed MCL for Total U is 20 µg/L.
5. Wells sampled April/May 1992.

923 E426/49906/10-4-94

Figure D-1. Second Round Total Uranium.

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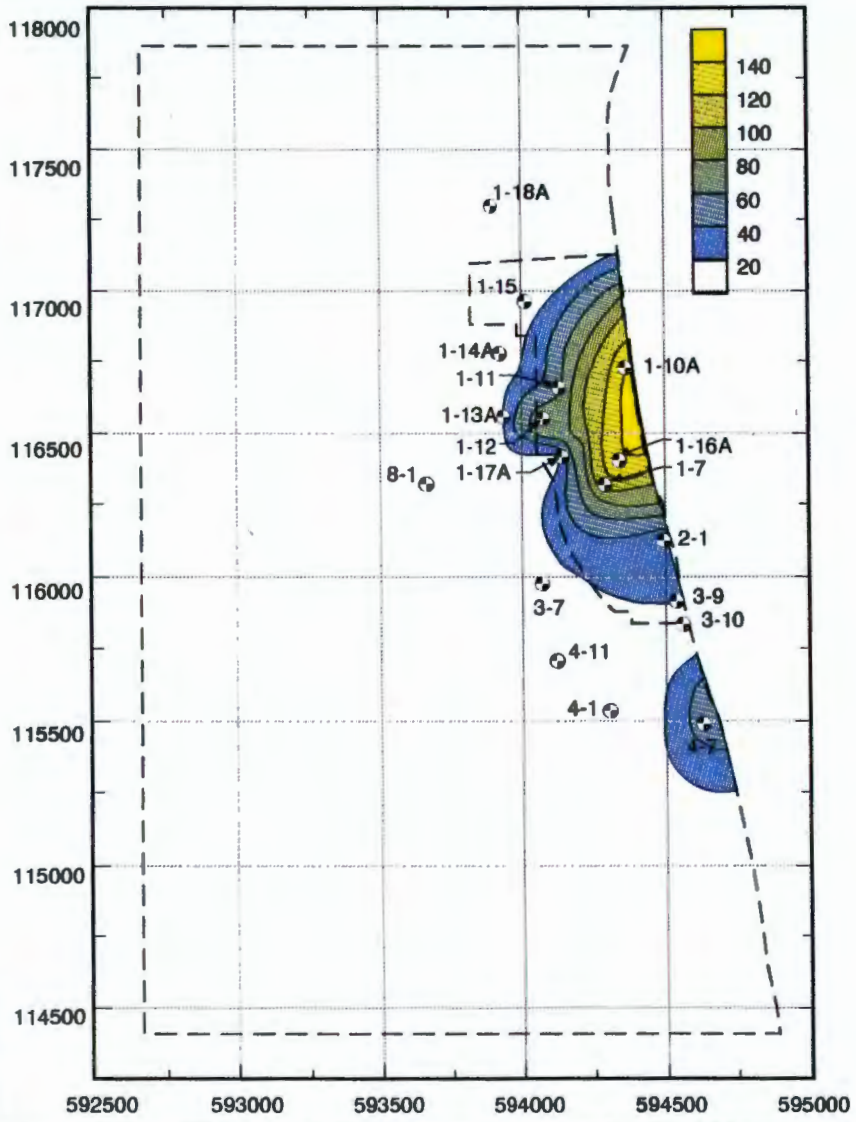

Well	Value, µg/L
1-7	107.00
1-10A	140.00
1-11	47.80
1-12	78.80
1-13A	5.78
1-14A	6.00
1-15	4.74
1-16A	138.00
1-17A	11.50
1-18A	4.73
2-1	22.60
3-7	13.20
3-9	24.30
3-10	14.40
4-1	13.00
4-7	43.30
4-11	12.80
8-1	4.59

Notes:
1. Non-detects were contoured using one-tenth of the reported detection limit shown above.
2. Well labels beginning with a "S" are prefixed with "699-". All other well labels are prefixed with "399-".
3. Coordinates are in meters and conform to the Lambert Coordinate System (NAD83).
4. The proposed MCL for Total U is 20 µg/L.
5. Wells sampled September 1992.

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Figure D-2. Third Round Total Uranium.

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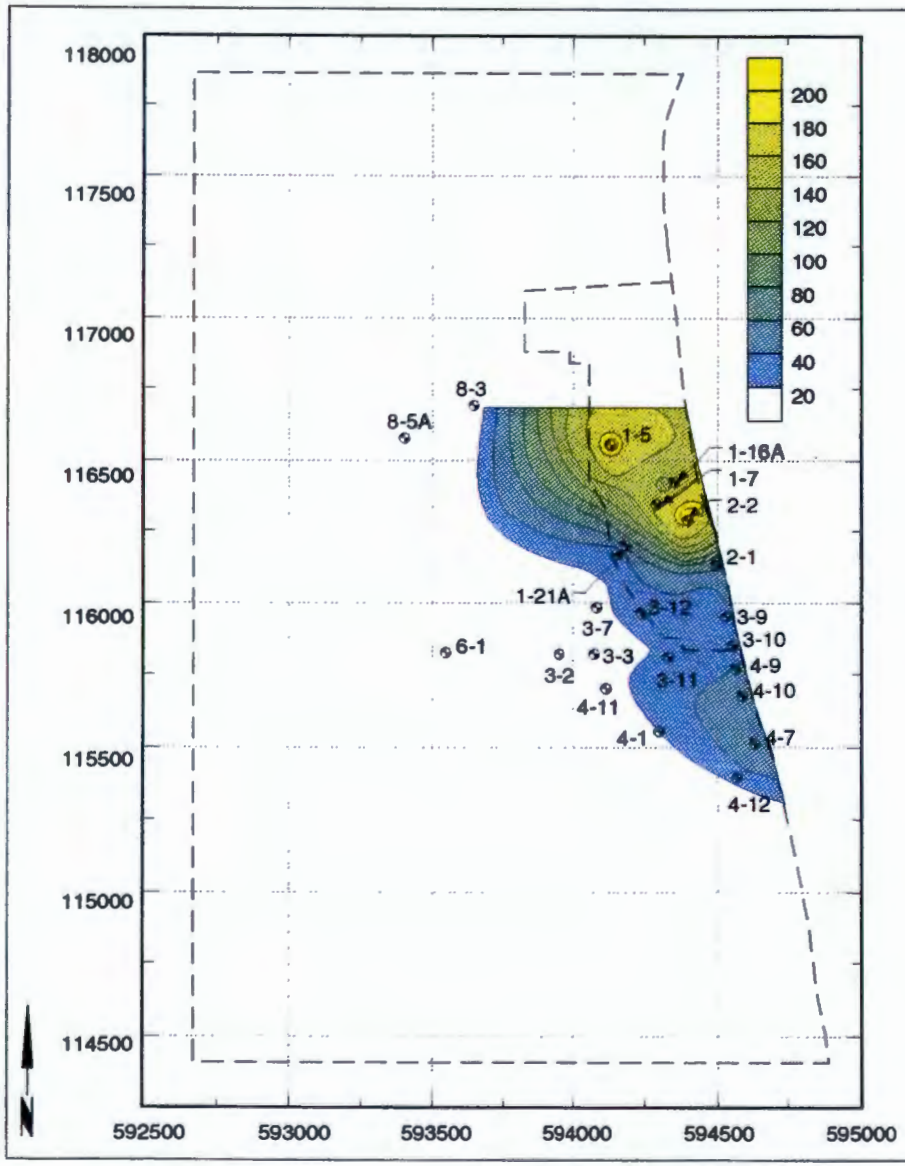

Well	Value, µg/L
1-5	190.00
1-7	160.00
1-16A	130.00
1-21A	36.00
2-1	48.00
2-2	210.00
3-2	15.00
3-3	10.00
3-7	13.00
3-9	27.00
3-10	24.00
3-11	24.00
3-12	29.00
4-1	16.00
4-7	59.00
4-9	45.00
4-10	56.00
4-11	13.00
4-12	21.00
6-1	7.80
8-3	5.00
8-5A	11.00

Notes:
1. Non-detects were contoured using one-tenth of the reported detection limit shown above.
2. Well labels beginning with a "S" are prefixed with "699-". All other well labels are prefixed with "399-".
3. Coordinates are in meters and conform to the Lambert Coordinate System (NAD83).
4. The proposed MCL for Total U is 20 µg/L.
5. Contour lines are terminated north of Well 399-8-3 due to a lack of data in that portion of the operable unit.
6. Wells sampled November/December 1992.

923 E426/49908/10-4-94

Figure D-3. Fourth Round Total Uranium.

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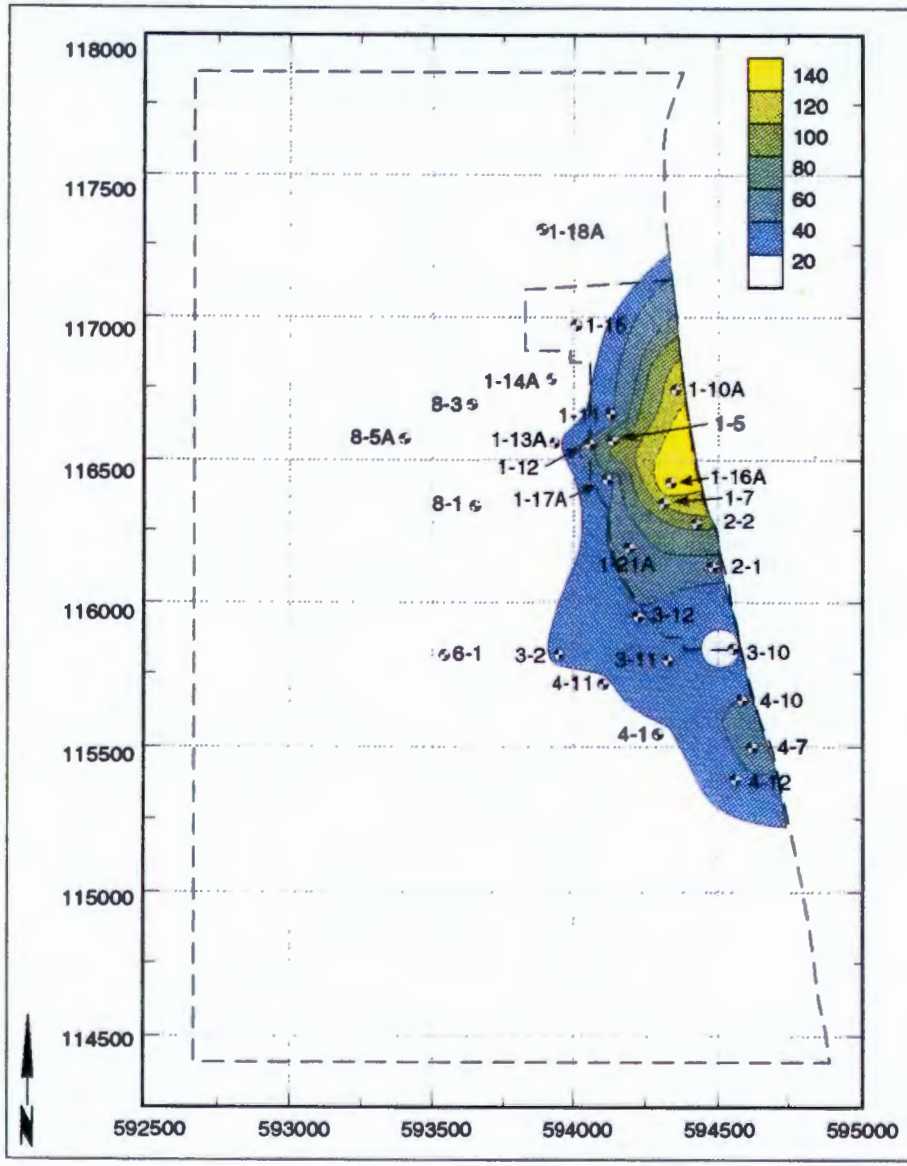

Well	Value, µg/L
1-5	87.00
1-7	81.00
1-10A	110.00
1-11	21.20
1-12	44.00
1-13A	6.30
1-14A	6.00
1-15	5.50
1-16A	145.00
1-17A	29.10
1-18A	4.24
1-21A	46.00
2-1	45.50
2-2	81.00
3-2	21.00
3-10	9.68
3-11	38.00
3-12	37.00
4-1	14.00
4-7	48.00
4-10	43.00
4-11	17.00
4-12	25.00
6-1	9.10
8-1	4.60
8-3	4.80
8-5A	11.00

Notes:
1. Non-detects were contoured using one-tenth of the reported detection limit shown above.
2. Well labels beginning with a "S" are prefixed with "699-". All other well labels are prefixed with "399-".
3. Coordinates are in meters and conform to the Lambert Coordinate System (NAD83).
4. The proposed MCL for Total U is 20 µg/L.
5. Wells sampled February/March 1993.

923 E426/49909/10-4-94

Figure D-4. Fifth Round Total Uranium.

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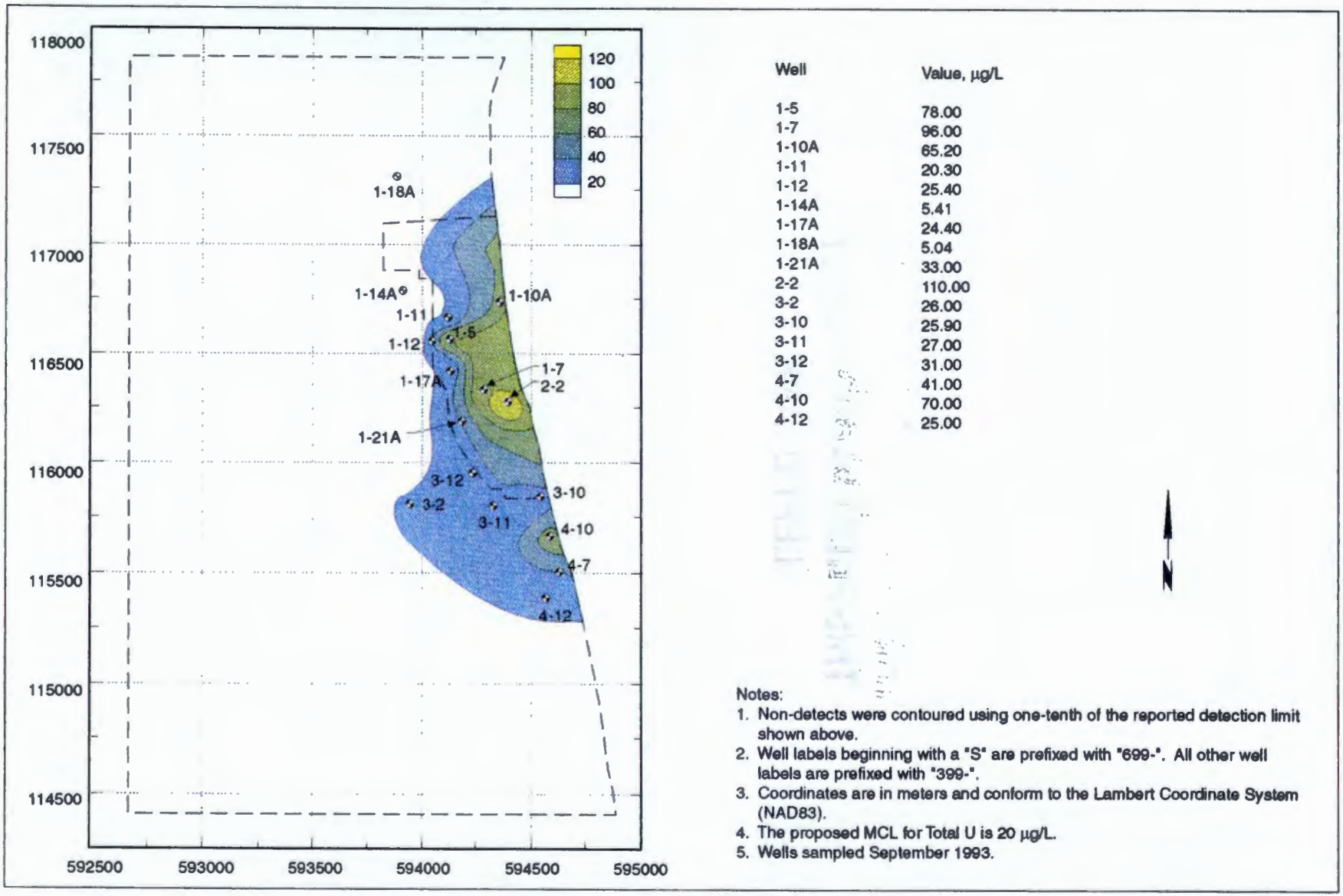

Well	Value, µg/L
1-5	78.00
1-7	96.00
1-10A	65.20
1-11	20.30
1-12	25.40
1-14A	5.41
1-17A	24.40
1-18A	5.04
1-21A	33.00
2-2	110.00
3-2	26.00
3-10	25.90
3-11	27.00
3-12	31.00
4-7	41.00
4-10	70.00
4-12	25.00

Notes:
1. Non-detects were contoured using one-tenth of the reported detection limit shown above.
2. Well labels beginning with a "S" are prefixed with "699-". All other well labels are prefixed with "399-".
3. Coordinates are in meters and conform to the Lambert Coordinate System (NAD83).
4. The proposed MCL for Total U is 20 µg/L.
5. Wells sampled September 1993.

923 E426/49910/10-19-94

Figure D-5. Sixth Round Total Uranium.

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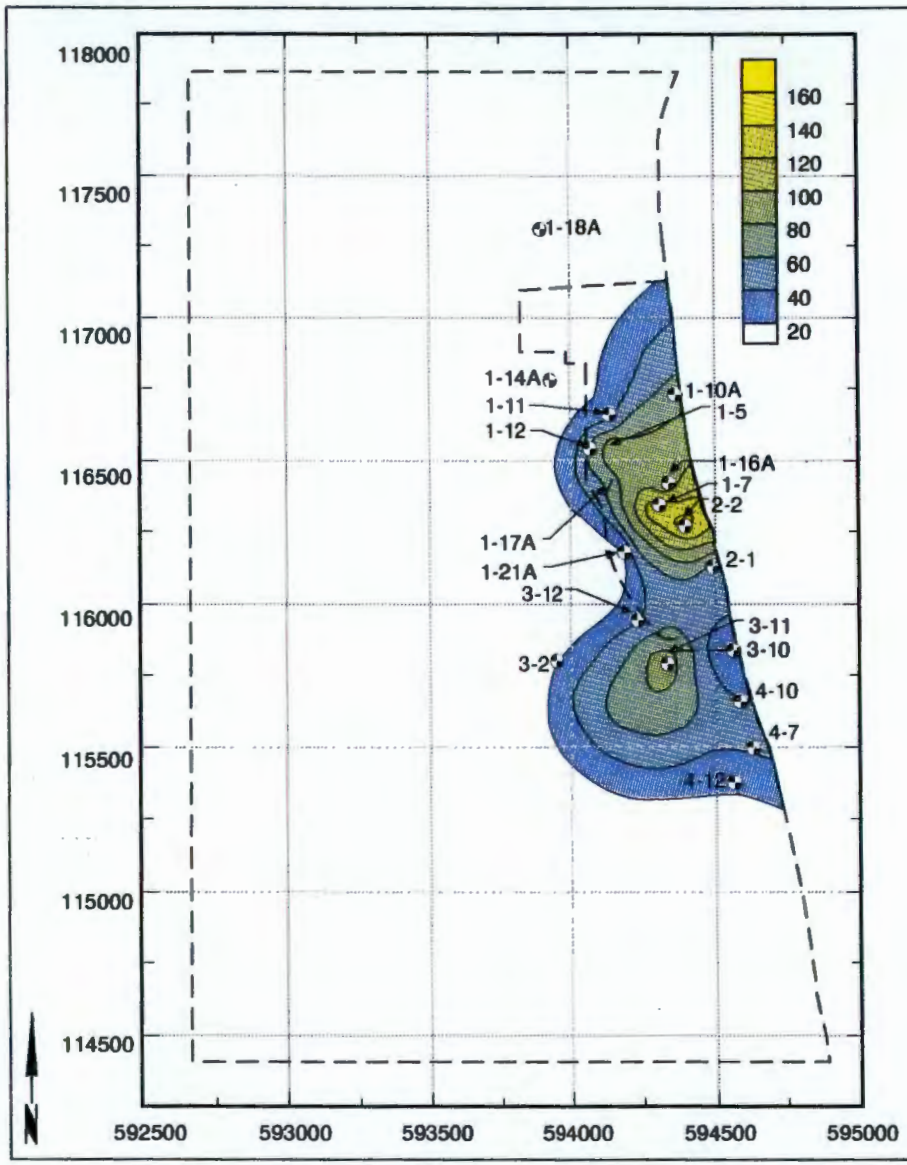

Well	Value, µg/L
1-5	93.80
1-7	131.00
1-10A	71.10
1-11	30.50
1-12	50.20
1-14A	6.74
1-16A	86.80
1-17A	62.60
1-18A	5.60
1-21A	21.00
2-1	57.90
2-2	150.00
3-2	22.30
3-10	20.30
3-11	96.50
3-12	38.90
4-7	42.80
4-10	42.40
4-12	19.70

Notes:
1. Non-detects were contoured using one-tenth of the reported detection limit shown above.
2. Well labels beginning with "S" are prefixed with "699-". All other well labels are prefixed with "399-".
3. Coordinates are in meters and conform to the Lambert Coordinate System (NAD83).
4. The proposed MCL for Total U is 20 µg/L.
5. Wells sampled June 1994.

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Figure D-6. Seventh Round Total Uranium.

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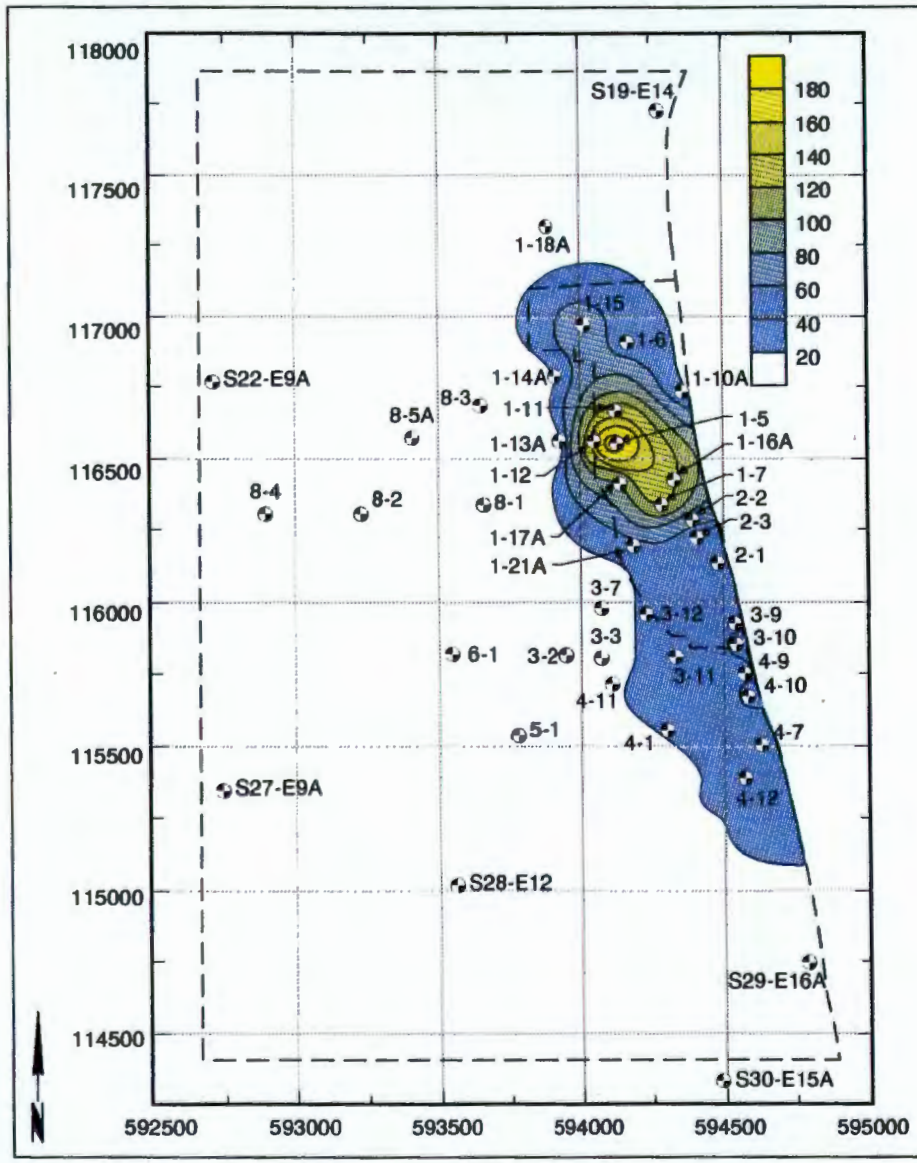

Well	Value, µg/L	Well	Value, µg/L
1-5	180.82	4-9	17.52
1-6	32.57	4-10	60.09
1-7	101.21	4-11	17.48
1-10A	18.36	4-12	22.55
1-11	113.88	5-1	0.63
1-12	132.10	6-1	1.05
1-13A	0.74	8-1	0.66
1-14A	17.97	8-2	0.33
1-15	56.35	8-3	0.05
1-16A	108.37	8-4	0.35
1-17A	74.07	8-5A	15.51
1-18A	0.52	S30-E15A	0.37
1-21A	27.84	S22-E9A	0.23
2-1	21.14	S27-E9A	0.47
2-2	46.47	S28-E12	0.52
2-3	26.98	S19-E14	0.50
3-2	13.09	S29-E16A	0.53
3-3	0.82		
3-7	1.05		
3-9	19.40		
3-10	43.50		
3-11	34.66		
3-12	26.15		
4-1	20.05		
4-7	34.38		

Notes:
1. Concentrations shown above represent the sum of U-234, U-235, and U-238, where one-tenth of the reported detection limit was used for any isotope reported as a non-detect. The reported U isotope values (in pCi/L) were converted to µg/L using conversion factors of 0.00016, 0.463, and 2.99 µg/pCi for U-234, -235, and -238, respectively.
2. Well labels beginning with "S" are prefixed with "699-". All other well labels are prefixed with "399-".
3. Coordinates are in meters and conform to the Lambert Coordinate System (NAD83).
4. The proposed MCL for Total U is 20 µg/L.
5. Wells sampled December 1991/January 1992.

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Figure D-7. First Round Uranium Isotopes Summed.

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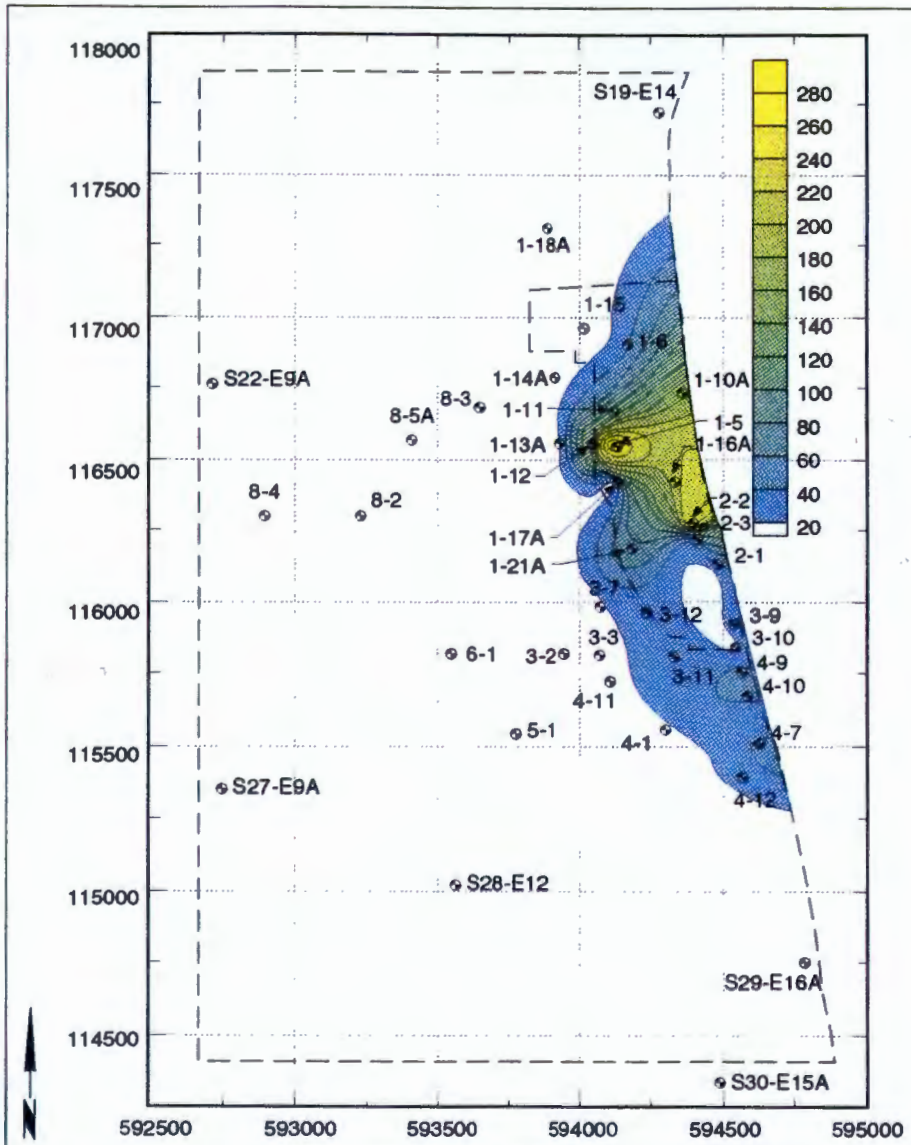

Well	Value, µg/L	Well	Value, µg/L
1-5	285.50	4-10	39.27
1-6	29.05	4-11	13.55
1-10A	157.73	4-12	25.31
1-11	82.69	5-1	0.69
1-12	138.99	6-1	0.96
1-13A	0.01	8-2	2.77
1-14A	9.73	8-3	6.34
1-15	5.43	8-4	0.36
1-16A	184.51	8-5A	1.27
1-17A	11.98	S30-E15A	2.58
1-18A	4.86	S22-E9A	3.00
1-21A	82.45	S27-E9A	6.31
2-1	24.26	S28-E12	5.72
2-2	227.04	S19-E14	0.66
2-3	33.67	S29-E16A	0.60
3-2	1.14		
3-3	7.77		
3-7	14.48		
3-9	18.96		
3-10	17.83		
3-11	33.20		
3-12	29.63		
4-1	14.74		
4-7	42.35		
4-9	51.44		

Notes:
1. Concentrations shown above represent the sum of U-234, U-235, and U-238, where one-tenth of the reported detection limit was used for any isotope reported as a non-detect. The reported U isotope values (in pCi/L) were converted to µg/L using conversion factors of 0.00016, 0.463, and 2.99 µg/pCi for U-234, -235, and -238, respectively.
2. Well labels beginning with "S" are prefixed with "699-". All other well labels are prefixed with "399-".
3. Coordinates are in meters and conform to the Lambert Coordinate System (NAD83).
4. The proposed MCL for Total U is 20 µg/L.
5. Wells sampled April/May 1992.

923 E426/49912/10-4-94

Figure D-8. Second Round Uranium Isotopes Summed.

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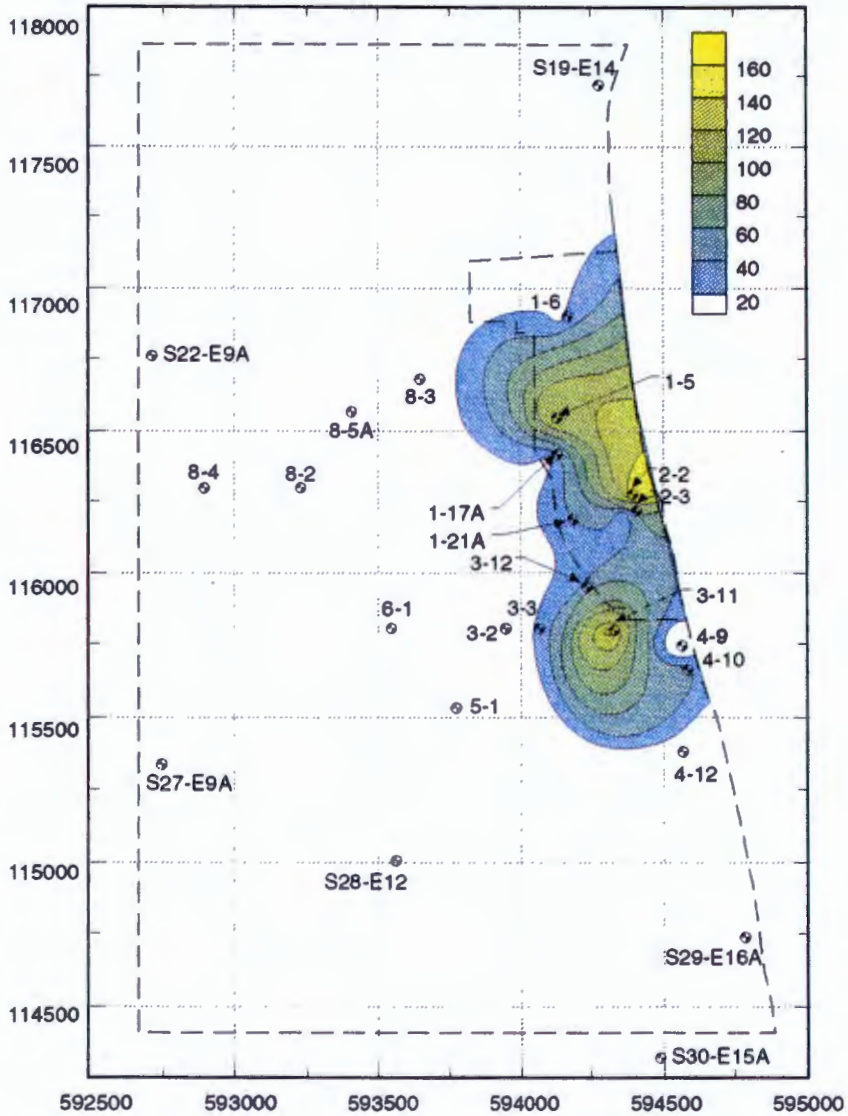

Well	Value, µg/L	Well	Value, µg/L
1-5	133.93	S28-E12	5.42
1-6	17.31	S19-E14	5.38
1-17A	16.29	S29-E16A	0.62
1-21A	36.52		
2-2	159.54		
2-3	39.64		
3-2	22.23		
3-3	14.50		
3-11	150.31		
3-12	33.35		
4-9	0.14		
4-10	51.35		
4-12	0.12		
5-1	7.18		
6-1	11.14		
8-2	0.33		
8-3	5.38		
8-4	0.45		
8-5A	16.95		
S30-E15A	0.25		
S22-E9A	0.16		
S27-E9A	0.45		

Notes:

1. Concentrations shown above represent the sum of U-234, U-235, and U-238, where one-tenth of the reported detection limit was used for any isotope reported as a non-detect. The reported U isotope values (in pCi/L) were converted to µg/L using conversion factors of 0.00016, 0.463, and 2.99 µg/pCi for U-234, -235, and -238, respectively.
2. Well labels beginning with "S" are prefixed with "699-". All other well labels are prefixed with "399-".
3. Coordinates are in meters and conform to the Lambert Coordinate System (NAD83).
4. The proposed MCL for Total U is 20 µg/L.
5. A filtered Total U value of 170.17 µg/L was measured for Well 399-5-1. This value was not used to generate the contour map above because it is inconsistent with previous values and was not validated. The value which was used is a validated result.
6. Wells sampled September 1992.

923 E426/49914/10-19-94

Figure D-9. Third Round Uranium Isotopes Summed.

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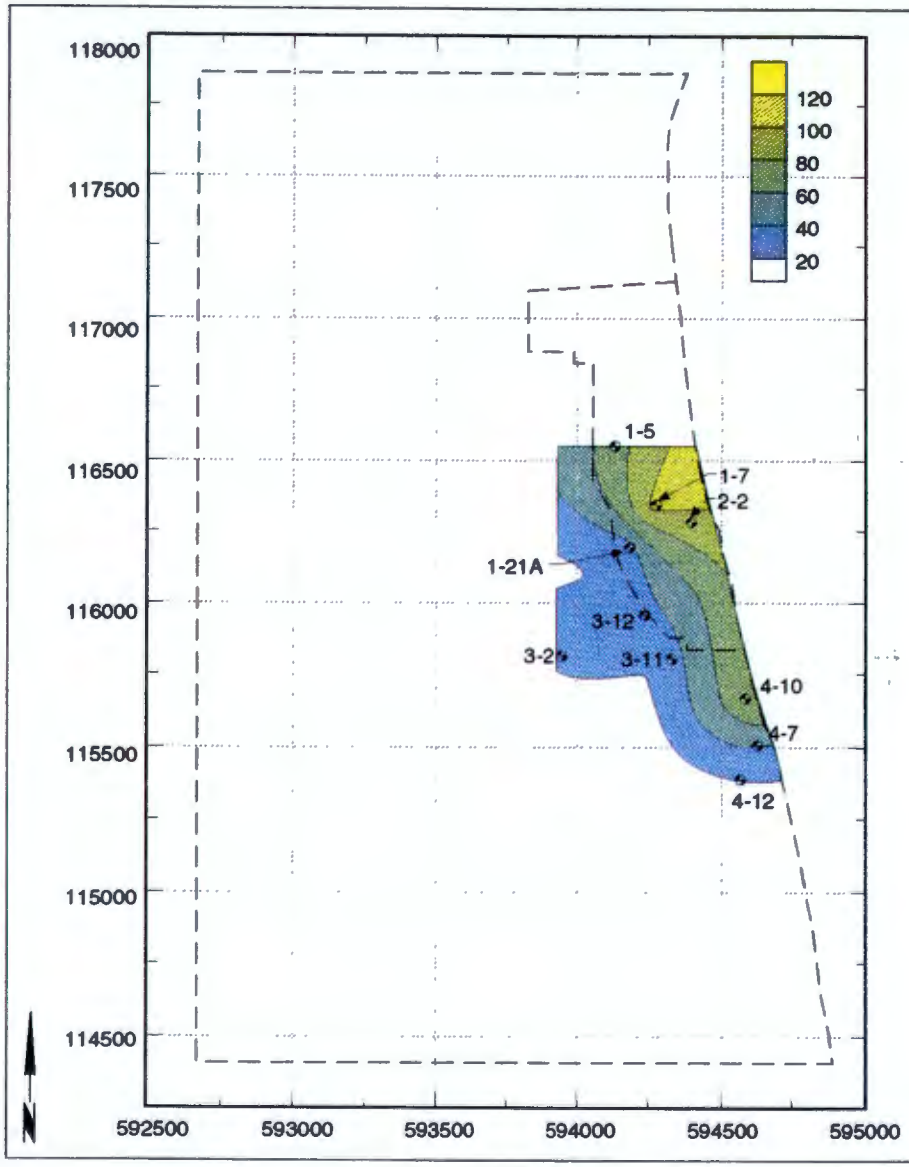

Well	Value, µg/L
1-5	64.59
1-7	102.08
1-21A	27.68
2-2	92.48
3-2	26.23
3-11	25.32
3-12	33.18
4-7	39.46
4-10	75.60
4-12	23.24

Notes:

1. Concentrations shown above represent the sum of U-234, U-235, and U-238, where one-tenth of the reported detection limit was used for any isotope reported as a non-detect. The reported U isotope values (in pCi/L) were converted to µg/L using conversion factors of 0.00016, 0.463, and 2.99 µg/pCi for U-234, -235, and -238, respectively.
2. Well labels beginning with "S" are prefixed with "699-". All other well labels are prefixed with "399-".
3. Coordinates are in meters and conform to the Lambert Coordinate System (NAD83).
4. The proposed MCL for Total U is 20µg/L.
5. 6th round data for Well 399-1-17A not used because sample was collected approximately 3 months later than all other round 6 samples.
6. Contours are terminated north of Well 399-1-5 and west of 399-3-2 due to a lack of data in those portions of the operable unit.
7. Wells sampled September 1993.

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Figure D-10. Sixth Round Uranium Isotopes Summed.

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APPENDIX E

APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

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Table E-1. Identification of Potential Federal ARARs at the 300-FF-5 Operable Unit. (Sheet 1 of 13)

Requirements	Applicable, Relevant and Appropriate, or To Be Considered	Comment
CHEMICAL-SPECIFIC		
Safe Drinking Water Act of 1974 Title 42 USC 300, et seq.		
National Primary Drinking Water Standards 40 CFR 141	Relevant and Appropriate	The NCP requires that maximum contaminant level goals (MCLGs) and maximum contaminant levels (MCLs) established under the Safe Drinking Water Act be attained by remedial actions for groundwater and surface waters that are current or future sources of drinking water where the MCLG or MCL are relevant and appropriate to the situation. Groundwater is currently not used for drinking; however, it could be used in the future, if the site is released from institutional controls. In addition, there is discharge of contaminated groundwater to the Columbia River, which is used for drinking water.
National Secondary Drinking Water Standards 40 CFR 143	Not ARAR	Federal secondary standards are not federally enforceable standards and are not typically applicable or relevant and appropriate requirements. These requirements are not ARAR because secondary maximum contaminant levels have not been established for operable unit contaminants of concern. However, MTCA [WAC 173-340-720 (2)(a)(ii)] specifies that MCLs, MCLGs, and SMCLs are applicable requirements for groundwater cleanup, where groundwater has a current or potential future use as drinking water.
Clean Water Act of 1977 Title 33 USC 1251, as amended		
Water Quality Standards 40 CFR 131	Applicable	The Water Quality Standards under 40 CFR 131 were promulgated pursuant to the Clean Water Act and are applicable to the 300-FF-5 operable unit. 40 CFR 131 establishes the requirements and procedures for states to develop and adopt water quality standards based on federal water quality criteria that are at least as stringent as the federal standards. 40 CFR 131 provides EPA the authority to review and approve state water quality standards. Washington State has received EPA approval and has adopted more stringent water quality criteria under WAC 173-201A. These criteria are presented in detail as state chemical-specific ARARs.
Atomic Energy Act of 1954, as amended Title 42 USC 2011 et seq.		
Environmental Radiation Protection Standards for Nuclear Power Operations 40 CFR 190	Relevant and Appropriate	The regulation specifies the levels below which normal operations of the uranium fuel cycle are determined to be environmentally acceptable. These standards are not applicable because the standard excludes operations at disposal sites, and the definition of the uranium fuel cycle focuses on those processes that result in generation of electrical power.

Table E-1. Identification of Potential Federal ARARs at the 300-FF-5 Operable Unit. (Sheet 2 of 13)

Requirements	Applicable, Relevant and Appropriate, or To Be Considered	Comment
		However, the standards are relevant and appropriate because they address acceptable dose to the public as a result of planned discharges which occurred as a result of past activities conducted at source operable units with 300-FF-5. The standard sets dose equivalents from the facility that are not to exceed 25 mrems/yr to whole body, 75 mrems/yr to thyroid, or 25 mrems/yr to any other organ.
Environmental Radiation Protection Standards for the Management and Disposal of Spent Nuclear Fuel, High-Level Waste, and Transuranic Radioactive Waste 40 CFR Part 191	Not ARAR	Standards under this regulation are not applicable and not relevant and appropriate since they contain environmental protection requirements for management and disposal of spent nuclear fuel, high-level waste and transuranic wastes at facilities operated by the Department of Energy. Wastes meeting this definition are not known to have been disposed in the 300-FF-5 operable unit.
Nuclear Regulatory Standards for Protection Against Radiation 10 CFR 20	Relevant and Appropriate	The regulation establishes standards for protection of the public against radiation arising from the use of regulated materials and as such are relevant and appropriate. Radioactive material from sources not licensed by the NRC are not subject to these regulations, therefore this standard is not applicable because the operable unit is not NRC-licensed. Remedial alternatives need to limit external and internal exposure from releases to levels that do not exceed 100 mrem/yr or 2 mrem/ hr from external exposure in unrestricted areas. Specific concentration limits of contaminants of concern in liquid effluent allowed in unrestricted areas are listed in Table E-3. These limits are based on annual effective dose equivalent from internal exposure for adults of 50 mrem.
Uranium Mill Tailings Radiation Control Act of 1978 Title 42 USC 2022		
Health and Environmental Protection Standards for Uranium and Thorium Mill Tailings 40 CFR 192	Relevant and Appropriate	The standard is not applicable because the operable unit is not a milling site for uranium or thorium. However, the standard is relevant and appropriate because it provides guidance for implementing remedial actions if contaminants have been released to groundwater. Subpart B sets groundwater protection requirements for concentrations of Ra-226, Ra-228, and gross alpha particle activity at EPA-established levels for drinking water: 5 pCi/L for Ra-226 and Ra-228, and 15 pCi/L for gross alpha activity excluding radon and uranium. Concentration limits for Ra-226 in soils for land cleanup actions are set at 5 pCi/g averaged over the upper 15 cm and 15 pCi/g averaged over any 15 cm thick layer more than 15 cm from the surface. The level of gamma radiation in any occupiable building is not to exceed 20 microroentgens/hr above background.

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Table E-1. Identification of Potential Federal ARARs at the 300-FF-5 Operable Unit. (Sheet 3 of 13)

Requirements	Applicable, Relevant and Appropriate, or To Be Considered	Comment
Radiation Protection of the Public and the Environment DOE Order 5400.5	To Be Considered	This DOE Order sets radiation standards for protection of the public in the vicinity of DOE facilities. The order sets limits for the annual effective dose equivalent of 100 mrem, but allows temporary limits of 500 mrem if avoidance of higher exposures is impractical. The standard sets annual dose limits for any organ at 5 mrem. An annual dose equivalent from drinking water supplies operated by DOE is set at 4 mrem and states that liquid effluent from DOE activities will not cause public drinking water systems to exceed EPA MCLs. Specific concentration limits in water for contaminants are listed in Table E-3. The DOE published proposed rule, Radiation Protection of the Public and the Environment (10 CFR 834), in the March 23, 1993 Federal Register (58 FR 16268), promulgates the standards presently found in DOE Order 5400.5. The proposed rule retains the substantive portions of the DOE Order, but differs from the existing Order in format, enhanced emphasis on the ALARA process, and changes the usage of derived concentration guides (DCGs). The proposed rule identifies DCGs not as "acceptable" discharge limits, but to be used as reference values for estimating potential dose and determining compliance with the requirements of the proposed rule. Where residual radioactive materials remain, the proposed rule states that various disposal modes should address impacts beyond the 1,000 year time period identified in the existing DOE Order.
Resource Conservation and Recovery Act Title 42 USC 6901 et seq		
Groundwater Protection Standards 40 CFR 264.92	Applicable	Groundwater restoration goals established by this section are applicable because groundwater has been impacted by releases from hazardous waste management units (i.e., 300-Area process trenches) located in source operable units above the 300-FF-5 operable unit. Restoration goals under CERCLA are to restore the groundwater to their beneficial use within the appropriate time frame established for each specific site. Three remediation levels of groundwater protection established by this section are background, MCL and alternate concentration levels (ACLs). MCLs are set at the same levels as SDWA MCLs and where no SDWA MCL has been set, health based ACLs may be established that are protective of human health and environment.
Toxic Substance Control Act Title 15 USC 2601 et seq.		
Regulation of PCBs 40 CFR 761	Not ARAR	Toxic Substance Control Act requirements are neither applicable nor relevant and appropriate because PCBs have not been detected in groundwater or in source operable unit soils at levels above 50 mg/kg. Handling, storage, and disposal requirements are applicable if PCBs are detected above 50 mg/kg.

Table E-1. Identification of Potential Federal ARARs at the 300-FF-5 Operable Unit. (Sheet 4 of 13)

Requirements	Applicable, Relevant and Appropriate, or To Be Considered	Comment
LOCATION-SPECIFIC		
National Historic Preservation Act of 1966 Title 16 USC 470 et seq.	Applicable	The National Historic Preservation Act requires that historically significant properties be protected. The Act requires that agencies undertaking projects must evaluate impacts to properties listed on or eligible for inclusion on the National Register of Historic Places. The National Register of Historic Places is a list of sites, buildings or other resources identified as significant to United States history. An eligibility determination provides a site the same level of protection as a site listed on the National Register of Historic Places. The regulations implementing the Act require that the lead agency for a project identify, evaluate and determine the effects of the project on any cultural resource sites that may be within the area impacted by the project. The implementing regulations require that negative impacts be resolved. This law is applicable to remedial actions at the 300-FF-5 operable unit since review of the PNL Hanford Cultural Resources Laboratory (HCRL) database identified cultural sites within the area of the operable unit. One site identified within the 300-FF-1 source operable unit has been evaluated for eligibility using criteria under Section 106 of the Act and determined to be eligible for inclusion on the National Register of Historic Places. The HCRL identifies areas within 400 m (1300 ft) of water resources as areas of high potential for culturally significant finds since these areas were historically used by Native American peoples. The HCRL also identified additional culturally significant sites within 0.8 km (0.5 mi) of the operable unit and that the "Manhattan Project" era buildings and facilities are potentially eligible for inclusion on the National Register of Historic Places.
Archeological and Historic Preservation Act Title 16 USC 469a	Applicable	This act requires that actions conducted at the site must not cause the loss of any archeological and historic data. This Act mandates preservation of the data and does not require protection of the actual facility. Archeological or historic sites have been identified within the operable unit and therefore these requirements are applicable.
Native American Graves Protection and Repatriation Act Public Law 101-601, as amended	Applicable	This law was enacted to establish protection, ownership and control of native American human remains and other objects of cultural significance to native Americans that are excavated or discovered on federal lands. This law is applicable to the 300-FF-5 operable unit since native American remains have been previously found within the operable unit and the operable unit is located adjacent to the Columbia River, an area of high cultural resource potential. The law specifies that inadvertent discovery of native American human remains during construction activities requires work to stop, reasonable efforts made to protect the items discovered, notification in writing to the Secretary of Interior, and appropriate Indian tribe(s) notified. Construction activity may resume 30 days after certification that all notification activities and protection measures required under the law have been enacted.

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Table E-1. Identification of Potential Federal ARARs at the 300-FF-5 Operable Unit. (Sheet 5 of 13)

Requirements	Applicable, Relevant and Appropriate, or To Be Considered	Comment
Endangered Species Act of 1973 Title 16 USC 1531 et seq.	Applicable	The Endangered Species Act includes requirements to protect species threatened by extinction and habitats critical to their survival. These requirements are applicable since the protected species, persistantsepal yellowcress, a candidate species for list as threatened or endangered was identified in the riparian zone during ecological surveys of the operable unit. A number of other candidate species of vegetation and animals reside in the 300 Areas, but the only endangered or threatened animal species observed along the riparian zone of the 300 Area are infrequent visitors.
Wild and Scenic Rivers Act Title 16 USC 1271 et seq	To Be Considered	Requirements of this act are "To Be Considered" because the Hanford Reach of the Columbia River has been proposed for inclusion on the national list of wild and scenic rivers. Remediation alternatives need to consider impacts to the Columbia River.
Hanford Reach Comprehensive River Protection Study and Interim Protection Act P.L. 100-605	To Be Considered	This law requires that the Secretary of Interior prepare a comprehensive river conservation study for the segment of the Columbia River from a point one mile below the Priest Rapids Dam approximately 51 miles downstream to river mile 345, north of Richland. This stretch of the river is commonly referred to as the Hanford Reach. This law is applicable to remedial actions performed at 300-FF-5 that may impact the river since the operable unit shoreline is located within the study area. Pursuant to this law, *The Hanford Reach of the Columbia River, Draft Comprehensive River Conservation Study and Environmental Impact Statement* has been prepared. This environmental impact statement documents the resources of the Hanford Reach and develops alternatives for their protection as required by PL 100-605. During the final EIS, the downstream boundary was relocated to river mile 346.5 to exclude the "300 Area" because of the extensive cleanup activities. The report recommends that Congress designate the Hanford Reach of the Columbia River a wildlife refuge and a wild and scenic river (NPS 1994). Enactment of this law also provides for interim protection of the Hanford Reach for a period of eight years. During the period of interim protection, construction of dams is prohibited and so are dredging and channelization projects. Interim protection also requires all other existing or planned federal and non-federal projects to minimize adverse impacts to the river and whenever possible, to make use of existing structures and facilities. Agencies planning projects within the area of the Hanford Reach are to coordinate with the Secretary of the Interior in order to minimize and mitigate potential adverse impacts.
Fish and Wildlife Conservation Act Title 16 USC 2901	Not ARAR	Fish and Wildlife Conservation Act is administrative in nature and is not considered applicable or relevant and appropriate. The act requires states to prepare conservation plans that include inventories and identification of nongame fish and wildlife. The act also includes statements encouraging federal agencies and programs to use all available statutory resources to conserve and promote protection of nongame fish and wildlife. Previous to this law, conservation measures were addressed for only game species.

Table E-1. Identification of Potential Federal ARARs at the 300-FF-5 Operable Unit. (Sheet 6 of 13)

Requirements	Applicable, Relevant and Appropriate, or To Be Considered	Comment
Compliance With Floodplain/Wetlands Environmental Review Requirements 10 CFR 1022	Applicable	This standard is potentially applicable to remedial actions at 300-FF-5 since wetlands may exist along the Columbia River shoreline. This regulation requires DOE and other federal agencies to comply with the requirements of Executive Order 11990 - Protection of Wetlands and Execute Order 11988 - Floodplain Management. Executive Order 11988 requires DOE procedures to ensure that any actions conducted in a floodplain consider flood hazards. Executive Order 11990 requires the protection of wetlands from destruction. The Executive Orders require that federal agencies implement these considerations through existing federal requirements, such as the National Environmental Policy Act. This regulation specifies that DOE prepare a floodplain/wetlands assessment which includes a discussion of purpose and need, a project description, location of wetlands with respect to the project, high hazard areas located in the floodplain, and potential positive and negative effects on floodplains/wetlands. The assessment is also to include descriptions of alternatives to the proposed action that may be necessary to avoid potential negative impacts. The floodplain/wetlands assessment should be prepared concurrent with and incorporated into the environmental assessment or environmental impact statement prepared for the project. This FS incorporates these requirements.
Action-Specific		
Resource Conservation and Recovery Act, as amended Title 42 USC 6901		
Criteria for Municipal Solid Waste Landfills 40 CFR 258	Not ARAR	This rule establishes the minimum national criteria for the location, design, operation, cleanup and closure of municipal solid waste landfills. This rule applies only to municipal solid waste landfills as defined under the standard and that received waste on or after October 9, 1993. The standard defines a municipal solid waste landfill as a discrete area of land that receives household waste and is not a land application unit, surface impoundment or waste pile as defined under 40 CFR 257. This standard is neither applicable or relevant and appropriate because the 300-FF-5 operable unit does not include source areas (which are addressed as part of the 300-FF-1 and 300-FF-2 operable units).
Identification and Listing of Wastes 40 CFR 261	Applicable	These requirements are applicable because this section establishes the framework for determining whether or not a waste is hazardous. Treatment wastes should be tested using methods established under this section.

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Table E-1. Identification of Potential Federal ARARs at the 300-FF-5 Operable Unit. (Sheet 7 of 13)

Requirements	Applicable, Relevant and Appropriate, or To Be Considered	Comment
Generator Standards 40 CFR 262	Applicable	Groundwater at the 300-FF-5 operable unit is not considered hazardous waste, however, treatment technologies for removal of radionuclides from groundwater may generate hazardous waste. Therefore, regulatory requirements for facilities that generate hazardous waste may be applicable to remediation of the 300-FF-5 operable unit. Requirements limit waste accumulation to 90 days, and specify packaging, training, emergency preparedness planning, and record-keeping procedures.
Standards Applicable to Transporters of Hazardous Waste 40 CFR 263	Applicable	Hazardous waste may be generated during remediation of operable unit groundwater and may require transport to treatment facilities. The requirements for transporters of hazardous waste would be applicable to hazardous waste shipments. Transporters must maintain records concerning generator's delivery to treatment, storage, and disposal facilities, proper labeling of transported waste, and compliance with manifest system.
Standards for Owners and Operators of TSD Facilities 40 CFR 264	Applicable	Groundwater at the 300-FF-5 operable unit is not considered hazardous waste, however, treatment technologies for removal of radionuclides from groundwater may generate hazardous waste. Regulatory requirements for owners and operators of hazardous waste storage, treatment, or disposal facilities are applicable if wastes are stored longer than 90 days or disposed onsite.
General Facility Standards 40 CFR 264.10-264.18	Applicable	If hazardous wastes are generated and stored longer than 90 days, general facility standards would be applicable to remediation activities for the 300-FF-5 operable unit. Requirements are specified that address facility identification, employee training, emergency preparedness, contingency planning, closure, and post-closure.
Preparedness and Prevention 40 CFR 264.30-264.37	Applicable	Facilities must be maintained and operated to minimize the possibility of fire, explosion, and unplanned release of hazardous waste to air, soil, and water. These requirements are applicable to the management of any hazardous waste generated as a result of remediation activity.
Closure and Post-Closure 40 CFR 264.110-264.178	Applicable	This section describes performance standards for controls to minimize or eliminate the escape of hazardous waste constituents from landfills or tanks to the ground and surface waters. Applicable if sludges containing hazardous waste from groundwater remedial actions are disposed in tanks.
Use and Management of Containers 40 CFR 264.170-264.178	Applicable	Requirements of this section are applicable if hazardous waste is held onsite prior to treatment or disposal. Subpart I provides standards and management practices for containers that include inspection, segregation, contaminant, and closure.

Table E-1. Identification of Potential Federal ARARs at the 300-FF-5 Operable Unit. (Sheet 8 of 13)

Requirements	Applicable, Relevant and Appropriate, or To Be Considered	Comment
Air Emission Standards for Process Vents 40 CFR 264.170 subparts AA	Applicable	This section is applicable to treatment systems with volatile organic concentrations greater than 10 ppm. Subpart AA applies to process vents associated with distillation, fractionation, thin-film evaporation, solvent extraction, and air or steam stripping operations.
Corrective Action Management Units 40 CFR 264.552	Not ARAR	The requirements for Corrective Action Management Units were identified in the Phase I/II FS as applicable standards, however, after re-evaluation, these requirements have been determined to be neither applicable nor relevant and appropriate to remediation of the 300-FF-5 operable unit because this operable unit addresses only contamination of groundwater, saturated soils, surface water, and river sediments. The 300-FF-1 and 300-FF-2 source operable units are responsible for 300 Area RCRA facilities. This rule presents provisions for the use of corrective action management units (CAMUs) and temporary units as remediation waste management units. Previous EPA experience found that implementing RCRA Subtitle C rules to remediation wastes provided disincentives to the implementation of more protective remedies and remediation was negatively impacted by RCRA regulatory controls.
Corrective Action and Groundwater Monitoring at Hazardous Waste Facilities 40 CFR 264 and 270	Applicable	Groundwater protection standards are established to protect upper aquifers that underlay the 300 Waste Management Area. These requirements are applicable to 300-FF-5 because releases from the 300 Area Process Trenches, regulated units under RCRA have impacted groundwater. The concentration limits in the underlying aquifer cannot exceed the levels established beyond the point of compliance. Maximum concentration limits are provided in Table 1 of 40 CFR 264.94.
Land Disposal Restrictions 40 CFR 268	Applicable	These requirements are applicable if restricted waste is generated during remediation and disposed. Specific treatment standards and prohibitions on storage are included in the requirements.
Clean Water Act of 1977, Title 33 USC 1251, as amended		The Clean Water Act establishes the guidelines and standards to control discharge of pollutants to waters of the U.S., in this case the Columbia River.

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Table E-1. Identification of Potential Federal ARARs at the 300-FF-5 Operable Unit. (Sheet 9 of 13)

Requirements	Applicable, Relevant and Appropriate, or To Be Considered	Comment
National Pollutant Discharge Elimination System (NPDES) 40 CFR 122 to 125	Applicable	The NPDES program controls release of toxic pollutants through monitoring requirements and implementation of a best management practices program. The administrative (e.g., permitting) requirements of the NPDES program are not applicable for on site discharge at CERCLA sites (in accordance with CERCLA Section 121(c)). The substantive requirements would still be applicable. A NPDES permit would be required if discharge of treated groundwater to the Columbia River is considered an offsite activity.
EPA Pretreatment Standards 40 CFR 403	Applicable	This regulation establishes the national pretreatment standards for waste discharge to publically owned and operated wastewater treatment plants. This regulation is potentially applicable to remedial alternatives that discharge wastewater to a publically owned treatment works (POTW).
Federal Water Quality Criteria 55FR 14350	To Be Considered	Federal water quality criteria are non-enforceable guidelines that are "To Be Considered" for remedial actions at 300-FF-5. Ambient water quality criteria provide protection for propagation of fish, shellfish, wild life, and recreation in and on the water. Criteria serve the dual purpose of establishing the water quality goals for a specific water body and serve as the regulatory basis for the establishment of state water quality-based treatment controls beyond the technology-based levels required in Sections 301(b) and 306 of the Act.
Safe Drinking Water Act (SDWA) as amended Title 42 USC 300f		The Safe Drinking Water Act mandates regulations to protect human health from contaminants in drinking water. There are no wells in the 300 Area used for drinking water purposes, but the groundwater aquifer does reach the Columbia River, which is used for drinking water.
Underground Injection Control Regulations 40 CFR 144-148	Applicable	These regulations address permitting for Underground Injection Control (UIC) to prevent contamination of underground sources of drinking water. These requirements concern siting, construction, operating, monitoring, and closure of injection wells. NPL sites that construct underground injection wells onsite are not required to comply with the administrative requirements (e.g., permitting), but must meet the substantive requirements of the program.
Clean Air Act of 1977 Title 42 USC 7401 et seq., as amended		The Clean Air Act (CAA) regulates emission of hazardous pollutants to the air. Controls for emissions are implemented through federal, state, and local programs. Pursuant to the CAA, EPA has promulgated National Ambient Air Quality Standards, National Emission Standards for Hazardous Air Pollutants, and New Source Performance Standards. Treatment actions that may be performed and are subject to air standards, include air stripping and thermal destruction.

Table E-1. Identification of Potential Federal ARARs at the 300-FF-5 Operable Unit. (Sheet 10 of 13)

Requirements	Applicable, Relevant and Appropriate, or To Be Considered	Comment
National Ambient Air Quality Standards 40 CFR 50	Applicable	Requirements of these regulations are applicable to airborne releases of radionuclides and criteria pollutants specified under the statue. Specific release limits for particulates are set at 50 ugm/m³ annually or 150 ugm/m³ per 24-hour period.
Ambient Air Quality Monitoring 40 CFR 58	Relevant and Appropriate	This regulation presents the criteria and requirements for ambient air quality monitoring and reporting for local air pollution control agencies and operators of new sources of air pollutants. This regulation is not applicable to 300-FF-5 because remedial actions do not meet the regulatory definition of a new source. However, these requirements may be considered relevant and appropriate to remedial actions that have the potential to emit air contaminants. This regulation defines the requirements for a national ambient air quality monitoring network of state and local air monitoring stations.
New Source Performance Standards (NSPS) 40 CFR 60	Not ARAR	Standards of performance for new stationary sources would not be applicable or relevant and appropriate to remedial actions proposed at the 300-FF-5 operable unit because none of the proposed actions include any of the sources identified in the standard.
National Emission Standard for Hazardous Air Pollutants (NESHAP), Subpart H - National Emission Standards for Emissions of Radionuclides Other than Radon From Department of Energy Facilities 40 CFR 61	Applicable	These requirements are applicable to the site and remedial alternatives because the potential to release air emissions to unrestricted areas exists. Subpart H sets emissions limits to ambient air from the entire facility not to exceed an amount that would cause any member of the public to receive an effective dose equivalent of 10 mrem/yr. The definition of facility includes all buildings, structures, and operations on one contiguous site. Radionuclide emission from stacks shall be monitored and effective dose equivalent values to members of the public calculated.
Radioactive Waste Management DOE Order 5820.2A	To Be Considered	Policies and guidelines established for the management of radioactive waste and contaminated facilities should be considered during selection of remedial alternatives. These standards are "To Be Considered" under CERCLA because they are not federally promulgated regulations. However, compliance with DOE orders is required at the Hanford Site. These guidelines set performance objectives to limit the annual effective dose equivalent beyond the facility boundary to 25 mrems. Disposal methods selected must be sufficient to limit the annual effective dose equivalent to 100 mrem for continuous exposure or 500 mrem for acute exposures when institutional controls are removed.
Chapter III-Management of Low-Level Waste		
Waste treatment [Paragraph 3(f)(1)(2)(3)]	To Be Considered	This section states that waste treatment techniques such as incineration, shredding, and compaction shall be implemented to meet performance requirements. These requirements are

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Table E-1. Identification of Potential Federal ARARs at the 300-FF-5 Operable Unit.
(Sheet 11 of 13)

Requirements	Applicable, Relevant and Appropriate, or To Be Considered	Comment
		"To Be Considered" and should be considered during selection of remedial alternatives.
Disposal [Paragraph 3(i)]	To Be Considered	Proposed remedial actions related to disposal of low-level waste should be selected and designed considering the criteria in this section. The section includes engineered modifications, disposal site selection, disposal facility and site design, and disposal facility
Chapter VI - Waste Management Plan Outline		
Radioactive and Mixed Waste Management [Paragraph 3(c)]	To Be Considered	This section is "To Be Considered" during selection of remedial alternatives because the section includes system and facility descriptions, current and future plans, and implementation requirements.
Hazardous Waste Management [Paragraph 3(d)]	To Be Considered	This section is "To Be Considered" and includes system and facility descriptions that should be considered during selection of remedial alternatives.
Radiation Protection for Occupational Workers DOE Order 5480.11	To Be Considered	DOE Order 5480.11 implements radiation protection standards and program requirements for worker protection at DOE and DOE-contractor operations. These standards were developed to be consistent with EPA standards and are based on recommendations by organizations recognized as authorities in the area of radiation protection. These standards are "To Be Considered" under CERCLA because they are not federally-promulgated regulations. However, compliance with DOE orders is required at the Hanford Site. DOE policy is to maintain radiation exposure as low as reasonably achievable (ALARA) and as low as possible where limiting values have been established. Limiting values for an annual effective dose equivalent to a worker from both internal and external sources received in any year is 5 rem. The limiting value to specific organs and tissues is 15 rem to the lens of the eye or 50 rem to any other organ or extremity of the body. Additional limiting values are established for the unborn (0.5 rem/yr) and children and minors (0.1 rem/yr). Radiation protection standards for the public entering controlled areas are set at 0.1 rem/yr for the committed effective dose equivalent from any external radiation. In addition, exposure shall not cause a dose equivalent to any tissue to exceed 5 rem/yr.

Table E-1. Identification of Potential Federal ARARs at the 300-FF-5 Operable Unit. (Sheet 12 of 13)

Requirements	Applicable, Relevant and Appropriate, or To Be Considered	Comment
Atomic Energy Act of 1954 Title 42 USC 2011 et seq., as amended		
Licensing Requirements for the Land Disposal of Radioactive Waste 10 CFR 61	Not ARAR	The Phase I/II FS identified the Licensing Requirements for Land Disposal of Radioactive Waste as relevant and appropriate to remediation activities at the 300-FF-5 operable unit. However, these requirements have been re-evaluated during preparation of this FS and determined to be neither applicable nor relevant and appropriate to remediation of this operable unit because land disposal is not within the scope of responsibilities for the 300-FF-5 operable unit. This operable unit addresses contamination of groundwater, saturated soils and river sediments.
Packaging and Transportation of Radioactive Material 10 CFR 71	Relevant and Appropriate	These requirements apply to the packaging, preparation for shipment, and transportation of licensed radioactive material. The regulations are applicable for NRC licensed plants and facilities where material is transported outside the confines of the plant. The Hanford Site is not an NRC-licensed plant; however, potentially radioactive waste will be generated by the remedial treatment of the groundwater. Subparts of this regulation are relevant and appropriate for packaging, testing, and preparation of packages containing radioactive material.
Environmental Radiation Protection Standards for the Management and Disposal of Spent Nuclear Fuel, High-Level, and Transuranic Radioactive Wastes 40 CFR Part 191	Not ARAR	Requirements established by this standard are neither applicable nor relevant and appropriate because the wastes covered by this regulation are not present in 300-FF-5.
Health and Environmental Protection Standards for Uranium and Thorium Mill Tailings 40 CFR 192	Relevant and Appropriate	Standards for cleanup set under this program are relevant and appropriate to remedial actions conducted at the site, including groundwater protection requirements for Ra-226, Ra-228, and gross alpha particle activity, which are set at levels established under state and federal water quality criteria programs. The standard is not applicable because the operable unit is not a uranium or thorium milling site.
Hazardous Materials Transportation Act 49 USC 1801 et seq.		
Hazardous Materials Regulation 49 CFR 171	Applicable	No person may offer to accept hazardous material for transportation in commerce unless the material is properly classed, described, packaged, marked, labeled, and in condition

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Table E-1. Identification of Potential Federal ARARs at the 300-FF-5 Operable Unit. (Sheet 13 of 13)

Requirements	Applicable, Relevant and Appropriate, or To Be Considered	Comment
		for shipment. These requirements are applicable to hazardous material used or generated during treatment of groundwater that is transported in commerce. Items could include ion exchange resins and recharge solutions, reverse osmosis brine, filters, and sludge from processing equipment.
Hazardous Materials Tables, Hazardous Materials Communications Requirements, and Emergency Response Information Requirements 49 CFR 172	Applicable	These requirements are only applicable if hazardous materials are transported off the Hanford Site. The class of each hazardous material is identified in tables with requirements pertaining to its packaging, labeling, and transportation. Small quantities of radioactive materials are not subject to any other requirements of the chapter if the activity level does not exceed that specified in §§173.421, 173.422, or 173.424. Packages used for shipping hazardous materials shall be designed and constructed, and contents so limited, that under conditions normally incident to transportation there is no significant release of hazardous materials to the environment.
Hazardous Waste Discharges 40 CFR 263.30	Applicable	In the event of a discharge of hazardous waste during transportation from the treatment facility to the disposal facility, this section is applicable.
National Environmental Policy Act (NEPA) Regulations 40 CFR 1500	Applicable	The National Environmental Policy Act was established to insure that environmental resources are provided adequate consideration along with economic and technical considerations in decision making. Under 10 CFR 1021, DOE adopts the Council on Environmental Quality (CEQ) NEPA implementing regulations codified in 40 CFR 1500 through 1508. All major federal actions considered to significantly impact the quality of the environment require preparation of an environmental impact statement. An environmental assessment may be prepared to assist in determining if an environmental impact statement is necessary. In accordance with the Secretary of Energy's NEPA policy (June 13, 1994) and CEQ regulation in 40 CFR 1502.25, NEPA values have been integrated into this FS.

Table E-2. Identification of Potential State ARARs at the 300-FF-5 Operable Unit.
(Sheet 1 of 13)

Requirements	Applicable, Relevant and Appropriate, To Be Considered	Comment
CHEMICAL-SPECIFIC		
Model Toxics Control Act Ch. 70.105D RCW		
Model Toxics Control Act Cleanup Regulations WAC 173-340-700	Applicable	Requirements under this section of MTCA may be applicable to the operable unit. This section identifies the methods used to develop cleanup standards and their use in selection of a cleanup action. Cleanup levels are based on protection of human health and the environment, the location of the site and other regulations that apply to the site. The standard specifies clean up goals implement the strictest federal or state cleanup criteria. In addition to meeting requirements of other regulations, MTCA uses three basic methods for establishing cleanup levels; Method A - routine, Method B - standard method, and Method C - conditional. These methods may be used to identify cleanup standards for groundwater, surface water, soils and protection of air quality. MCLs, MCLGs and secondary drinking water standards are identified in the regulation as potential groundwater cleanup criteria. Cleanup levels for soils may be calculated using these methods, or may be set at 100 times the most stringent federal or state groundwater protection standard, unless demonstrated that this is not appropriate for the site. MTCA surface and groundwater cleanup levels for contaminants of concern are listed in Table E-4.
Hazardous Waste Management Act Ch. 70.105 RCW		
Dangerous Waste Regulations WAC 173-303	Applicable	Groundwater at the 300-FF-5 operable unit is not considered dangerous waste, however, treatment technologies for removal of radionuclides from groundwater may generate hazardous waste. Therefore, sections of the dangerous waste regulations may be applicable to remediation of the 300-FF-5 operable unit.
Designation of Waste WAC 173-303-070	Applicable	The requirements of this section, are applicable because technologies for removal of radionuclides may generate wastes that could designate as dangerous waste. These requirements establish the methods and procedures to determine if solid waste requires management as dangerous waste.

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Table E-2. Identification of Potential State ARARs at the 300-FF-5 Operable Unit. (Sheet 2 of 13)

Requirements	Applicable, Relevant and Appropriate, To Be Considered	Comment
Discarded Chemical Products WAC 173-303-081	Applicable	This section specifies that chemical products, residue, containers, or contaminated materials may be designated dangerous waste if they are handled in a manner considered as disposal and the product is considered to have one of the generic names listed in the Discarded Chemical List under WAC 173-303-9903. This section is applicable to remedial actions at the operable unit since there is potential to use commercial chemical products that have generic names identified in WAC 173-303-9903 that will require disposal.
Dangerous Waste Sources WAC 173-303-082	Applicable	This section of the dangerous waste regulations specify that any waste or residue from waste that is listed in the waste sources list in WAC 173-303-9904 is considered a designated waste and requires management as a dangerous waste. This section is applicable since remedial actions at the site may generate listed wastes. The section is also considered applicable since the process trenches, a RCRA TSD unit, and process ponds are reported to have received listed wastes and releases from these units have impacted groundwater.
Dangerous Waste Characteristics WAC 173-303-090	Applicable	This section sets the methods used to classify wastes as dangerous or extremely hazardous based on the characteristics of ignitability, corrosivity, reactivity and toxicity. Classification of wastes is applicable to any wastes generated at the operable unit.
Dangerous Waste Criteria WAC 173-303-100	Applicable	This section of the dangerous waste regulations presents criteria and methods to evaluate solid waste to determine if they are dangerous wastes. Wastes are evaluated against each of these three criteria: toxicity, persistence and carcinogenicity. Specific evaluation methods are presented for each category. This section is applicable since remedial actions at the site may generate solid waste that will require evaluation to determine if it must be managed as dangerous waste.
Regulation of Public Ground Water Ch. 90.44 RCW		
Water Quality Standards for Groundwater WAC 173-200	Not ARAR	This standard specifically exempts CERCLA and MTCA cleanup actions and therefore is neither applicable nor relevant and appropriate to the operable unit.
Water Pollution Control Act and Water Resource Act Ch. 90.48 RCW and Ch.90.54 RCW		

Table E-2. Identification of Potential State ARARs at the 300-FF-5 Operable Unit. (Sheet 3 of 13)

Requirements	Applicable, Relevant and Appropriate, To Be Considered	Comment
Surface Water Quality Standards WAC 173-201A	Applicable	Under MTCA [WAC 173-340-720(1)(c)(iii)], groundwater quality must meet surface water quality criteria at the point of discharge. Groundwater from the 300-FF-5 operable unit discharges to the Columbia River. Water quality standards are set at levels protective of aquatic life. Table E-4 lists criteria for operable unit contaminants of concern.
Sediment Management Standards WAC 173-204	Applicable	The chapter sets surface sediment quality standards and provides a management and decision process for reduction of pollutant discharges and the cleanup of contaminated sediments. This chapter is applicable to all existing or proposed actions at the 300-FF-5 operable unit that may affect surface sediment quality. The Department of Ecology determines fresh water surface sediment quality on a case-by-case basis. Numeric criteria for freshwater sediments have not been promulgated. The Department of Ecology may apply the most restrictive standard if the beneficial uses of more than one resource are affected, such as at the interface between surface sediments, groundwater, or surface water.
Solid Waste Management, Recovery and Recycling Act Ch. 70.95 RCW		
Minimum Functional Standards for Solid Waste Handling WAC 173-304	Relevant and Appropriate	The standard is not applicable to the 300-FF-5 groundwater operable unit, but may be considered relevant and appropriate because waste management facilities are present in source operable units above the 300-FF-5 groundwater operable unit and remediation activities may generate solid waste. The standard sets groundwater maximum contaminant levels (MCLs) at the same levels as the drinking water standards under 40 CFR 141.
Health Standards for Public Drinking Water Supplies WAC 246-290	Relevant and Appropriate	The rules established under WAC 246-290 define the regulatory requirements necessary to protect consumers using public drinking water supplies. The rules are intended to conform with the federal Safe Drinking Water Act (SDWA), as amended. WAC 246-290-310 establishes maximum contaminant levels (MCLs) which define the water quality requirements for public water supplies. The requirements of WAC 246-290-310 are not applicable to the 300-FF-5 operable unit since they address public drinking water supplies and groundwater at the site is not used for drinking water. However, these standards may be relevant and appropriate since groundwater discharges to the Columbia River, which is used for drinking water. WAC 246-290-310 establishes both primary and secondary MCLs and identifies that enforcement of the primary standards is the Department of Health's first priority. Since the standards set under WAC 246-290-310 are set at the levels established under the federal SDWA, refer to Tables E-3 and E-4 for federal drinking water MCLs and MCLGs.

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Table E-2. Identification of Potential State ARARs at the 300-FF-5 Operable Unit. (Sheet 4 of 13)

Requirements	Applicable, Relevant and Appropriate, To Be Considered	Comment
State Radiation Protection Requirements Ch. 70.98 RCW		Washington State Radiation Protection Requirements are implemented under specific sections of WAC 246.
Radiation Protection Standards WAC 246-221	Applicable	This regulation is considered applicable because it establishes standards for acceptable levels of exposure to radiation. The occupational dose limit for adults, excluding planned special exposures, is not to exceed an annual limit of a total effective dose equivalent equal to 5 rem, or the sum of the deep dose equivalent and committed dose equivalent to any individual organ or tissue other than the lens of the eye should not exceed 50 rem. An eye dose equivalent of 15 rem is set for exposure to the eye. The shallow dose equivalent for the skin or any extremities is 50 rem. Occupational dose limits for minors are set at 10% of the annual occupational dose limit for adults. The standard identifies the methods required to demonstrate compliance and provides derived air concentration (DAC) and annual limit on uptake (ALI) values that may be used to determine an individuals occupational dose. Dose limits that individual members of the public may receive in unrestricted areas from external sources are not to exceed 0.002 rem in an hour, or 0.5 rem per yr. The standard specifies requirements for monitoring personnel exposure for both external and internal exposure. Chapter 246-221-290 establishes annual average concentration limits for radioactive releases in gaseous and liquid effluent to unrestricted areas.
Radiation Protection- Air Emissions WAC 246-247	Applicable	This regulation promulgates air emission limits for airborne radionuclide emissions as defined in WAC 173-480 and 40 CFR 61 Subparts H and I. The ambient air standards under WAC 173-480 requires that the most stringent standard be enforced. Ambient air standards under 40 CFR 61 Subparts H and I are not to exceed amounts that result in an effective dose equivalent of 10 mrem/yr to any member of the public. The ambient standard in WAC 173-480 specifies that emission of radionuclides to the air must not cause a dose equivalent of 25 mrem per year to the whole body or 75 mrem per year to any critical organ.
Radiation Protection at Uranium and Thorium Milling Operations WAC 246-252	Relevant and Appropriate	This regulation is not applicable to 300-FF-5 because the site was not a uranium or thorium milling operation. However, the regulation is relevant and appropriate because it contains specific concentration limits for protection of groundwater: gross alpha excluding radon and uranium not to exceed 15 pCi/L, and combined radium-226 and radium-228 not to exceed 5 pCi/L.

Table E-2. Identification of Potential State ARARs at the 300-FF-5 Operable Unit.
(Sheet 5 of 13)

Requirements	Applicable, Relevant and Appropriate, To Be Considered	Comment
LOCATION-SPECIFIC		
Department of Game State Environmental Policy Act (SEPA) Procedures WAC 232-012	Not ARAR	This standard defines the requirements that the Department of Game must take to protect endangered or threatened wildlife. These requirements are not applicable since no endangered or threatened wildlife were identified at the operable unit during wildlife surveys performed within the area of the operable unit or during Department of Natural Resources records searches. However, the requirements of this chapter will be re-evaluated should protected wildlife species be identified within the operable unit.
Natural Area Preserves RCW 79.70		
Washington Natural Heritage Program	To be Considered	The Washington State Natural Heritage Program is authorized under RCW 79.70, Natural Area Preserves and serves as an advisory council to the Washington State Department of Natural Resources, Fish and Wildlife, the Parks and Recreation Commission, and other state agencies managing state owned land or natural resources. The requirements of the Natural Heritage Program are "To Be Considered" guidance for remedial actions at the 300-FF-5 operable unit since the persistentsepal yellowcress (*Rorippa columbiae*), a plant listed as endangered by the Natural Heritage Program, has been identified within the operable unit, and two species, the Columbia River milkvetch (*Astragalus columbianus*) and Hoover's desert parsley (*Lomatium tuberosum*), listed as threatened, have the potential to occur within the operable unit. The list of state endangered, threatened and sensitive plants developed by the program, along with program recommended levels of protection, are to be used to assist resource managers in determining which species of concern occur in their areas and recommend protection. The designations provided to plants by the Washington State Natural Heritage program are advisory and do not specify a regulatory level of protection.
Shoreline Management Act RCW 90.58		
Shoreline Management Act Guidelines WAC 173-16	Not ARAR	Regulations and restrictions of the Shorelines Management Act implemented under WAC 173-16 are only applicable to lands controlled by the State of Washington. The federal government owns the river shoreline within the area of the operable unit. Therefore, these requirements are neither applicable nor relevant and appropriate to remediation of the 300-FF-5 operable unit. This chapter establishes standards that restrict certain activities near shorelines and limit contaminant concentrations along shorelines.

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Table E-2. Identification of Potential State ARARs at the 300-FF-5 Operable Unit.
(Sheet 6 of 13)

Requirements	Applicable, Relevant and Appropriate, To Be Considered	Comment
ACTION - SPECIFIC		
Model Toxics Control Act Ch. 70.105D RCW		
Model Toxics Control Act Cleanup Regulations WAC 173-340	Applicable	This chapter is potentially applicable to the operable unit because it describes the requirements for selecting cleanup actions, preferred technologies, policies for use of permanent solutions, the time frame for cleanup, and the process for making decisions. The regulation specifies that all cleanup actions be protective of human health, comply with all applicable state and federal regulations, and provide for compliance monitoring.
Selection of Cleanup Actions WAC 173-340-360	Applicable	Specific criteria for the various cleanup methods are presented in the regulation. The chapter specifies permanent solutions using cleanup technologies that minimize the amount of untreated hazardous substances remaining onsite. Technologies that recycle or re-use materials, followed by methods that destroy or detoxify hazardous substances, are preferred over those cleanup methods that may leave contaminants onsite. Cost may also play a role in determining points of compliance and selection of cleanup actions. For example, if a cleanup actions cost is disproportionate to the incremental increase in protection compared to a lesser preferred cleanup action, the less preferred action may be selected.
Cleanup Actions WAC 173-340-400	Applicable	Applicable to remedial actions at the site because it establishes specific requirements that ensure cleanup actions are designed, constructed, and implemented in a manner consistent with acceptable engineering practices, a site cleanup plan, and other requirements of 173-340-360.
Compliance Monitoring WAC 173-340-410	Applicable	This section of the regulation specifies requirements for compliance monitoring for remedial actions.
Institutional Controls WAC 173-340-440	Applicable	Requirements of this section apply to cleanup actions where residual concentrations exceed levels specified under 173-340-700 through 760 at conditional points of compliance established in the regulation or as determined by the Department of Ecology. Institutional controls may include physical, administrative/legal, or financial measures.

Table E-2. Identification of Potential State ARARs at the 300-FF-5 Operable Unit. (Sheet 7 of 13)

Requirements	Applicable, Relevant and Appropriate, To Be Considered	Comment
Hazardous Waste Management Act 70.105 RCW		
Dangerous Waste Regulations WAC 173-303	Applicable	Groundwater at the 300-FF-5 operable unit is not considered dangerous waste, however, treatment technologies for removal of radionuclides from groundwater may generate hazardous waste. Therefore, sections of the dangerous waste regulations may be applicable to remediation of the 300-FF-5 operable unit. However, under CERCLA, onsite remedial actions have to comply with only the substantive aspects of the standard and do not have to meet the administrative requirements. The section defines the procedures to determine if the solid waste is a dangerous waste.
Land Disposal Restrictions WAC 173-303-140	Applicable	This section of the regulation is applicable to remedial actions at the site if dangerous wastes are generated from remedial processes that are restricted from land disposal. The section describes requirements for restricted wastes, and defines the circumstances under which a prohibited waste may be landfilled.
Spills and Discharges into the Environment WAC 173-303-145	Applicable	Applicable to remedial actions at the site because it sets forth the requirements that apply when any dangerous waste or hazardous substance is intentionally or accidentally spilled or discharged into the environment, such that human health and the environment are threatened, regardless of the quantity of dangerous waste or hazardous substance.
Division, Dilution, and Accumulation WAC 173-303-150	Applicable	This section of the regulation is applicable to management of dangerous wastes, and states that any actions that divide or dilute wastes to change their designation is prohibited, except for the purposes of treating, neutralizing, or detoxifying such wastes. Subpart (2)(b) requires designation of each phase of the heterogeneous waste, in accordance with the dangerous waste designation requirements of WAC 173-303, and handles each phase accordingly.
Containers WAC 173-303-160	Applicable	This section is applicable to remedial actions at the site because it specifies that containers and inner liners shall not be considered as a part of the waste when measuring or calculating the quantity of a dangerous waste. Additionally, requirements for rinsing or vacuum cleaning the containers are specified.
Overpacked Containers WAC 173-303-161	Applicable	The requirements of this section are applicable to the remedial actions performed at the site if dangerous waste is generated. The section specifies the conditions that must be met to place small containers of dangerous waste in overpacked drums (40 CFR 178 and 179).

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Table E-2. Identification of Potential State ARARs at the 300-FF-5 Operable Unit. (Sheet 8 of 13)

Requirements	Applicable, Relevant and Appropriate, To Be Considered	Comment
Requirements for Generators of Dangerous Waste WAC 173-303-170	Applicable	Requirements for generators of dangerous waste established under this chapter are applicable to remedial actions performed at the site if dangerous waste is generated. Requirements defined under this section include: a 90-day waste accumulation period, specific levels of training, emergency preparedness, and record-keeping.
Accumulating Dangerous Waste Onsite WAC 173-303-200	Applicable	Requirements of this section are applicable to remedial actions at the site that generate dangerous waste. Dangerous waste may be accumulated onsite without a permit for 90 days or less after the date of generation. Requirements are included for labeling, marking, and inspection of the dangerous waste while it is being accumulated.
Special Accumulation Standards WAC 173-303-201	Applicable	The requirements of this section apply to persons who generate less than 2,200 pounds (1,000 kg) per month and do not accumulate onsite more than 2,200 pounds(1,000 kg) of dangerous waste. Requirements of this section may apply to the remedial actions at the site if more than 200 pounds, but less than 2,200 pounds, of dangerous waste is generated. It is not anticipated that wastes will be accumulated in tanks.
General Requirements for Dangerous Waste Management Facilities 173-303-280	Applicable	The general requirements for dangerous waste management facilities are only applicable to remediation actions at the operable unit that generated dangerous waste and provide storage in excess of 90 days. However, some of the general requirements identified under this section are applicable to generators, such as training, emergency preparedness, contingency planning, and management of containers.
General Waste Analysis WAC 173-303-300	Applicable	Analysis of a waste is required to determine the presence of dangerous waste before it is stored, treated, or disposed of. These requirements are applicable if wastes are generated by remedial actions.
Security WAC 173-303-310	Applicable	Security procedures will be taken to ensure that the remedial actions at the site do not injure persons and that access to the site is controlled. These requirements are applicable if dangerous wastes are generated by remedial actions at the site.
General Inspection WAC 173-303-320	Applicable	Requirements to inspect facilities to prevent malfunctions and deterioration, operator errors, and discharges that may cause or lead to the release of dangerous waste constituents to the environment, or a threat to human health, are applicable if dangerous wastes are generated by remedial activities conducted at 300-FF-5.

Table E-2. Identification of Potential State ARARs at the 300-FF-5 Operable Unit. (Sheet 9 of 13)

Requirements	Applicable, Relevant and Appropriate, To Be Considered	Comment
Personnel Training WAC 173-303-330	Applicable	A program of classroom instruction or on-the-job training for facility personnel is applicable if dangerous waste is generated as a result of remedial actions at the site.
Preparedness and Prevention WAC 173-303-340	Applicable	This section describes preparations and preventive measures, which help avoid or mitigate fire, explosion, or unplanned sudden or nonsudden releases of dangerous waste or dangerous waste constituents. This section is applicable if a dangerous waste is generated as a result of remedial actions at the site.
Contingency Plan and Emergency Procedures WAC 173-303-350	Applicable	Spill prevention, control and countermeasures (SPCC) plans are required for remedial actions performed at the site to lessen the potential impact on public health and the environment in the event of an emergency. Substantive sections of this section are applicable if dangerous waste is generated as a result of remedial actions at the site.
Other General Requirements WAC 173-303-395	Applicable	The regulations in this section define specific precautions for ignitable, reactive, or incompatible wastes. This section is applicable if dangerous waste is generated as a result of remedial actions at the site.
Use and Management of Containers WAC 173-303-630	Applicable	This section discusses procedures for management of containers used to store dangerous waste and is applicable if a dangerous waste is generated as a result of remedial actions at the site.
Groundwater Protection 173-303-645	Applicable	Groundwater protection standards are established to protect upper aquifers that underlay dangerous waste management units. The requirements of this section are applicable because contaminant releases from a regulated dangerous waste facility, the 300 Area Process Trenches have impacted 300-FF-5 operable unit groundwater. Contaminant concentrations based on protection of groundwater may be established at background concentrations, at MCLs established under the SDWA, or at health-based alternate concentration levels (ACLs) that do not pose present or future risk to human health or environment.
Solid Waste Management, Recovery, and Recycling Act Ch. 70.95 RCW		

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Table E-2. Identification of Potential State ARARs at the 300-FF-5 Operable Unit. (Sheet 10 of 13)

Requirements	Applicable, Relevant and Appropriate, To Be Considered	Comment
Minimum Functional Standards for Solid Waste Handling WAC 173-304	Applicable	These regulations may be considered applicable to remediation of the 300-FF-5 operable unit because solid waste, such as excavation spoils, waste concrete and pipe may be generated during remediation.
Onsite Containerized Storage, Collection, and Transportation Standards for Solid Waste WAC 173-304-200	Applicable	Requirements of this section are applicable to the containerized storage, collection, and transportation of solid waste. Excavation activities and treatment processes may generate waste that would need to comply with these solid waste standards.
Water Well Construction Ch. 18.104 RCW		
Minimum Standards for Construction and Maintenance of Water Wells WAC 173-160	Applicable	Requirements are applicable to remedial actions that include construction of wells used for groundwater extraction, monitoring, or injection of treated groundwater or wastes.
Water Pollution Control and Water Resources Act Ch. 90.48 RCW and Ch. 90.54 RCW		
Protection of Upper Aquifer Zones WAC 173-154	Relevant and Appropriate	This regulation directs Ecology to provide for protection of upper aquifers and upper aquifer zones to avoid depletions, excessive water level declines, or reductions in water quality. This regulation is not applicable to remedial actions at 300-FF-5 because the regulation establishes the policy and program for Ecology. However, the regulation may be considered relevant and applicable to remedial alternatives that involve removal or re-injection of groundwater from upper aquifers.
State Waste Discharge Program WAC 173-216	Applicable	Requirements of this program are applicable to remedial actions that include discharges to the ground (e.g., groundwater reinjection). The chapter implements a permit system applicable to industrial and commercial operations that discharge to the groundwater, surface waters, or sewerage systems. Specific discharges prohibited under the program are identified. Application for a permit will not be required for on-site remedial actions; however, onsite CERCLA remedial actions must meet substantive requirements of the regulations. The intent of the law is to maintain the highest possible standards, and the law requires the use of all known available and reasonable methods to prevent and control the discharge of wastes into the waters of the state.

Table E-2. Identification of Potential State ARARs at the 300-FF-5 Operable Unit.
(Sheet 11 of 13)

Requirements	Applicable, Relevant and Appropriate, To Be Considered	Comment
Underground Injection Control Program WAC 173-218	Relevant and Appropriate	Not applicable because groundwater is not used as a drinking water source. However, it is relevant and appropriate to remedial actions that involve underground injection of treated water or wastes. The regulation sets procedures and practices designed to meet SDWA requirements under 40 CFR 124, 141, 144 and 146. Onsite remedial actions need only meet the substantive requirements of the standard.
State NPDES Program WAC 173-220	Applicable	Establishes a state permit program pursuant to the national NPDES system. Substantive sections of the regulation are applicable to alternatives that discharge to the Columbia River, however, under CERCLA Section 121, on-site response actions do not require a permit.
Washington Clean Air Act Ch. 70.94 RCW and Ch. 43.21A RCW		
General Regulations for Air Pollution WAC 173-400	Applicable	Substantive standards established for the control and prevention of air pollution under this regulation are applicable to remedial actions proposed for the operable unit. The regulation requires that all sources of air contaminants meet emission standards for visible, particulate, fugitive, odors, and hazardous air emissions.
General Standards for Maximum Emissions WAC 173-400-040	Applicable	This section requires that all emission units use reasonably available control technology, which may be determined for some source categories to be more stringent than the emission limitations listed in this chapter.
Emission Standards for Sources Emitting Hazardous Air Pollutants WAC 173-400-075	Applicable	Requirements of this standard are applicable to remedial actions performed at the site that could result in the emission of hazardous air pollutants. The regulation requires that source testing and monitoring be performed.
Implementations of Regulations for Air Contaminant Sources WAC 173-403	Applicable	Substantive requirements of this section may be applicable to remedial actions performed at 300-FF-5. A new source would include any process or source that may increase emissions or ambient air concentration of any contaminant for which federal or state ambient or emission standards have been established. Remedial actions under CERCLA need to meet the substantive requirement of best available control technology for emission control, however, under CERCLA Section 121, on-site remedial actions are exempt from administrative requirements and do not require a permit.

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Table E-2. Identification of Potential State ARARs at the 300-FF-5 Operable Unit. (Sheet 12 of 13)

Requirements	Applicable, Relevant and Appropriate, To Be Considered	Comment
Controls for New Sources of Air Pollution WAC 173-460	Not ARAR	This chapter establishes controls for new sources emitting toxic air pollutants; however, the standard specifically exempts sites subject to MTCA actions. The standard establishes three major requirements for new sources of air pollutants: use of best available control technology, quantification of toxic emissions, and demonstration that human health is protected.
Ambient Air Quality Standards for Particulate Matter WAC 173-470	Applicable	Requirements for maximum acceptable levels for particulate matter in the ambient air at 150 ug/m^3 over a 24-hour period, or 60 ug/m^3 annual geometric mean, are applicable requirements. Also applicable is the 24-hour ambient air concentration standard for particles less than 10um in diameter (PM_{10}), which are set at 105 ug/m^3 and 50 ug/m^3 geometric mean. The section defines standards for particle fallout not to exceed 10 g/m^2 per month in an industrial area or 5 g/m^2 per month in residential or commercial areas. Alternate levels for areas where natural dust levels exceed 3.5 g/m^2 per month are set at 6.5 g/m^2 per month, plus background levels for industrial areas, and 1.5 g/m^2 per month plus background in residential and commercial areas.
Ambient Air Quality Standards and Emission Limits for Radionuclides WAC 173-480	Applicable	Requirements of this standard are applicable to remedial actions performed at the site and requires that the most stringent federal or state standard be enforced. The WAC 173-480 standard defines the maximum allowable level for radionuclides in the ambient air, which shall not cause a maximum accumulated dose equivalent of 25 mrems/yr to the whole body or 75 mrems/yr to any critical organ. However, ambient air standards under 40 CFR 61 Subparts H and I are not to exceed amounts that result in an effective dose equivalent of 10 mrem/yr to any member of the public. Emission standards for new and modified emission units shall utilize best available radionuclide control technology. The standard requires all sources of emissions to meet levels set in 246-220, including determination of compliance using methods established by the Department of Social and Health Services.
Emission Standards and Controls for Sources Emitting Volatile Organic Compounds (VOC) WAC 173-490	Relevant and Appropriate	This chapter establishes technically feasible and attainable standards for sources emitting volatile organic compounds. This regulation is not applicable to remedial actions conducted at the 300-FF-5 operable unit because the source of potential volatile organic compound emissions generated by remedial actions does not meet the definition of emission sources specified under WAC 173-490-03. However, this regulation may be considered relevant and appropriate if remedial actions have the potential to emit volatile organic compounds into the air.

Table E-2. Identification of Potential State ARARs at the 300-FF-5 Operable Unit.
(Sheet 13 of 13)

Requirements	Applicable, Relevant and Appropriate, To Be Considered	Comment
State Radiation Protection Requirements Ch. 70.98 RCW		
Radioactive Waste-Licensing Land Disposal WAC 246-250	Not ARAR	The Phase I/II FS identified the Radioactive Waste - Licensing Land Disposal requirements as relevant and appropriate to remediation activities at the 300-FF-5 operable unit. However, these requirements have been re-evaluated during preparation of this FS and determined to be neither applicable nor relevant and appropriate to remediation of this operable unit because land disposal is not within the scope of responsibilities for the 300-FF-5 operable unit. This operable unit addresses contamination of groundwater, saturated soils and river sediments.
Richland Pretreatment Ordinance City of Richland Ordinance No. 35-84	To be Considered	This city ordinance establishes a set of uniform requirements for discharges to the City of Richland waste water collection and treatment system. This ordinance is "To Be Considered" to remedial alternatives that include discharge of wastes to the city wastewater treatment system.

Table E-3. Chemical-Specific ARAR Concentration Limits for Radioactive Contaminants. (Sheet 1 of 2)

Contaminant	Drinking Water 40 CFR 141[a]	NRC Standards for Protection Against Radiation 10 CFR 20[c,d]	Protection of the Public and Environment, DOE Order 5400.5[e]
	MCL (Current[f]/ Proposed[g]) (pCi/L)	Water (pCi/L)	Water (pCi/L)
Ce-141	300/1900	30000	2000
Co-60	100/220	3000	200
Cr-51	6000/38000	5E+05	40000
Cs-137	200/120	1000	120
Gross Alpha	15/15	-	-
Gross Beta	4 mrem/yr	-	-
H-3	20000/61000	1E+06	80000
I-129	1/21	200	20
K-40	-	4000	280
La-140	60/650	9000	800
Pu-238	-/7.2	20	1.6
Pu-239	-/65	20	1.2
Pu-241	-/63	1000	80
Ra-226	5[h]/20	60	4
Ra-228	5[h]/20	60	4
Total Ra	5[h]/20	-	4[j]
Ru-106	30/200	3000	240
Sr-90	8/42	500	40
Tc-99	900/3800	60000	4000
Th-228	15/150	200	16
Th-232	15/92	30	2
U-234	-	300	20
U-235	-	300	24

Table E-3. Chemical-Specific ARAR Concentration Limits for Radioactive Contaminants. (Sheet 2 of 2)

Contaminant	Drinking Water 40 CFR 141[a]	NRC Standards for Protection Against Radiation 10 CFR 20[c,d]	Protection of the Public and Environment, DOE Order 5400.5[e]
	MCL (Current[f]/ Proposed[g]) (pCi/L)	Water (pCi/L)	Water (pCi/L)
U-238	-	300	24
Total U (natural)	-/20 ug/L[k]	300	224
Zn-65	300/400	5000	360

a - State Drinking Water Standards, WAC 246-290, are as stringent as current federal MCLs, unless otherwise noted
b - Calculated using the formula in WAC 173-340.
c - 10 CFR 20, Appendix B, Table II, Column 2, Concentration Limits for Radionuclides in Liquid Effluent Released to Unrestricted Areas
d - Washington State Water Quality Standards for radionuclides are established under WAC 173-201A at 1/100TH the value listed in WAC 246-221, Appendix A, Table II, Column 2. WAC 246-221, Appendix A, Table II, Column 2 is equivalent to 10 CFR 20, Appendix B, Table II, Column 2.
e - Derived Concentration Guide for representing a 4 mrem/yr effective dose equivalent for drinking water.
f - Current MCL
g - Proposed MCL as reported in the Advanced Notice of Proposed Rule published in 56 FR 33050, July 18, 1991. The notice also published a proposed MCLG of 0 for the radionuclide. MCLGs have not been promulgated for radionuclides.
h - The MCL reported is for combined Ra-226 and Ra-228.
i - Calculated using the slope factor for Ra-226.
j - Reported as the standard for Ra-226.
k - The proposed MCL for uranium is 20 ug/L.
\- Criteria not listed

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Table E-4. Chemical-Specific ARAR Concentration Limits for Non-Radioactive Contaminants. (Sheet 1 of 5)

Contaminant	Drinking Water Standards 40 CFR 141[a] and 40 CFR 143[b]		Washington State Model Toxics Cleanup Act WAC 173-340-720		Washington State Surface Water Quality Standards WAC 173-201A[c]	
	MCLs (current/proposed)	MCLGs (current/proposed)	Groundwater		Freshwater	
			Method B	Method C	Acute	Chronic
	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)
Aluminum	0.05[b]	-	16	35	-	-
Antimony	0.006	0.006	0.006	0.014	9	1.6
Arsenic (III & V)	0.05	-	0.005[d]	0.005[d]	0.36 & 0.85	0.19 & 0.048
Barium	2	2	1.12	2.45	-	-
Beryllium	0.004	0.004	2.0E-5	0.0002	0.130	0.0053
Cadmium	0.005	0.005	0.008	0.018	0.002	0.0007
Chromium (VI & III)	0.1	0.1	0.08 & 16	0.18 & 35	0.016 & 1.2	0.011 & 0.14
Cobalt	-	-	-	-	-	-
Copper	1.3	-	0.59	1.3	0.01	0.007
Cyanide	0.2	0.2	0.32	0.7	0.022	0.005
Fluoride	4	4	0.96	2.1	-	-
Lead	0.015	-	-	-	0.031	0.0012
Magnesium	-	-	-	-	-	-
Manganese	0.05[b]	-	0.08	0.18	-	-
Mercury	0.002	0.002	0.0048	0.01	0.0024	1.2E-5
Nickel	0.1	0.1	0.32	0.7	0.91	0.1
Nitrate	44	44	25.6	56	-	-
Nitrite	3.3	3.3	1.6	3.5	-	-
Phosphate	-	-	-	-	-	-
Selenium	0.05	0.05	0.08	0.18	0.02	0.005
Silver	0.1[b]	-	0.08	0.18	0.00096	-
Sodium	-	-	-	-	-	-
Thallium	0.002	0.0005	0.0012	0.0025	1.4	0.04
Tin	-	-	9.6	21	-	-

Table E-4. Chemical-Specific ARAR Concentration Limits for Non-Radioactive Contaminants. (Sheet 2 of 5)

Contaminant		Drinking Water Standards 40 CFR 141[a] and 40 CFR 143[b]		Washington State Model Toxics Cleanup Act WAC 173-340-720		Washington State Surface Water Quality Standards WAC 173-201A[c]	
		MCLs (current/proposed)	MCLGs (current/proposed)	Groundwater		Freshwater	
				Method B	Method C	Acute	Chronic
		(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)
Vanadium		-	-	0.112	0.25	-	-
Zinc		5[b]	-	4.8	11	0.07	0.063
Calcium		-	-	-	-	-	-
Ammonia (As N)		12.1	-	-	-	0.13	0.024
Bromide		-	-	-	-	-	-
Chloride		250[b]	-	-	-	860	230
Iron		0.3[b]	-	-	-	-	1
Potassium		-	-	-	-	-	-
Sulfate		250[b]	-	-	-	-	-
Vinyl Chloride		0.002	0	2.3E-5	0.00023	-	-
Benzene		0.005	0	0.0015	0.015	5.3	-
Carbon Disulfide		-	-	0.8	1.75	-	-
Carbon tetrachloride		0.005	0	0.00034	0.0034	35.2	-
1,2-dichloroethene (total)	cis	0.07	0.07	0.08	0.18	12	-
	trans	0.1	0.1	0.16	0.35	12	-
Chloroform		0.1	-	0.007	0.07	29	1.2
Ethylbenzene		0.7	0.7	0.8	1.8	-	-
Trichloroethane		0.2	0.2	7.2	16	-	-
Trichloroethene		0.005	0	0.004	0.04	45	22
Tetrachloroethene		0.005	0	0.00086	0.0086	5.3	0.84
Toluene		1	1	1.6	3.5	18	-
Benzoic Acid		-	-	64	140	-	-
Methylene chloride		0.005	0	0.006	0.06	-	-
4-Methylphenol		-	-	-	-	-	-

Table E-4. Chemical-Specific ARAR Concentration Limits for Non-Radioactive Contaminants. (Sheet 3 of 5)

Contaminant	Drinking Water Standards 40 CFR 141[a] and 40 CFR 143[b]		Washington State Model Toxics Cleanup Act WAC 173-340-720		Washington State Surface Water Quality Standards WAC 173-201A[c]	
	MCLs (current/proposed)	MCLGs (current/proposed)	Groundwater		Freshwater	
			Method B	Method C	Acute	Chronic
	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)
Naphthalene	-	-	0.032	0.07	2.3	0.62
2-Methylnaphthalene	-	-	0.032	0.07	-	-
delta-BHC	-	-	-	-	-	-
gamma-BHC (Lindane)	0.0002	0.0002	6.7E-05	0.00067	0.0002	8.0E-05
2,4,-Dichlorophenoxy acetic acid	0.07	0.07	0.16	0.35	-	-
2,4,5-Trichlorophenoxyacetic acid	-	-	0.16	0.35	-	-
2,4,5-Trichlorophenoxy propoinic acid	0.05	0.05	0.13	0.28	-	-
Acenaphthene	-	-	0.96	2.1	1.7	0.52
Dibenzofuran	-	-	-	-	-	-
Diethylphthalate	-	-	13	28	0.940	0.003
Fluorene	-	-	0.64	1.4		-
Endosulfan sulfate (Endosulfan)	-	-	-	-	0.00022	5.6E-05
N-Nitrosodiphenylamine	-	-	0.018	0.18	-	-
Pentachlorophenol	0.001	0	0.0007	0.0073	0.024	0.015
PCB	0.0005	0	1.1E-5	0.00011	0.002	1.4E-5
Phenanthrene	-	-	0.48	1.1	-	-
Anthracene	-	-	4.8	11	-	-
Di-n-butylphthalate	-	-	1.6	3.5	0.94	0.003
Fluoranthene	-	-	0.64	1.4	4.0	-
Pyrene	-	-	0.48	1.1	-	-
Butylbenzylphthalate	-	-	3.2	7.0	0.94	0.003

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Table E-4. Chemical-Specific ARAR Concentration Limits for Non-Radioactive Contaminants. (Sheet 4 of 5)

Contaminant	Drinking Water Standards 40 CFR 141[a] and 40 CFR 143[b]		Washington State Model Toxics Cleanup Act WAC 173-340-720		Washington State Surface Water Quality Standards WAC 173-201A[c]	
	MCLs (current/proposed)	MCLGs (current/proposed)	Groundwater		Freshwater	
			Method B	Method C	Acute	Chronic
	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)
Benzo(a)anthracene	-	-	1.2E-05	0.00012	-	-
4-Chloroanaline	-	-	0.064	0.14	-	-
Chrysene	-	-	1.2E-5	0.00012	-	-
bis(2-Ethylhexyl)phthalate	0.006	0	0.006	0.06	0.4	0.36
Benzo(b)fluoranthene	-	-	1.2E-05	0.00012	-	-
Benzo(k)fluoranthene	-	-	1.2E-05	0.00012	-	-
Benzo(a)pyrene	0.0002	0	1.2E-5	0.00012	-	-
Indeno(1,2,3-cd)pyrene	-	-	1.2E-05	0.00012	-	-
Dibenz(a,h)anthracene	-	-	1.2E-05	0.00012	-	-
Benzo(g,h,i)perylene	-	-	0.48	1.1	-	-
4,4"-DDD	-	-	0.0004	0.004	0.0011	1.0E-06
4,4"-DDE	-	-	0.00026	0.0026	0.0011	1.0E-06
Styrene	0.1	0.1	0.0015	0.015	-	-
1,1,2,2-Tetrachloroethane	-	-	0.00022	0.0022	9.3	2.4
4-Methyl-2-Pentanone(MIBK)	-	-	0.4	0.88	-	-
2-Hexanone	-	-	0.4	0.88	-	-
Xylenes - (Total)	10	10	16	35	-	-
Acetone	-	-	0.8	1.75	-	-
Bromoform	0.1	-	0.006	0.06	11	-
2-Butanone	-	-	0.48	1.1	-	-
Chlorobenzene	0.1	0.1	0.16	0.35	0.25	0.05
Vinyl Acetate	-	-	8	18	-	-

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Table E-4. Chemical-Specific ARAR Concentration Limits for Non-Radioactive Contaminants. (Sheet 5 of 5)

Contaminant	Drinking Water Standards 40 CFR 141[a] and 40 CFR 143[b]		Washington State Model Toxics Cleanup Act WAC 173-340-720		Washington State Surface Water Quality Standards WAC 173-201A[c]	
	MCLs (current/proposed)	MCLGs (current/proposed)	Groundwater		Freshwater	
			Method B	Method C	Acute	Chronic
	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)
Coliform bacteria	e	-	-	-	f	-

[a] State MCLs and MCLGs are based on federal standards, as amended.
[b] Secondary Drinking Water Standard under 40 CFR 143
[c] Calculated using hardness of 62.5 mg/l, pH of 7.95 or temperature at 10°C or if the criteria have not been developed, the value presented is the LOEL - Lowest Observed Effect Level, per EPA Water Quality Criteria 1986
[d] Cleanup level based on background concentration for the State of Washington as noted in Table 1, footnote b, WAC 173 -340-720
[e] Total coliform MCL compliance criteria is based on the presence or absence of total coliform in a sample, rather than coliform density.
[f] Fecal coliform organism levels for a Class A surface water shall not exceed a geometric mean value of 100 colonies/100 mL, and not have more than 10 percent of all samples obtained for calculating the geometric mean value exceeding 200 colonies/mL.
- Criteria not listed

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APPENDIX F

GROUNDWATER EXTRACTION RATE CALCULATIONS

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1.0 INTRODUCTION

This appendix contains a description of the groundwater extraction rate calculations done to support estimates of cost for the containment remediation alternatives (Alternatives C through F). Calculations were made using Microsoft's commercially available spreadsheet program *Excel*. The presentation of results in the form of probabilities was made possible through the use of another commercially available program, Decisioneering's *Crystal Ball*. *Crystal Ball* directly adds to the functionality of *Excel* through what is referred to as an add-in. *Excel/Crystal Ball* calculations are done using Monte Carlo sampling of probability distribution functions (PDFs) describing uncertainty in variable values.

A description of the equations used in the calculations is presented below, followed by a description of the variable PDFs and a summary discussion of the results obtained. The results presented are for a single Monte Carlo simulation consisting of 5,000 runs, where each run results in new variable values being sampled from the PDFs. The reader is referred to Attachment F-1 for a *Crystal Ball* report of the Monte Carlo simulation if more detail concerning variable or calculated values is desired.

2.0 EQUATIONS

Equations used to calculate groundwater extraction rates are based on simple and fundamental relationships described in introduction hydrogeology texts such as Freeze and Cherry (1979).

2.1 HYDRAULIC CONTAINMENT

Hydraulic containment requires intercepting all contaminated groundwater prior to reaching the Columbia River. The rate of groundwater flowing through the contaminated portion of the aquifer is proportional to the groundwater velocity and the width and thickness of the contaminated zone. This relationship is shown below in Equations F-1 through F-3,

$$QGW_{sel} = W_{sel} * B * K_u * I_{avg} \quad \text{(F-1)}$$

$$QGW_{ext,max} = W_{ext} * B * K_u * I_{max} \quad \text{(F-2)}$$

$$QGW_{ext,avg} = W_{ext} * B * K_u * I_{avg} \quad \text{(F-3)}$$

where:

	QGW	= volumetric flow rate of contaminated groundwater (ft^3/d),
	W	= contaminated aquifer width perpendicular to groundwater flow (ft),
	B	= vertical thickness of the contaminated zone (ft),

K_u = horizontal hydraulic conductivity of the unconfined aquifer (ft/d),
I = horizontal hydraulic gradient.

The *sel*, *ext*, *max*, and *avg* subscripts differentiate between the selective alternative (*sel*), the extensive alternative with a maximum hydraulic gradient (*ext,max*), and the extensive alternative with an average hydraulic gradient (*ext,avg*).

For hydraulic containment it is nearly impossible to extract contaminated groundwater without also extracting clean groundwater from below and downgradient. Hence the actual amount of groundwater extracted is greater than the amount of groundwater moving through the contaminated zone of the aquifer. Equations F-4 through F-6 are used to account for this difference,

$$QPUMP_{sel} = QGW_{sel} * (1 + O) \quad \text{(F-4)}$$

$$QPUMP_{ext,max} = QGW_{ext,max} * (1 + O) \quad \text{(F-5)}$$

$$QPUMP_{ext,avg} = QGW_{ext,avg} * (1 + O) \quad \text{(F-6)}$$

where: $QPUMP$ = total groundwater extracted (ft^3/d),
QGW = volumetric flow rate of contaminated groundwater (ft^3/d),
O = fraction of clean groundwater extracted.

The meaning and use of subscripts in the above equations is the same as previously described.

2.2 SLURRY WALL CONTAINMENT

Groundwater flow through the sides of the slurry wall is considered negligible. Extraction of groundwater for the slurry wall containment alternative therefore need only be done at a rate which negates the effects of vertical recharge to the unconfined aquifer. This recharge comes from precipitation, and upward flow from the confined aquifer through the confining layer formed by the Lower Mud Unit. The rate of recharge due to precipitation is proportional to the rate of infiltration and the surface area within the slurry wall. The rate of recharge due to upward flow is proportional

to the hydraulic conductivity and thickness of the confining layer, the hydraulic head loss across the layer, and the area enclosed within the slurry wall. These relationships are described in Equations F-7 and F-8,

$$QR_{sel} = A_{sel} * \left[P + \frac{K_c * H}{Z} \right] \quad \text{(F-7)}$$

$$QR_{ext} = A_{ext} * \left[P + \frac{K_c * H}{Z} \right] \quad \text{(F-8)}$$

where:
- QR = volumetric flow rate of recharging precipitation (ft^3/d),
- A = surface area of contaminated zone (ft^2),
- P = recharge rate of precipitation (ft/d),
- K_c = vertical hydraulic conductivity of the confining layer (ft/d),
- H = head loss vertically through the confining layer (ft), and
- Z = thickness of the confining layer (ft).

The *sel* and *ext* subscripts differentiate between the selective (*sel*) and extensive (*ext*) alternatives.

For the slurry wall containment alternatives, unlike the hydraulic containment alternatives, it is possible to design an extraction system such that only a negligible amount of clean groundwater is removed. Equations analogous to F-4 through F-6 are therefore unnecessary for the slurry wall containment alternatives, and the volumetric flow rate of vertical recharge can be used directly as the extraction rate for contaminated groundwater. The reason for this difference in alternatives is twofold: the rate of groundwater extraction necessary to compensate for vertical recharge (slurry wall containment) is much smaller than that necessary to compensate for horizontal groundwater flow (hydraulic containment), and the extraction well can be situated in the center of the contaminated groundwater (slurry wall containment) versus downgradient and next to the Columbia River (hydraulic containment). It is noteworthy that the above argument assumes that the amount of groundwater flow through the slurry wall is negligible.

3.0 VARIABLE VALUES

A discussion of the derivation of variable values for the equations listed in Section 2.0 follows. These values are summarized for each variable in Table F-1 as minimum, maximum, and expected values. With the exception of hydraulic conductivity, uniform and triangular PDFs were used. The use of only these two relatively simple PDFs is reasonable considering the quantity of available data is insufficient to support the use of more complex PDFs.

The decision as to whether a particular variable is best described using a uniform or triangular PDF is somewhat subjective. In the discussion that follows a triangular PDF was chosen unless it was felt that the variable showed no bias towards a particular value, in which case a uniform PDF was selected. A lognormal distribution was used for hydraulic conductivity to allow a wide range while reflecting low probabilities for extreme high values.

3.1 HYDRAULIC CONDUCTIVITY (*K*)

A great deal of information is available in regards to the conductivity of the unconfined aquifer within the 300 Area. This information is not discussed here, but the reader is instead referred to the detailed summary presented in Section 4.1.1 of the report. Even though data is available from aquifer testing, modeling efforts, and studies of cyclic water fluctuations, a large uncertainty still surrounds the reported conductivity values. As explained in Section 4.1.1 of the report, a reasonable range for conductivity in the Hanford formation in the 300 Area is approximately 300 to 10,000 m/day (1,000 to 32,800 ft/day). A lognormal PDF with this range was chosen for K_u with mean value of 3,660 m/day (12,000 ft/day) and a standard deviation of 3,600 m/day (12,000 ft/day). When simulated using Monte Carlo simulation methods a resultant mean value of 3,050 m/day (9,995 ft/day), and a mode of 1,230 m/day (4,025 ft/day) were derived. After further discussions with professional hydrogeologists, consideration of the local hydrogeology, and best professional judgement, a most likely value for hydraulic conductivity that will be used in the evaluations presented in the FS portion of this report is 1,830 m/day (6,000 ft/day). The difference between this value and the mean value of 3,050 m/day (9,995 ft/day) results in a conservative estimation of parameters evaluated in the remedial alternative evaluations presented in Appendix G.

Much less is known of the vertical hydraulic conductivity of the Lower Mud Unit which forms the confining layer between the confined and unconfined aquifers. Values typical for a consolidated silt vary from approximately 3.0×10^{-2} to 3.0×10^{-4} ft/d (1.0×10^{-5} to 1.0×10^{-7} cm/s) (Freeze and Cherry 1979). A uniform PDF was chosen for K_c using the above values as minima and maxima. These are provided in Attachment F-1.

3.2 HYDRAULIC GRADIENT (*I*)

Hydraulic gradients were directly measured from equipotential maps created for this purpose. A single map representing average conditions was created for each month in the period October 1991 through September 1992. Data for these maps came from electronically recorded hydraulic heads measured hourly in selected 300 Area wells (Cambell and Newcomer 1992). Monthly averages were calculated for a well only if the following conditions were met: a reasonable number of measurements were available, and the quality of the data were not in question. Gradients were measured only from those equipotential maps having enough wells represented to insure an accurate depiction of the phreatic surface.

A minimum of five gradients were measured in the area of contamination from each of the equipotential maps used. January was found to have the greatest measured gradients (7.0×10^{-4} to 8.0×10^{-4}), while September had gradients considered representative of an average month (2.3×10^{-4} to 7.7×10^{-4}). This range of values appears to be uniformly distributed over the year. Therefore, uniform PDFs were chosen to represent I_{max} (January) and I_{avg} (September) using the above ranges of minima and maxima. These are provided in Attachment F-1.

3.3 THICKNESS OF CONTAMINATED AQUIFER (*B*)

It is assumed that the aquifer beneath the waste water surface disposal facilities in the 300 Area is contaminated to a minimum depth of 3 m (10 ft) given the local downward gradients due to the mounding which existed when the facilities were active. How much deeper the contamination goes beyond 3 m (10 ft) is unknown, but uranium has been detected in samples taken from a well (399-1-8) screened between 12 and 25 m (40 and 80 ft) beneath the phreatic surface (DOE-RL 1993, Chamness 1993). It is possible that aquifer contamination at depth is local only to well 399-1-8 if the pathway for contaminated water was through the seal surrounding the well casing. But since this hypothesis has not been tested it was assumed that contamination in the aquifer could extend to a depth of 15 m (50 ft) below the phreatic surface for conservatism. Contamination seems to be most associated with the Hanford Formation which is in the uppermost portions of the unconfined aquifer; therefore, a triangular PDF for ***B*** was chosen with a range of 3 to 15 m (10 to 50 ft), and an expected value of 6 m (20 ft).

3.4 WIDTH OF CONTAMINATED AQUIFER (*W*)

The width of the contaminated aquifer perpendicular to the groundwater flow direction was measured directly from the total uranium plume map created using the projected conditions for 1996 (the earliest a groundwater extraction system would likely to be operating) (Figure 4-4 of the report). As evident in Figures F-1 and F-2, respectively, groundwater flowed directly into the Columbia River during the month of January, while during September there was a component of groundwater flow parallel to the river. Since the uranium plume is elongated north to south along the Columbia River, the contaminated aquifer width measured perpendicular to the groundwater flow direction was greater for January than for September.

Using the 20 μg/L contour line (representing the proposed MCL) to define the area of contaminated aquifer for the extensive alternative results in a measured width varying from 1,460 to 1,950 m (4,800 to 6,400 ft). Similarly using the 80 μg/L contour line for the selective alternative results in a measured width of 150 to 240 m (500 to 800 ft). The above minima and maxima were used in triangular PDFs for W_{sel} and W_{ex}, where the expected values for the two PDFs were 1,710 and 200 m (5,600 and 500 ft), respectively. Since the measured hydraulic gradients were greater for January than they were for September, contaminated aquifer width and hydraulic gradient were correlated in the spreadsheet model using a correlation coefficient of 0.9.

3.5 OVER-EXTRACTION WHEN PUMPING (*O*)

In Sections 2.1 and 2.2 it was explained that extraction of clean groundwater was assumed not to occur for the slurry wall containment alternative, but that some fraction of groundwater extracted would be clean for the hydraulic contaminant alternative. Unfortunately no data are available concerning the amount of clean water extracted when pumping for the hydraulic containment alternative. A triangular PDF was chosen to describe *O*, with a minimum value of 30%, a maximum value of 70%, and an expected value of 50%.

It is noteworthy that the amount of vertical flow due to partial well penetration effects increases with increasing well spacing. An interception trench can therefore be expected to best minimize the amount of clean groundwater extracted from below the depth of contaminated aquifer.

3.6 AREA OF CONTAMINATED AQUIFER (*A*)

The area of the contaminated aquifer was measured directly from the total uranium plume map created using the projected conditions for 1996 (the earliest a groundwater extraction system would likely to be operating) (Figure 4-4 of the report). Using the 20 μg/L contour line to define the area of contaminated aquifer for the extensive alternative results in a measurement of 5.6×10^5 m^2 (6.0×10^6 ft^2). Similarly using the 80 μg/L contour line for the selective alternative results in a measured area of 5.0×10^4 m^2 (5.4×10^5 ft^2). Although these measurement are precise, there exists some uncertainty in the location of the contour lines of the aforementioned figure. Triangular PDFs were assigned to A_{sel} and A_{ext} using the above measurements as expected values. Minima and maxima for the triangular distributions are 3.8×10^4 and 6.3×10^4 m^2 (4.1×10^5 and 6.8×10^5 ft^2) for A_{sel}, and 4.6×10^5 and 6.5×10^5 m^2 (5.0×10^6 and 7.0×10^6 ft^2) for A_{ext}, respectively.

3.7 PRECIPITATION RECHARGE RATE (*P*)

The coarse-textured soils of the 300 Area can experience an annual precipitation recharge of up to 11 cm/yr (1×10^{-3} ft/d) if kept free from vegetation (Gee et al. 1992). This amount of recharge represents 70% of the long-term annual precipitation rate (Gee et al. 1992). Recharge from precipitation can alternatively be kept to near zero if an area is paved or vegetated. Either one of these extremes are equally appropriate because the nature of future land use for the 300 Area has not yet been determined. A uniform PDF was chosen for *P*, with minima and maxima of 0 and 11 cm/yr (1×10^{-3} ft/d), respectively.

3.8 THICKNESS OF THE CONFINING LAYER (*Z*)

The thickness of the confining layer formed by the Lower Mud Unit between the confined and unconfined aquifers varies between approximately 12 and 18 m (40 and 60 ft) (DOE-RL 1993). A uniform PDF having the aforementioned range was chosen for Z.

3.9 HYDRAULIC HEAD LOSS VERTICALLY THROUGH THE CONFINING LAYER (*H*)

Hydraulic head data is available from measurements taken in seven nested wells located across the 300 Area (DOE-RL 1993). These data consistently demonstrate that for all but one nested well (399-1-18) the hydraulic head in the confined aquifer is approximately 11 m (35 ft) greater than that in the unconfined aquifer. Measurements taken in nested well 399-1-18 indicate a much smaller hydraulic head difference, which might be attributable to thinning of the confining layer in the northern portion of the 300 Area. Hydraulic head data measured in nested well 399-1-18 can, however, be effectively neglected because the well is located north of the area of aquifer contamination. A triangular PDF was chosen for *H* having an expected value of 11 m (35 ft), and minima and maxima of 6 and 12 m (20 and 40 ft).

4.0 CALCULATED VALUES

The following is a discussion of the values calculated using the equations of Section 2.0 and the variable values of Section 3.0. Deterministically calculated expected values are summarized in Table F-1, and modes are presented in Attachment F-1. For the purposes of this section all discussion will be in terms of mode. (The mode is the most frequently observed value.)

4.1 HYDRAULIC CONTAINMENT

Modes calculated for the groundwater extraction rate for the hydraulic containment remediation alternatives are approximately 271 gpm for the selective alternative, and 2,742 gpm for the extensive alternative (using the maximum hydraulic gradient).

4.2 SLURRY WALL CONTAINMENT

Modes calculated for the groundwater extraction rate for the selective and extensive slurry wall containment remedial alternatives are approximately 13 and 186 gpm, respectively. These modes are one to two orders of magnitude less than those calculated for the hydraulic containment remedial alternatives.

5.0 REFERENCES

Cambell, M.D. and D.R. Newcomer, 1992, *Automatic Measurement of Water Levels Within the 300-FF-5 Boundary*, Pacific Northwest Laboratory, Richland, Washington.

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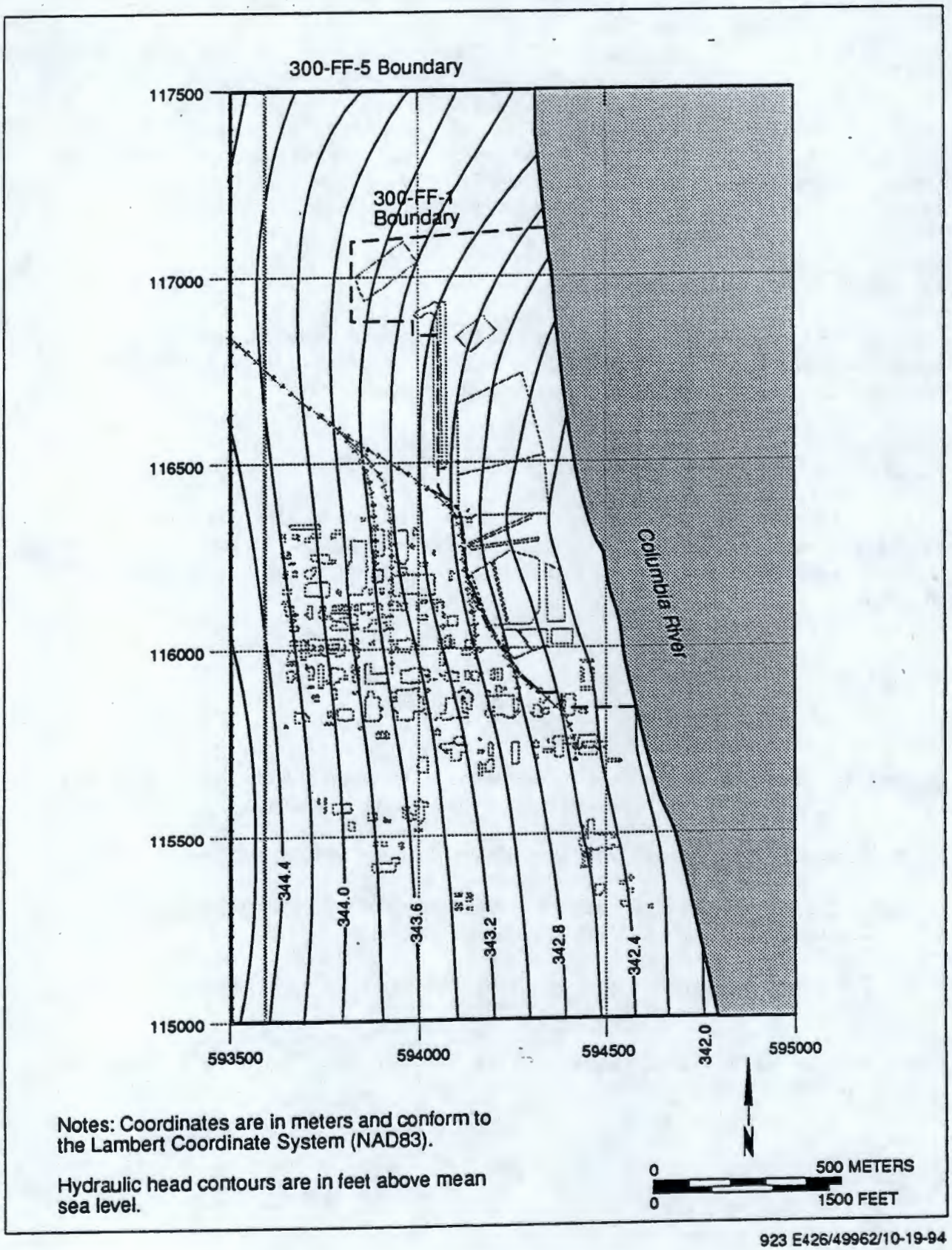
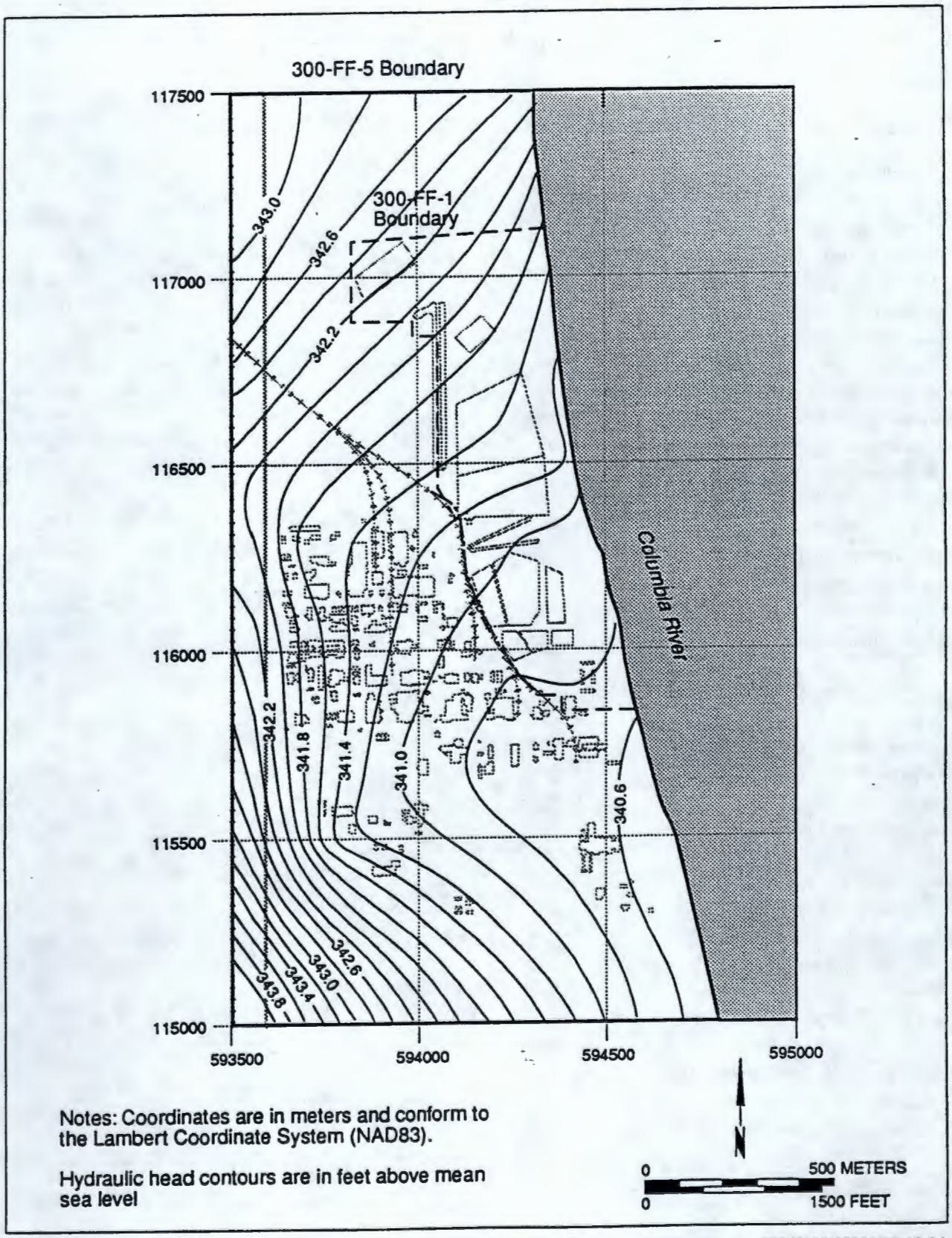
Freeze, R.A., and J.A. Cherry, 1979, *Groundwater*, Prentice-Hall, Inc., Englewood Cliffs, New Jersey.

Gee, G.W., M.J. Fayer, M.L. Rockhold, and M.D. Campbell, 1992, "Variations in Recharge at the Hanford Site", in *Northwest Science*, Vol. 66, No 4, p.237.



923 E426/49962/10-19-94

Figure F-1. Equipotential Map for January 1992.



923 E426/53236/10-19-94

Figure F-2. Equipotential Map for September 1992.

Table F-1. Groundwater Extraction Rate Variables and Calculated Flow Rates.

Description	Units	Name	Values: Likliest	Values: Minimum	Values: Maximum	Assumed Distribution
VARIABLE VALUES:						
Unconfined (water-table) aquifer:						
Horizontal hydraulic conductivity	ft/day	K_u	6,000			Lognormal
Hydraulic gradient - maximum monthly average		I_{max}	7.50 E-4	7.0 E-4	8.0 E-4	Uniform
Hydraulic gradient - yearly average		I_{avg}	5.0 E-4	2.3 E-4	7.7 E-4	Uniform
Thickness of contaminated zone	ft	B	20	10	50	Triangular
Confined aquifer (Ringold Lower Mud Unit):						
Vertical hydraulic conductivity	ft/day	K_c	3.0 E-3	3.0 E-4	3.0 E-2	Uniform
Thickness of lower confining layer	ft	Z	55	50	60	Uniform
Head loss through confining layer	ft	H	35	20	40	Triangular
Precipitation recharge (infiltration) rate	ft/day	P	5.0 E-4	0	1.0 E-3	Uniform
Over-extraction when pumping		O	50%	30%	70%	Triangular
Contaminated zone area:						
Selective remediation	ft^2	A_{sel}	5.4 E+5	4.1 E+5	6.8 E+5	Triangular
Extensive remediation	ft^2	A_{ext}	6.0 E+6	5.0 E+6	7.0 E+6	Triangular
Contaminated zone width:						
Selective remediation	ft	W_{sel}	650	500	800	Triangular
Extensive remediation	ft	W_{ext}	5,600	4,800	6,400	Triangular
CALCULATED VALUES:						
Selective slurry wall containment:						
Groundwater from infiltration	gpm		1.4			
Groundwater from confined aquifer	gpm		5.4			
Total extracted groundwater flow rate	gpm	QR_{sel}	7			
Extensive slurry wall containment:						
Groundwater from infiltration	gpm		15.6			
Groundwater from confined aquifer	gpm		59.5			
Total groundwater extracted inside wall	gpm	QR_{ext}	75			
Groundwater extracted outside wall	gpm	Q_{ext_ow}	50			
Selective hydraulic containment - average flow:						
Groundwater flow rate	gpm	QGW_{sel}	203			
Total recovered groundwater for treatment	gpm	$QPump_{sel}$	304			
rounded	gpm	$QPump_{sel}$	300			
Extensive hydraulic containment - maximum flow:						
Groundwater flow rate	gpm	QGW_{ext_max}	2,618			
Total recovered groundwater for treatment	gpm	$QPump_{ext_max}$	3,927			
rounded	gpm	$QPump_{ext_max}$	3,900			
Extensive hydraulic containment - average flow:						
Groundwater flow rate	gpm	QGW_{ext_avg}	1,745			
Total recovered groundwater for treatment	gpm	$QPump_{ext_avg}$	2,618			
rounded	gpm	$QPump_{ext_avg}$	2,600			

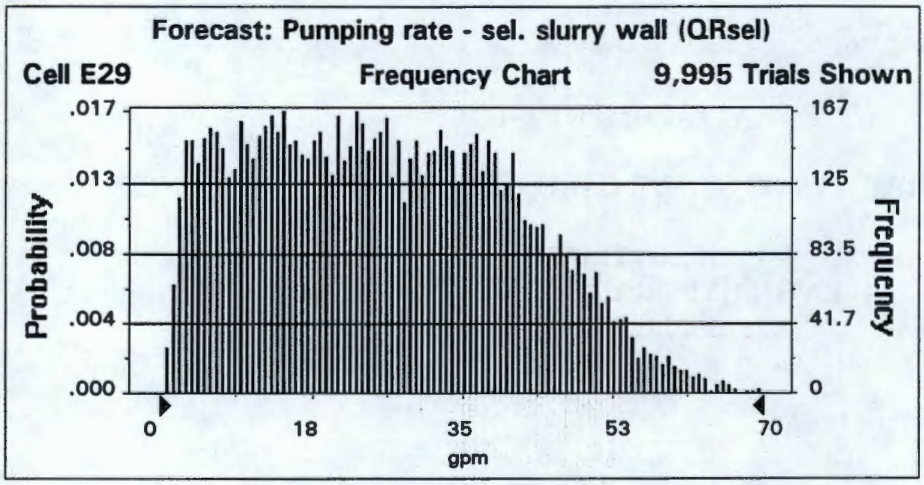
ATTACHMENT F-1

RESULTS OF MONTE CARLO SIMULATION

10,000 TRIALS
LATIN HYPERCUBE SAMPLING
(SAMPLE SIZE - 100)

Forecast: Pumping rate - sel. slurry wall (QRsel, gpm)

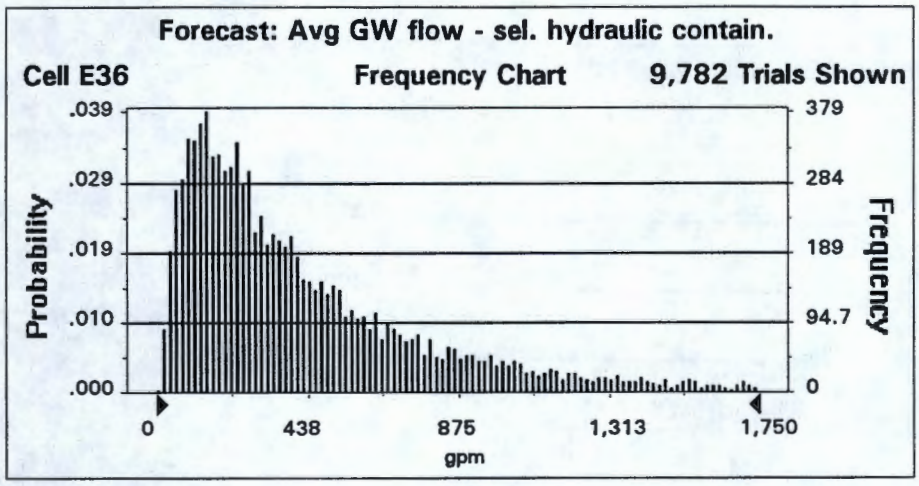
Mean	26
Median (approx.)	25
Mode (approx.)	13
Standard Deviation	15



Percentile	gpm (approx.)
0%	1
5%	4
25%	14
50%	25
75%	37
95%	51
100%	81

Forecast: Avg GW flow - sel. hydraulic contain. (gpm)

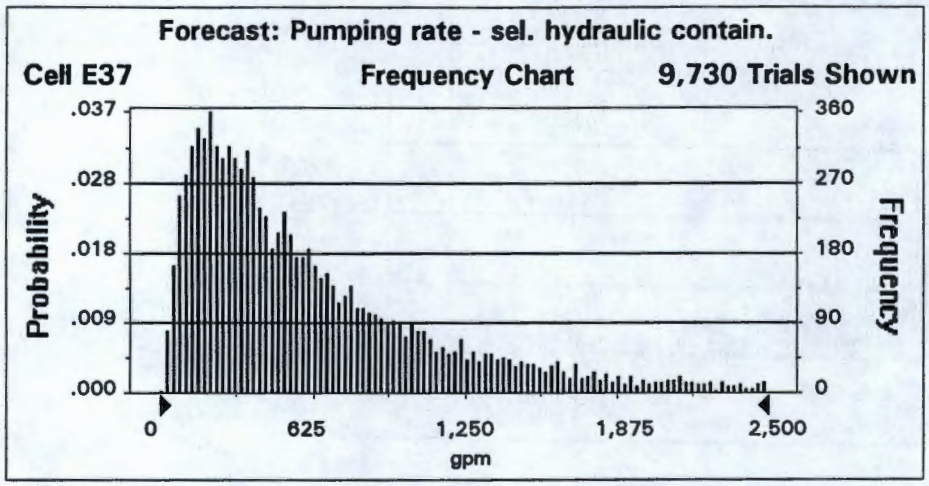
Mean	464
Median (approx.)	324
Mode (approx.)	123
Standard Deviation	438



Percentile	gpm (approx.)
0%	11
5%	67
25%	170
50%	324
75%	605
95%	1,344
100%	4,510

Forecast: Pumping rate - sel. hydraulic contain. (gpm)

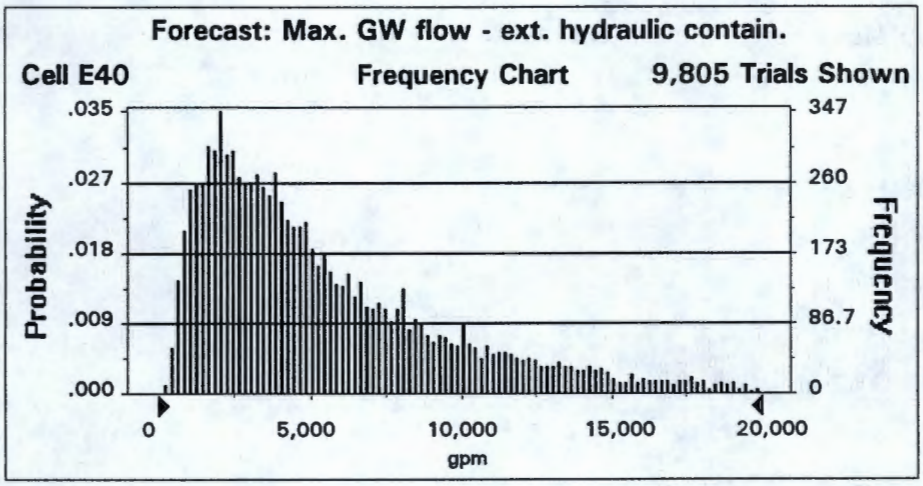
Mean	696
Median (approx.)	489
Mode (approx.)	195
Standard Deviation	661



Percentile	gpm (approx.)
0%	15
5%	99
25%	255
50%	489
75%	907
95%	2,040
100%	7,220

Forecast: Max. GW flow - ext. hydraulic contain. (gpm)

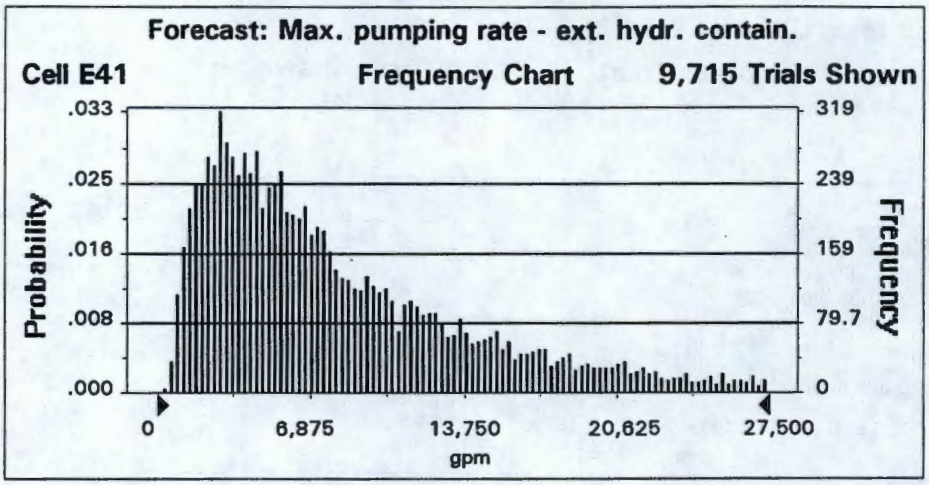
Mean	5,856
Median (approx.)	4,393
Mode (approx.)	2,050
Standard Deviation	4,753



Percentile	gpm (approx.)
0%	249
5%	1,076
25%	2,453
50%	4,393
75%	7,835
95%	15,624
100%	32,991

Forecast: Max. pumping rate - ext. hydr. contain. (gpm)

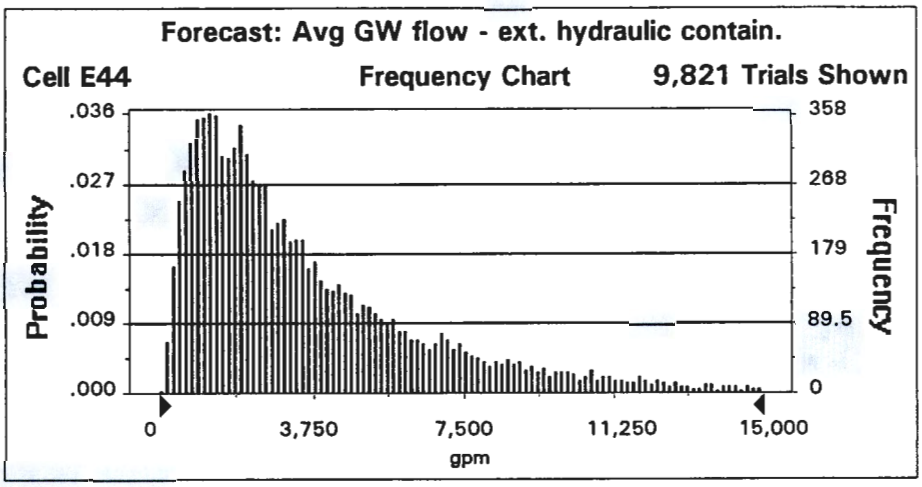
Mean	8,787
Median (approx.)	6,610
Mode (approx.)	2,692
Standard Deviation	7,165



Percentile	gpm (approx.)
0%	364
5%	1,604
25%	3,684
50%	6,610
75%	11,689
95%	23,581
100%	52,095

Forecast: Avg GW flow - ext. hydraulic contain. (gpm)

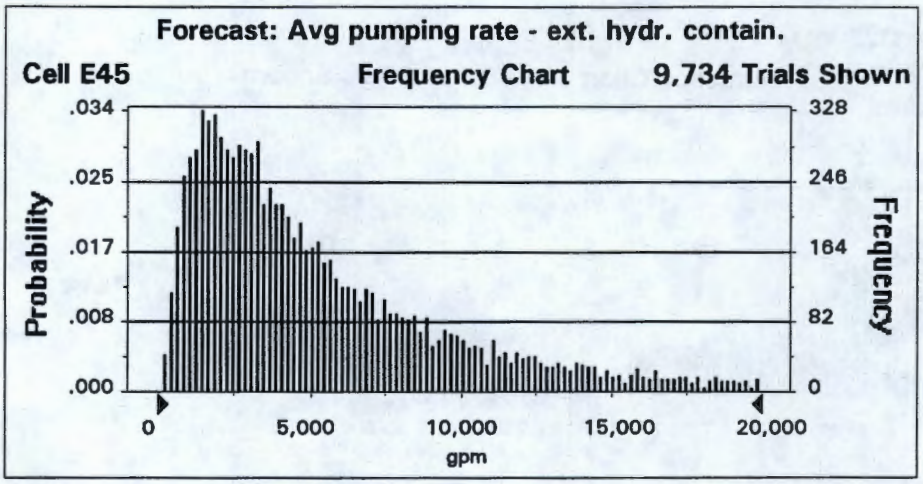
Mean	3,897
Median (approx.)	2,775
Mode (approx.)	1,229
Standard Deviation	3,505



Percentile	gpm (approx.)
0%	112
5%	610
25%	1,495
50%	2,775
75%	5,121
95%	11,008
100%	32,029

Forecast: Avg pumping rate - ext. hydr. contain. (gpm)

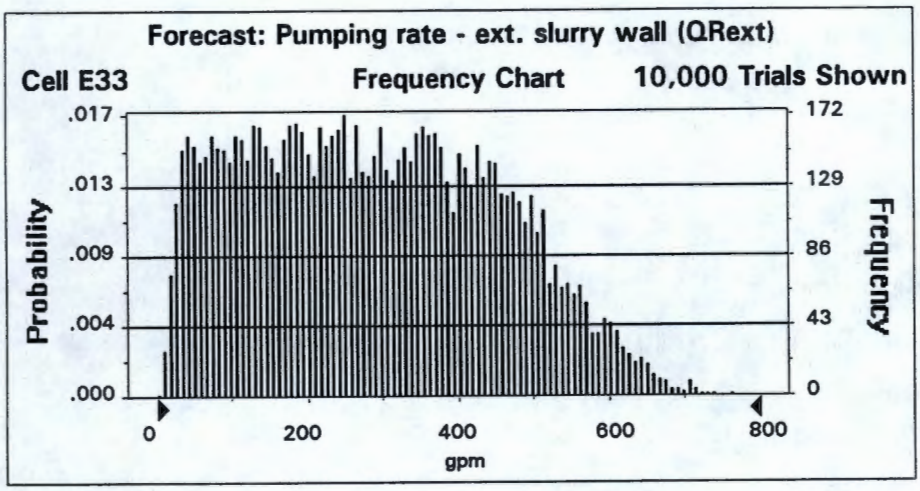
Mean	5,848
Median (approx.)	4,169
Mode (approx.)	1,857
Standard Deviation	5,287



Percentile	gpm (approx.)
0%	154
5%	913
25%	2,245
50%	4,169
75%	7,663
95%	16,596
100%	48,815

Forecast: Pumping rate - ext. slurry wall (QRext, gpm)

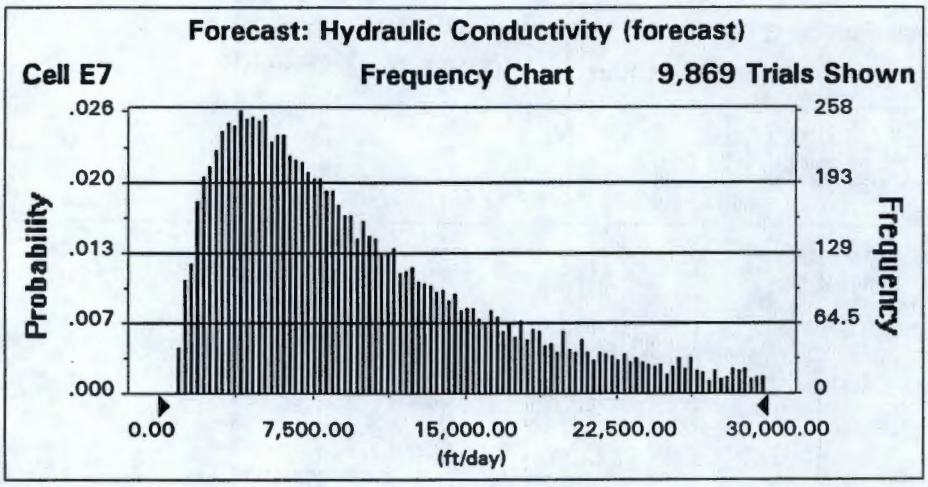
Mean	288
Median (approx.)	279
Mode (approx.)	186
Standard Deviation	163



Percentile	gpm (approx.)
0%	7
5%	46
25%	150
50%	279
75%	416
95%	562
100%	767

Forecast: Hydraulic Conductivity (ft/day; assumption as forecast)

Mean	9,995.08
Median (approx.)	8,077.96
Mode (approx.)	4,025.17
Standard Deviation	6,911.41



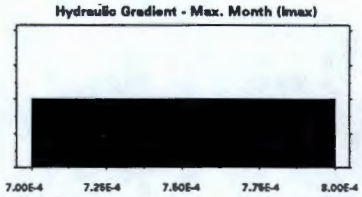
Percentile	(ft/day) (approx.)
0%	1,006.52
5%	2,203.39
25%	4,727.83
50%	8,077.96
75%	13,519.11
95%	24,747.19
100%	32,781.80

Assumptions

Assumption: Hydraulic Gradient - Max. Month (Imax)

Uniform distribution with parameters:

Minimum	7.00E-04
Maximum	8.00E-04



Mean value in simulation was 7.50E-4

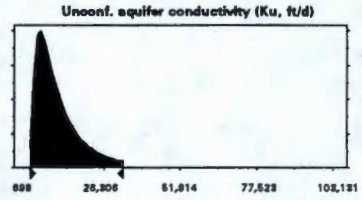
Correlated with:

Extensive Plume Width at River (Wext, ft)	0.90

Assumption: Unconf. aquifer conductivity (Ku, ft/d)

Lognormal distribution with parameters:

Mean	12,000
Standard Dev.	12,000

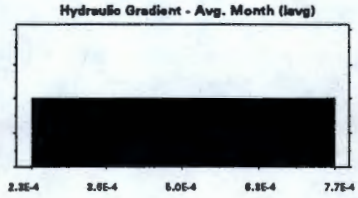


Selected range is from 1,000 to 32,800
Mean value in simulation was 9,995

Assumption: Hydraulic Gradient - Avg. Month (Iavg)

Uniform distribution with parameters:

Minimum	2.3E-04
Maximum	7.7E-04



Mean value in simulation was 5.0E-4

Correlated with:

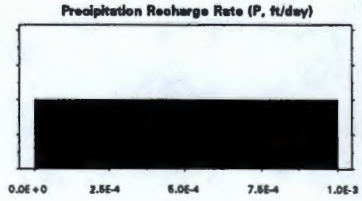
Selective Plume Width at River (Wsel, ft)	0.90

Assumption: Precipitation Recharge Rate (P, ft/day)

Uniform distribution with parameters:

Minimum	0.0E+00
Maximum	1.0E-03

Mean value in simulation was 5.0E-4

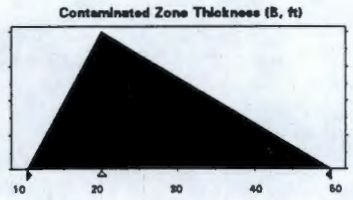


Assumption: Contaminated Zone Thickness (B, ft)

Triangular distribution with parameters:

Minimum	10
Likeliest	20
Maximum	50

Mean value in simulation was 27

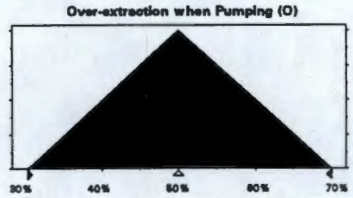


Assumption: Over-extraction when Pumping (O)

Triangular distribution with parameters:

Minimum	30%
Likeliest	50%
Maximum	70%

Mean value in simulation was 50%

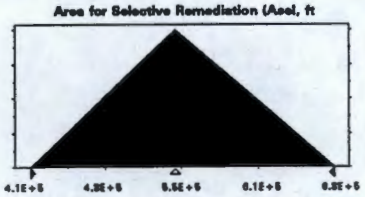


Assumption: Area for Selective Remediation (Asel, ft)

Triangular distribution with parameters:

Minimum	4.1E+05
Likeliest	5.4E+05
Maximum	6.8E+05

Mean value in simulation was 5.4E+5

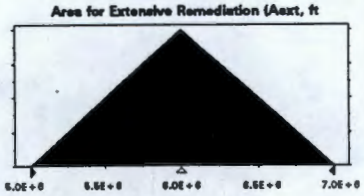


Assumption: Area for Extensive Remediation (Aext, ft)

Triangular distribution with parameters:

Minimum	5.0E+06
Likeliest	6.0E+06
Maximum	7.0E+06

Mean value in simulation was 6.0E+6

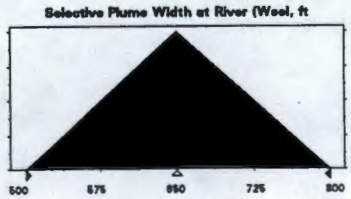


Assumption: Selective Plume Width at River (Wsel, ft)

Triangular distribution with parameters:

Minimum	500
Likeliest	650
Maximum	800

Mean value in simulation was 650



Correlated with:

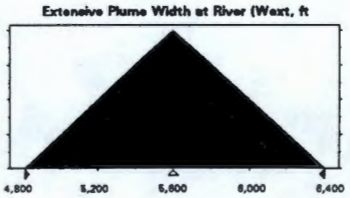
Hydraulic Gradient - Avg. Month (Iavg)	0.90

Assumption: Extensive Plume Width at River (Wext, ft)

Triangular distribution with parameters:

Minimum	4,800
Likeliest	5,600
Maximum	6,400

Mean value in simulation was 5,600



Correlated with:

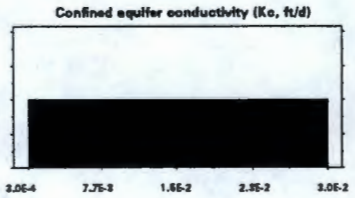
Hydraulic Gradient - Max. Month (Imax)	0.90

Assumption: Confined aquifer conductivity (Kc, ft/d)

Uniform distribution with parameters:

Minimum	3.0E-04
Maximum	3.0E-02

Mean value in simulation was 1.5E-2

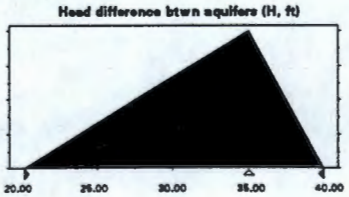


Assumption: Head difference btwn aquifers (H, ft)

Triangular distribution with parameters:

Minimum	20.00
Likeliest	35.00
Maximum	40.00

Mean value in simulation was 31.67

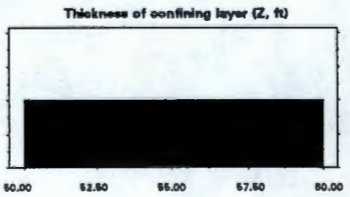


Assumption: Thickness of confining layer (Z, ft)

Uniform distribution with parameters:

Minimum	50.00
Maximum	60.00

Mean value in simulation was 55.00



End of Assumptions

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APPENDIX G

COST ESTIMATE DETAILS AND SENSITIVITY/UNCERTAINTY ANALYSIS

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APPENDIX G

COST ESTIMATE DETAILS AND SENSITIVITY/UNCERTAINTY ANALYSIS

This appendix provides details of the cost estimates for the remediation alternatives for the 300-FF-5 operable unit. Key sensitivities and uncertainties in these cost estimates, based on probabilistic analysis, are also discussed. A summary of the deterministic cost estimates and the estimated uncertainty in these costs was presented in Table 6-3. The cost estimates for the individual alternatives are presented in Tables G-1 through G-4. Basic unit costs and other common factors used in the cost estimates are presented in Table G-5. Estimated capital and operating costs for groundwater treatment are presented in Tables G-6 (for the slurry wall alternatives) and G-7 (for the hydraulic containment alternatives).

The cost estimates are intended to be sufficiently accurate for comparative evaluation of the costs of the alternatives. The cost estimates are not intended for budgeting purposes. Costs are presented on a present-value basis, and include capital, operating, and maintenance cost for the life of remedial action, institutional controls, and monitoring. The bases for the cost estimates are the descriptions and design assumptions for the remediation alternatives, as discussed in Sections 6.2 and 6.3. Changes from these descriptions and assumptions could significantly change the cost estimates.

Known implementation difficulties with quantifiable cost impacts (e.g., personnel protective gear and associated loss of productivity) are included in the cost estimates. Unit costs are based on typical costs for similar commercial work, adjusted for the unique requirements of the Hanford Site. Unit costs were obtained in early 1994, or were adjusted to 1994 from earlier estimates. The cost estimates for the alternatives are presented on a net present value basis. The net interest rate of 5% is the rate recommended by the EPA for feasibility study cost estimates.

To address the uncertainties in the cost estimates, including the groundwater extraction rates, a stochastic (probabilistic) approach was used. The deterministic cost estimates were prepared using linked computer spreadsheets (e.g., changes to the cost estimates for groundwater treatment are automatically reflected in the cost of the remediation alternatives). A Monte Carlo simulation program (Crystal Ball®, commercially available) was then used within the spreadsheet program (Excel®, commercially available) to perform the probabilistic analysis. Estimated variability and uncertainty in the input costs were used to create estimated probability distribution functions (PDFs) for unit costs and other input cost factors (i.e., "assumptions") for the Monte Carlo simulation. These input PDFs were based on the experience and best professional judgement of the engineers and hydrogeologists that prepared the cost estimates and flow rate estimates. The Monte Carlo simulation results in estimated PDFs for the total costs of the alternatives. These PDFs represent approximations of the potential range and probability of the costs.

The results of the probabilistic analysis for groundwater extraction rates are presented in Appendix F. These results discussed in Appendix F were used as input for a probabilistic uncertainty/sensitivity analysis for the cost estimates. The results of the probabilistic cost estimate simulation are presented in the attachment to this appendix and discussed below.

The key variables affecting the cost estimates for Alternatives A (No Action) and B (Institutional Controls) are:

- Annual monitoring cost
- Duration of monitoring.

The cost of Alternative B is simply the cost of Alternative A plus the capital cost of implementing institutional controls. The capital cost of institutional controls is small in comparison to the present-value cost of monitoring. Therefore, Alternative B will always be slightly more expensive than Alternative A. In addition, because the same monitoring costs are included in the costs for all of the other alternatives, these two alternatives will always be much less expensive than the alternatives involving groundwater containment, extraction, and treatment. Therefore, the relative costs of the alternatives are insensitive to the cost of monitoring.

The key variables affecting the cost estimates for the hydraulic containment alternatives (C and D) are:

- Design capacity of the groundwater treatment system (i.e., groundwater extraction rate)
- Duration of operation for the groundwater extraction and treatment system

The primary uncertainty in the cost of hydraulic containment is the required size of the groundwater extraction and treatment system. The design capacity for hydraulic containment is determined by the flow rate in the aquifer and related hydraulic properties. The key sensitivities and uncertainties in the required extraction rates are discussed in Appendix E.

The key variables affecting the cost estimates for the slurry wall containment alternatives (E and F) are:

- Slurry wall length and unit cost
- Design capacity of the groundwater treatment system
- Duration of operation for the groundwater extraction and treatment system

The primary uncertainty in the cost of slurry wall containment is in the length and unit cost of the slurry wall. Because of the smaller design capacity required, the total costs of the slurry wall alternatives are much less sensitive to extraction rates than the hydraulic containment alternatives.

The cost of a groundwater treatment system is primarily a function of the design capacity. The capital cost of the treatment system increases approximately to the 0.6 power of the capacity increase (in gpm). The operating costs for groundwater treatment are dominated by labor costs, making treatment system operation relatively insensitive to the size and operating flow rate of the system. The design flow capacity equals the expected average operating flow rate for all of the alternatives except Alternative D (Extensive Hydraulic Containment), as discussed in Sections 6.2.2 and 6.3.4. For Alternative D, the total cost of groundwater treatment is much more sensitive to changes is design flow capacity than to changes in expected operating flow rate.

For this operable unit, both the size of the groundwater extraction and treatment systems and the length of the slurry wall are functions of the area to be contained, which is in turn a function of the contaminant concentration contour selected for containment. The cost of hydraulic containment increases more rapidly with increasing remediation area than slurry wall containment. As a result, the estimated cost for slurry wall containment is greater than hydraulic containment for selective remediation, but lower for extensive remediation.

From both the deterministic and probabilistic estimated costs of the alternatives, it is clear that the least expensive alternatives are Alternative A (No Action) and B (Institutional Controls). As discussed above, there is little uncertainty in the relative costs of these two alternatives.

The next most expensive alternatives are the selective remediation alternatives (C and E). For selective remediation, the deterministic cost estimate predicts that the cost of hydraulic containment would be approximately 60% of the cost of slurry wall containment. This estimate corresponds to the mode (most likely value) in the PDF for the cost ratio of Alternatives C and E (see Attachment). There is an estimated 25% chance that slurry wall containment would be less expensive. The uncertainty in the relative costs is primarily due to uncertainty in the required extraction rate for hydraulic containment.

The most expensive alternatives are the extensive remediation alternatives (D and F). For extensive remediation, the deterministic cost estimate predicts that the cost of hydraulic containment would be approximately 120% of the cost of slurry wall containment. This estimate corresponds approximately to the mode (most likely value) in the PDF for the cost ratio of Alternatives D to E (see Attachment). The Monte Carlo simulation predicts about a 30% chance that hydraulic containment would be less expensive. The uncertainty is the relative costs is primarily due to uncertainty in the required extraction rate for hydraulic containment.

Table G-1. Cost Estimate for Alternative A - No Action.

Item	Quantity	Units	Unit Cost	Cost[a]	Notes
CAPITAL COSTS				$0	Use existing monitoring wells
LONG-TERM COSTS					
Annual groundwater monitoring costs				$140,000	Allowance assuming semiannual monitoring for reduced suite
Contingency			25%	$35,000	
TOTAL ANNUAL COSTS				$175,000	
NET PRESENT VALUE OF LONG-TERM COSTS	6	yr	$175,000	$888,000	Interest rate per Table G-5
TOTAL ALTERNATIVE COST (NET PRESENT VALUE)[b]				$900,000	Rounded to hundred thousands

[a] Costs are for mid-1994.

[b] The sum of capital and operating costs and the net present value of long-term costs.

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Table G-2. Cost Estimate for Alternative B - Institutional Controls.

Item	Quantity	Units	Unit Cost	Cost[a]	Notes
CAPITAL COSTS					
Institutional controls				$50,000	Allowance for restrictions, assume existing fencing, signs and patrols will be used
Groundwater monitoring wells				$0	Use existing wells
Subtotal Capital Costs				$50,000	
Contractor overhead and profit			25%	$13,000	
Subtotal				$63,000	
Engineering and construction surveillance			30%	$19,000	
Subtotal				$82,000	
Contingency			25%	$21,000	
TOTAL CAPITAL COSTS				**$103,000**	
LONG-TERM COSTS					
Institutional controls maintenance				$60,000	Allowance to include maintenance of restrictions, fencing, security, and patrols
Annual groundwater monitoring costs				$140,000	allowance assuming semiannual monitoring for reduced suite
Subtotal Annual Costs				$200,000	
Contingency			25%	$50,000	
TOTAL ANNUAL COSTS				$250,000	
NET PRESENT VALUE OF LONG-TERM COSTS	6	yr	$250,000	**$1,269,000**	Interest rate per Table G-5
TOTAL ALTERNATIVE COST (NET PRESENT VALUE)[b]				**$1,400,000**	Rounded to hundred thousands

[a] Costs are for mid-1994.

[b] The sum of capital and operating costs and the net present value of long-term costs.

Table G-3. Cost Estimate for Hydraulic Containment Alternatives

Item	Unit Cost	Units	Selective Alternative C Qty	Selective Alternative C Cost[a]	Extensive Alternative D Qty	Extensive Alternative D Cost[a]	Notes
Length of interceptor system		ft	650		5,600		
Well spacing		ft	100		100		
Treatment system design capacity		gpm	300		3,900		
CAPITAL COSTS:							
Groundwater treatment system				$3,390,000		$19,040,000	See Table G-7
Piezometers	$22,000	each	3	$66,000	28	$616,000	For elevation monitoring; 4-in. diam.
Extraction wells	$30,000	each	7	$210,000	56	$1,680,000	6-in. diam.
Well pumps	varies	each	7	$24,500	56	$280,000	25 or 100 gpm each; with controls
Piping from wells to treatment system	$30	lf	1,300	$39,000	11,200	$336,000	Assume double the length of interceptor system
River discharge piping				$100,000		$100,000	Allowance, 3,000 lf of piping
Institutional controls				$50,000		$50,000	Allowance for restrictions, assume existing fencing, signs and patrols will be used
Subtotal Capital Costs				$3,879,500		$22,102,000	
Contractor overhead and profit	25%			$970,000		$5,526,000	
Subtotal				$4,849,500		$27,628,000	
Engineering and construction surveillance	30%			$1,455,000		$8,288,000	
Subtotal				$6,304,500		$35,916,000	
Contingency	25%			$1,576,000		$5,526,000	
TOTAL CAPITAL COSTS				$7,880,500		$41,442,000	
LONG-TERM COSTS							Present value calculation; interest per Table G-5
Treatment system operation		yr	3	$3,219,000	3	$14,066,000	Annual cost per Table G-7
Institutional controls maintenance	$60,000	yr	6	$305,000	6	$305,000	Allowance to include maintenance of restrictions, fencing, security, and patrols
Annual groundwater monitoring costs	$140,000	yr	6	$711,000	6	$711,000	Allowance assuming semiannual monitoring for reduced suite
Subtotal Annual Costs				$4,235,000		$15,082,000	
Contingency	25%			$1,059,000		$3,771,000	
NET PRESENT VALUE OF LONG-TERM COSTS				$5,294,000		$18,853,000	
TOTAL ALTERNATIVE COST (NET PRESENT VALUE)[b]				$13,200,000		$60,300,000	Rounded to hundred thousands

[a] Costs are for mid-1994.

[b] The sum of capital and operating costs and the net present value of long-term costs.

Table G-4. Cost Estimate for Slurry Wall Containment Alternatives

Item	Unit Cost	Units	Selective Alternative E Qty	Selective Alternative E Cost[a]	Extensive Alternative F Qty	Extensive Alternative F Cost[a]	Notes
CAPITAL COSTS:							
Slurry wall - typical	$2,400	lf	3,000	$7,200,000	13,500	$32,400,000	120 ft deep; vendor budget estimate
Extra for wall in developed area		LS				$2,000,000	Allowance; see Section 6.3.6
Imported fine soil for slurry wall	$10	cy	20,000	$200,000	90,000	$900,000	Assume 50% of excavated soil
Hauling and disposal of excavated soil	$40	cy	2,000	$80,000	9,000	$360,000	At ERDF; assume 5% of excavated soil
Groundwater treatment system				$550,000		$1,710,000	See Table G-6
Piezometers	$22,000	each	4	$88,000	8	$176,000	For elevation monitoring; 4-in. diam.
Extraction wells	$30,000	each	2	$60,000	3	$90,000	6-in. diam.
Well pumps	varies	each	2	$6,000	3	$11,000	10 or 25 gpm each; with controls
Piping from wells to treatment system	$30	lf	1,000	$30,000	1,000	$30,000	Allowance
River discharge piping				$100,000		$100,000	Allowance, 3,000 lf of piping
Institutional controls				$50,000		$50,000	Allowance for restrictions, assume existing fence, signs, and patrols will be used
Subtotal Capital Costs				$8,364,000		$37,827,000	
Contractor overhead and profit	25%			$2,091,000		$9,457,000	
Subtotal				$10,455,000		$47,284,000	
Engineering and construction surveillance	30%			$3,137,000		$14,185,000	
Subtotal				$13,592,000		$61,469,000	
Contingency	25%			$3,398,000		$15,367,000	
TOTAL CAPITAL COSTS				$16,990,000		$76,836,000	
LONG-TERM COSTS							Present value calculation; interest per Table G-5
Treatment system operation		yr	100	$9,725,000	100	$14,489,000	Annual cost per Table G-6
Institutional controls maintenance	$60,000	yr	100	$1,191,000	100	$1,191,000	Allowance to include maintenance of restrictions, fencing, security, and patrols
Annual groundwater monitoring costs	$140,000	yr	100	$2,779,000	100	$2,779,000	Allowance assuming semiannual monitoring for reduced suite
Subtotal Annual Costs				$13,695,000		$18,459,000	
Contingency	25%			$3,424,000		$4,615,000	
NET PRESENT VALUE OF LONG-TERM COSTS				$17,119,000		$23,074,000	Interest rate per Table G-5
TOTAL ALTERNATIVE COST (NET PRESENT VALUE)[b]				$34,100,000		$99,900,000	Rounded to hundred thousands

[a] Costs are for mid-1994.

[b] The sum of capital and operating costs and the net present value of long-term costs.

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Table G-5. Basic Unit Costs and Factors.

Item	Unit Cost	Units	Std Dev	Source/Comments
GENERAL FACTORS				
Date of aquifer recovery	2001	yrs		3-10 yrs from late 1993 (see Section 4.3)
Duration of monitoring	6			Assume starts with ROD in 1995
Duration of hydraulic containment operation	3	yrs		Assume 3 yrs from ROD for design and construction
Duration of slurry wall containment	100	yrs	75	
Slurry wall length - selective remediation	3,000	ft	600	
Slurry wall length - extensive remediation	13,500	ft	2,000	
Interest rate (net of inflation)	5%			EPA value; for present value calculations
Contractor overhead & profit factor	25%			Stochastic values 20% - 30% (uniform distribution)
Engineering & construction surveillance	30%			Per Westinghouse (29% rounded)
Contingency	25%			Appropriate for FS
Combined factor	203%			OH&P, E&CS, contingency
SITE WORK (labor, materials and equipment):				Not including contractor overhead & profit
Slurry wall unit cost - normal (undeveloped areas)	$2,400	lf	$600	120 ft deep; Geocon budget estimate Uncertainties considered for both $/sf and depth Includes volume reduction costs for contam. soil
ERDF hauling & disposal cost per 300-FF-1 FS	$40	cy	$10	Not including OH&P, E&CS, or contingency
Clean fine soil (delivered to site)	$10	cy	$2	McGee Ranch; delivered to site
Piezometers	$22,000	each	$3,300	4" stainless well with level sensors; 40 ft deep
Groundwater extraction well, 6"	$30,000	each	$4,500	stainless steel; 40 ft deep
Groundwater pump, 10 gpm	$3,000	each	$450	Submersible, electric, stainless steel, with controls
Groundwater pump, 25 gpm	$3,500	each	$525	Submersible, electric, stainless steel, with controls
Groundwater pump, 50 gpm	$4,000	each	$600	Submersible, electric, stainless steel, with controls
Groundwater pump, 100 gpm	$5,000	each	$750	Submersible, electric, stainless steel, with controls
Groundwater collection piping	$30	lf	$5	6-in. diam. buried 3 ft
River discharge piping	$100,000	LS	$25,000	Allowance
Building	$80	sf	$20	For treatment system
OTHER:				
Institutional controls	$50,000	LS	$12,500	Allowance for restrictions, assume existing fencing, signs, and patrols will be used
Annual institutional controls maintenance	$60,000	yr	$15,000	Allowance to include maintenance of restrictions, fencing, security, and patrols
Annual monitoring costs	$140,000	yr	$35,000	Allowance assuming semiannual monitoring for reduced suite

TABLE G-6. Estimated Groundwater Treatment System Costs - Low Flowrates.

Item Description	Unit Cost	Selective Qty	Selective Size		Selective Cost[a]	Extensive Qty	Extensive Size		Extensive Cost[a]	Notes
Treatment system design capacity			7	gpm			125	gpm		
Normal operational flowrate			7	gpm			125	gpm		
CAPITAL COSTS:										
Feed tank		1	3,400	gal	$15,000	1	60,000	gal	$83,000	8-hour storage at normal flow
Sand filters		1	10	gpm	$16,000	1	125	gpm	$72,000	Manual batch backwash
Ion exchange columns		2	10	gpm	$64,000	2	125	gpm	$280,000	Columns in series; onsite regeneration
Ion exchange regeneration system					$10,000				$59,000	Tank and chemical addition
Effluent storage tank		1	3,400	gal	$10,200	1	60,000	gal	$83,000	8-hour storage at normal flow
Mix tank		1	400	gal	$1,000	1	7,500	gal	$24,000	Precipitation subsystem
Mixer		1	2	hp	$2,000	1	10	hp	$5,000	
Chemical addition subsystem					$10,000				$20,000	
Clarifier		1	5	gpm	$45,000	1	30	gpm	$133,000	Derived from Denver Sala LT 200 (lamella design)
Filter press		1			$50,000	1			$50,000	
Subtotal equipment costs					$223,200				$809,000	Before installation
Treatment system building	$80		1,500	sf	$120,000		2,000	sf	$160,000	Including operator/administrative office
Freight	6%				$13,000				$49,000	% of raw equipment cost
Electrical and instrumentation	20%				$45,000				$162,000	% of raw equipment cost
Piping and ventilation	15%				$33,000				$121,000	% of raw equipment cost; not insulated
Installation	50%				$112,000				$405,000	Includes site preparation and foundations
TOTAL CAPITAL COSTS					**$550,000**				**$1,710,000**	Installed equipment cost (rounded to ten thousands)
ANNUAL OPERATING COSTS:	Rate	Hrs				Hrs				
Manager-Engineer	$60	2,000			$120,000	2,000			$120,000	8 hrs/day, 5 days/week, 50 wks/yr
Operator	$30	2,912			$87,360	2,912			$87,360	8 hrs/day, 7 days/week, 52 wks/yr
Health Physics Technician	$35	208			$7,280	208			$7,280	4 hrs/wk, 52 wks/yr
Clerical support	$25	208			$5,200	208			$5,200	4 hrs/wk, 52 wks/yr
Laboratory (20 samp/wk)	$200	1,040		samp	$208,000	1,040		samp	$208,000	System monitoring and control
Chemical costs	$2		3,700	K gal	$7,400		65,700	K gal	$131,400	Ion exchange and precipitation
Maintenance, power, and misc.	10%				$55,000				$171,000	% of installed equip. cost; incl. sludge disposal
TOTAL ANNUAL OPERATING COST					**$490,000**				**$730,000**	Rounded to thousands

Note: Capital costs are based on vendor quotes and adjusted to reflect special needs associated with the Hanford project

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TABLE G-7. Estimated Groundwater Treatment System Costs - High Flowrates.

Item Description	Unit Cost	Selective Qty	Selective Size		Selective Cost[a]	Extensive Qty	Extensive Size		Extensive Cost[a]	Notes
Treatment system design capacity			300	gpm			3,900	gpm		
Normal operational flowrate			300	gpm			2,600	gpm		
CAPITAL COSTS:										
Feed tank		1	140,000	gal	$138,000	1	1,200,000	gal	$500,000	8-hr storage at normal flow
Sand filters		2	300	gpm	$122,000	5	1,000	gpm	$252,000	Columns in parallel; automatic backwash
Ion exchange columns		3	300	gpm	$750,000	16	500	gpm	$5,280,000	2 columns in series; onsite regeneration
Ion exchange regeneration system					$100,000				$466,000	Tank and chemical addition
Effluent storage tank		1	144,000	gal	$140,000	1	1,250,000	gal	$513,000	8-hour storage at normal flow
Mix tank		1	18,000	gal	$40,000	1	234,000	gal	$188,000	Precipitation subsystem
Mixer		1	20	hp	$7,000	1	280	hp	$34,000	
Chemical addition subsystem					$20,000				$30,000	
Clarifier		1	80	gpm	$239,000	1	980	gpm	$1,077,000	Derived from Denver Sala LT 200 (lamella design)
Filter press		1			$50,000	1			$557,000	
Subtotal equipment costs					$1,606,000				$8,897,000	Before installation
Process control building	$80		3,000	sf	$240,000		20,000	sf	$1,600,000	Including operator/administrative office
Freight	6%				$96,000				$534,000	% of raw equipment cost
Electrical and instrumentation	20%				$321,000				$1,779,000	% of raw equipment cost
Piping	20%				$321,000				$1,779,000	% of raw equipment cost; insulated
Installation	50%				$803,000				$4,449,000	Includes site preparation and foundations
TOTAL CAPITAL COSTS					**$3,390,000**				**$19,040,000**	Installed equipment cost (rounded to ten thousands)
ANNUAL OPERATING COSTS:	Rate	Hrs				Hrs				
Manager-Engineer	$60	2,000			$120,000	2,000			$120,000	8 hrs/day, 5 days/week, 50 wks/yr
Operators (2)	$30	5,824			$174,720	5,824			$174,720	8 hrs/day, 7 days/week, 52 wks/yr
Health Physics Technician	$35	416			$14,560	416			$14,560	8 hrs/wk, 52 wks/yr
Clerical support	$25	416			$10,400	416			$10,400	8 hrs/wk, 52 wks/yr
Laboratory (20 samp/wk)	$200	1,040		samp	$208,000	1,040		samp	$208,000	System monitoring and control
Chemical costs	$2		157,700	K gal	$315,400		1,366,600	K gal	$2,733,200	Ion exchange and precipitation
Maintenance, power, and misc.	10%				$339,000				$1,904,000	% of installed equip. cost; incl. sludge disposal
TOTAL ANNUAL OPERATING COST					**$1,182,000**				**$5,165,000**	Rounded to thousands

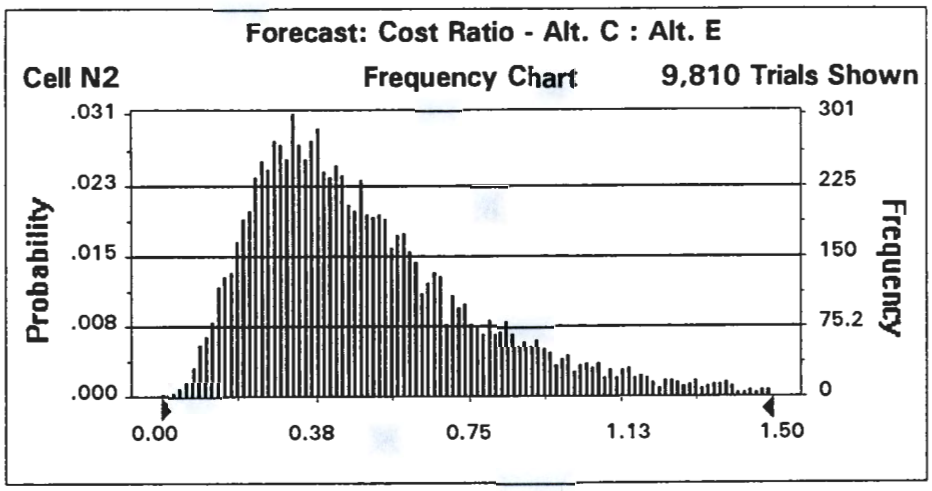
Note: Capital costs are based on vendor quotes and adjusted to reflect special needs associated with the Hanford project

APPENDIX G-1

RESULTS OF MONTE CARLO SIMULATION
10,000 TRIALS
LATIN HYPERCUBE SAMPLING
(SAMPLE SIZE = 100)

Forecast: Cost Ratio - Alt. C : Alt. E

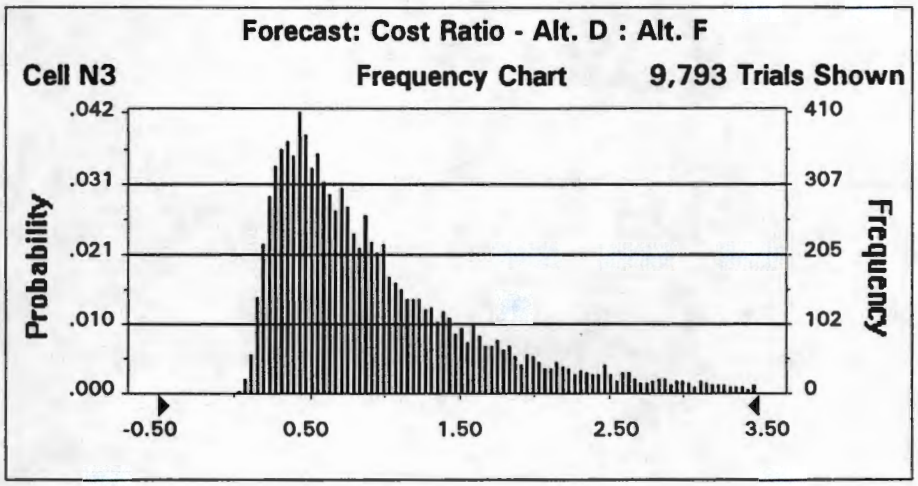
Mean	0.53
Median (approx.)	0.45
Mode (approx.)	0.30
Standard Deviation	0.34



Percentile	Value (approx.)
0%	0.00
5%	0.16
25%	0.30
50%	0.45
75%	0.66
95%	1.15
100%	5.39

Forecast: Cost Ratio - Alt. D : Alt. F

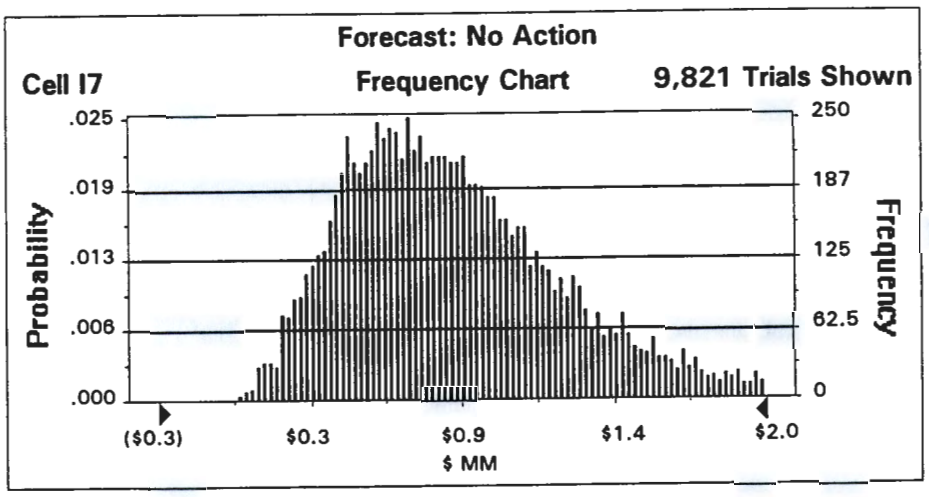
Mean	1.03
Median (approx.)	0.77
Mode (approx.)	0.44
Standard Deviation	0.87



Percentile	Value (approx.)
0%	-0.01
5%	0.23
25%	0.46
50%	0.77
75%	1.31
95%	2.70
100%	13.06

Forecast: No Action

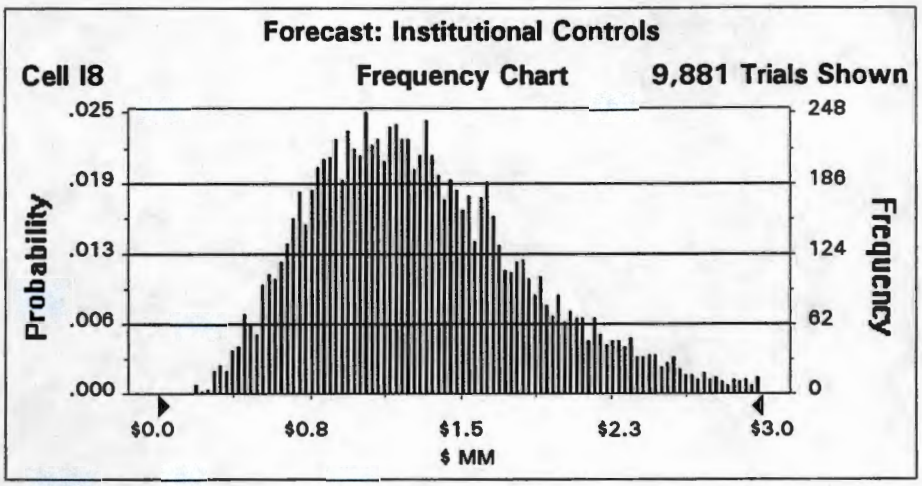
Mean	$0.9
Median (approx.)	$0.8
Mode (approx.)	$0.6
Standard Deviation	$0.4



Percentile	$ MM (approx.)
0%	($0.0)
5%	$0.3
25%	$0.6
50%	$0.8
75%	$1.1
95%	$1.7
100%	$3.4

Forecast: Institutional Controls

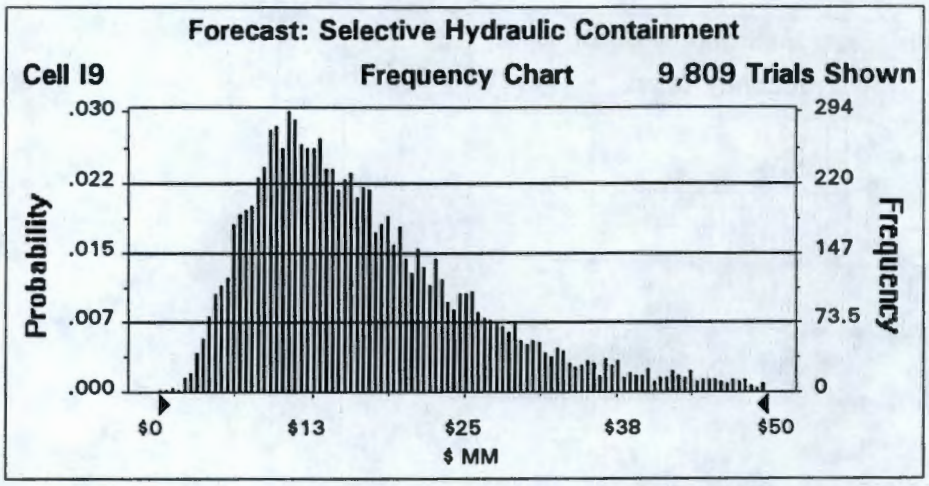
Mean	$1.3
Median (approx.)	$1.2
Mode (approx.)	$1.3
Standard Deviation	$0.6



Percentile	$ MM (approx.)
0%	$0.1
5%	$0.6
25%	$0.9
50%	$1.2
75%	$1.6
95%	$2.4
100%	$4.5

Forecast: Selective Hydraulic Containment

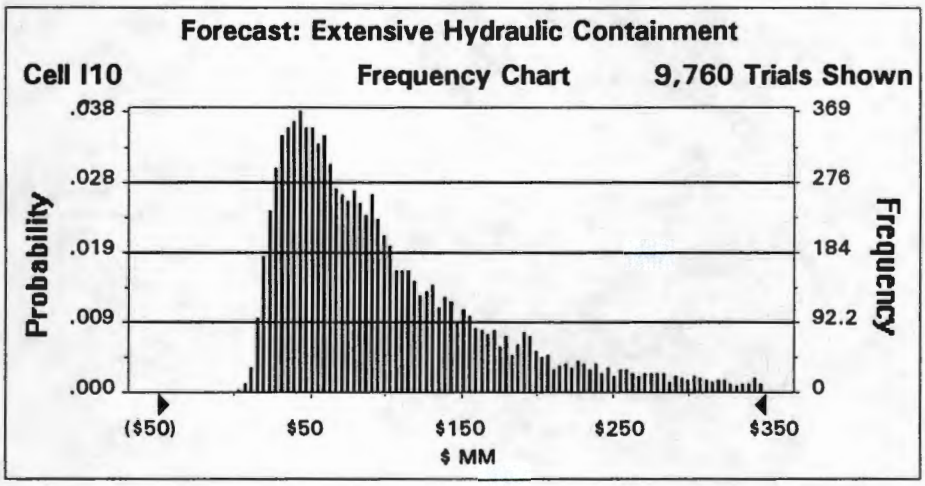
Mean	$18
Median (approx.)	$15
Mode (approx.)	$11
Standard Deviation	$11



Percentile	$ MM (approx.)
0%	$0
5%	$6
25%	$10
50%	$15
75%	$22
95%	$39
100%	$124

Forecast: Extensive Hydraulic Containment

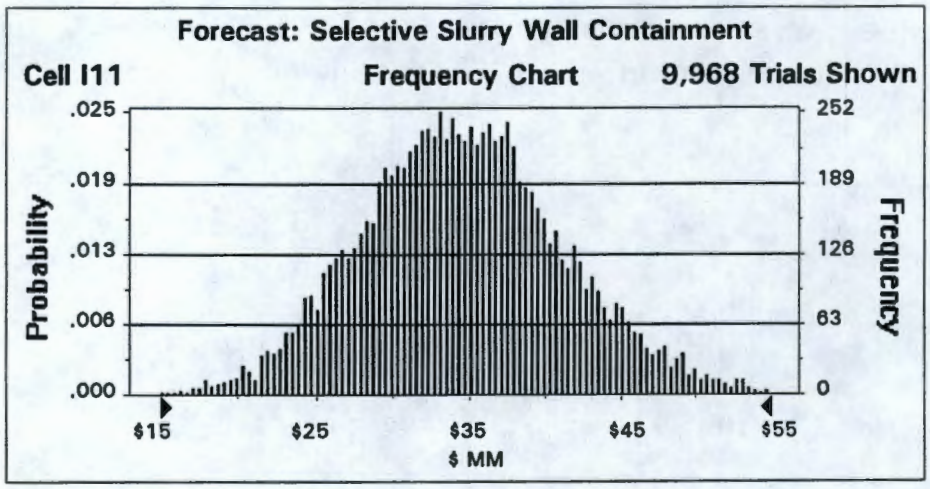
Mean	$108
Median (approx.)	$82
Mode (approx.)	$47
Standard Deviation	$90



Percentile	$ MM (approx.)
0%	($2)
5%	$25
25%	$49
50%	$82
75%	$138
95%	$287
100%	$1,079

Forecast: Selective Slurry Wall Containment

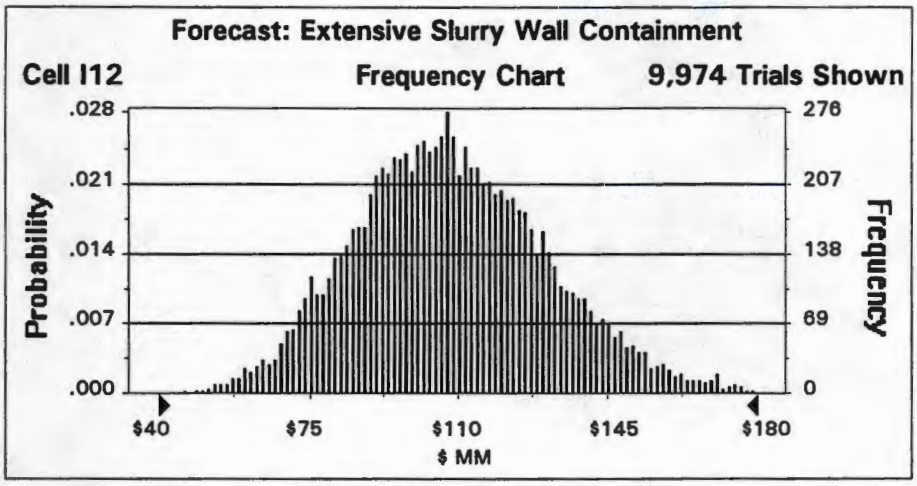
Mean	$35
Median (approx.)	$35
Mode (approx.)	$33
Standard Deviation	$7



Percentile	$ MM (approx.)
0%	$13
5%	$24
25%	$30
50%	$35
75%	$39
95%	$46
100%	$64

Forecast: Extensive Slurry Wall Containment

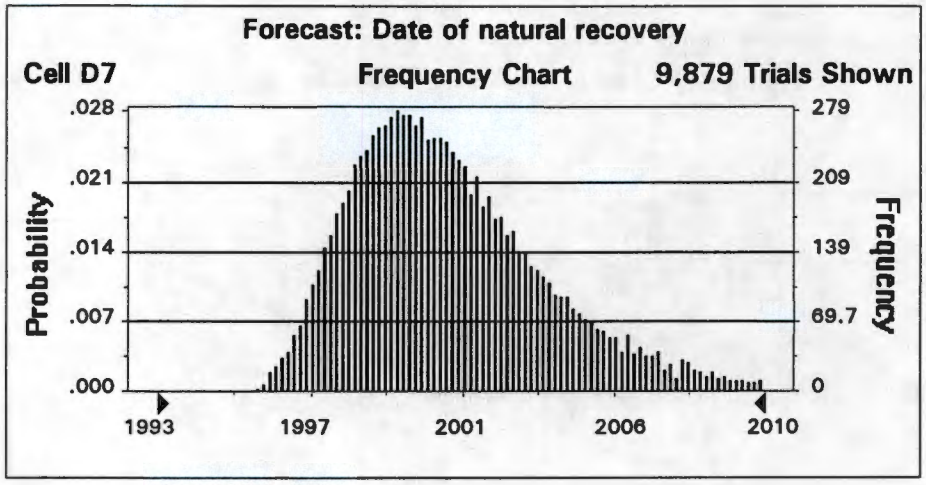
Mean	$109
Median (approx.)	$108
Mode (approx.)	$108
Standard Deviation	$23



Percentile	$ MM (approx.)
0%	$33
5%	$74
25%	$93
50%	$108
75%	$124
95%	$149
100%	$202

Forecast: Date of natural recovery

Mean	2001
Median (approx.)	2000
Mode (approx.)	2000
Standard Deviation	3



Percentile	Value (approx.)
0%	1995
5%	1997
25%	1999
50%	2000
75%	2003
95%	2007
100%	2025

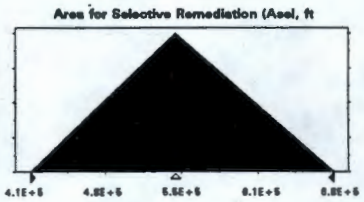
Assumptions

Assumption: Area for Selective Remediation (Asel, ft)

Triangular distribution with parameters:

Minimum	4.1E+05
Likeliest	5.4E+05
Maximum	6.8E+05

Mean value in simulation was 5.4E+5

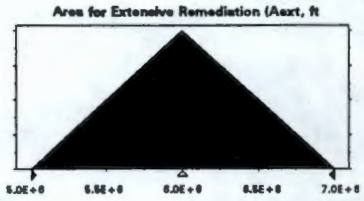


Assumption: Area for Extensive Remediation (Aext, ft)

Triangular distribution with parameters:

Minimum	5.0E+06
Likeliest	6.0E+06
Maximum	7.0E+06

Mean value in simulation was 6.0E+6

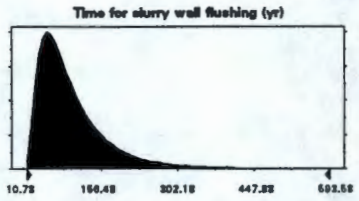


Assumption: Time for slurry wall flushing (yr)

Lognormal distribution with parameters:

Mean	100.00
Standard Dev.	75.00

Mean value in simulation was 100.01

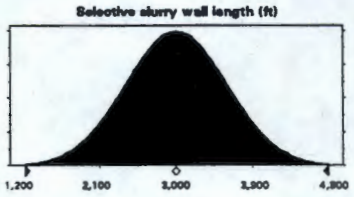


Assumption: Selective slurry wall length (ft)

Normal distribution with parameters:

Mean	3,000
Standard Dev.	600

Mean value in simulation was 3,000

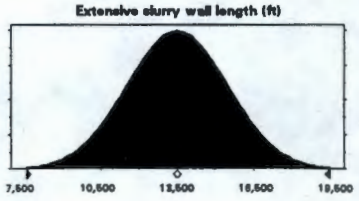


Assumption: Extensive slurry wall length (ft)

Normal distribution with parameters:

Mean	13,500
Standard Dev.	2,000

Mean value in simulation was 13,501

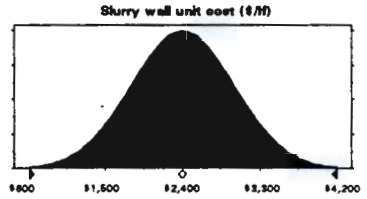


Assumption: Slurry wall unit cost ($/lf)

Normal distribution with parameters:

Mean	$2,400
Standard Dev.	$600

Mean value in simulation was $2,400

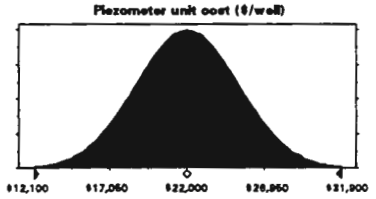


Assumption: Piezometer unit cost ($/well)

Normal distribution with parameters:

Mean	$22,000
Standard Dev.	$3,300

Mean value in simulation was $22,000

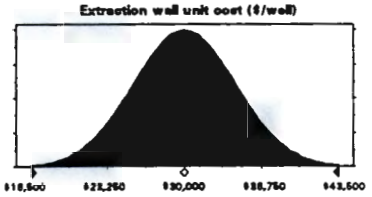


Assumption: Extraction well unit cost ($/well)

Normal distribution with parameters:

Mean	$30,000
Standard Dev.	$4,500

Mean value in simulation was $30,002

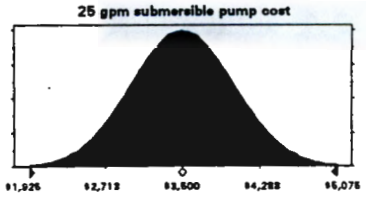


Assumption: 25 gpm submersible pump cost

Normal distribution with parameters:

Mean	$3,500
Standard Dev.	$525

Mean value in simulation was $3,500

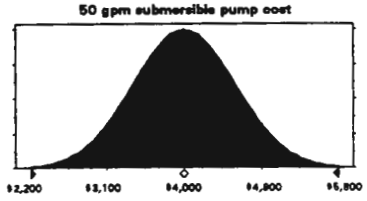


Assumption: 50 gpm submersible pump cost

Normal distribution with parameters:

Mean	$4,000
Standard Dev.	$600

Mean value in simulation was $4,000

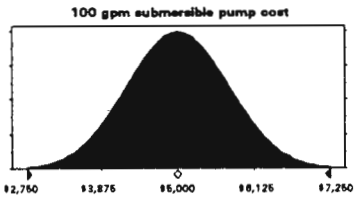


Assumption: 100 gpm submersible pump cost

Normal distribution with parameters:

Mean	$5,000
Standard Dev.	$750

Mean value in simulation was $5,000

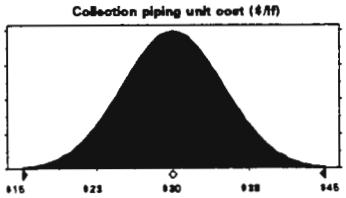


Assumption: Collection piping unit cost ($/lf)

Normal distribution with parameters:

Mean	$30
Standard Dev.	$5

Mean value in simulation was $30

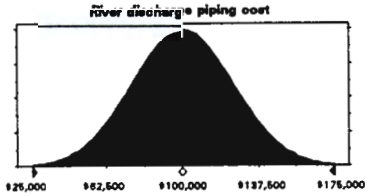


Assumption: River discharge piping cost

Normal distribution with parameters:

Mean	$100,000
Standard Dev.	$25,000

Mean value in simulation was $100,005

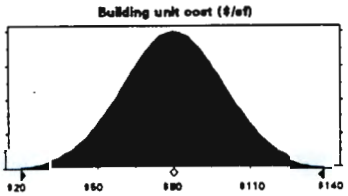


Assumption: Building unit cost ($/sf)

Normal distribution with parameters:

Mean	$80
Standard Dev.	$20

Mean value in simulation was $80

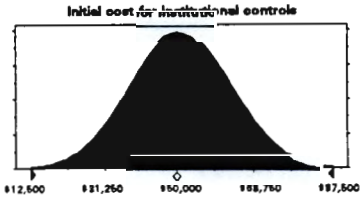


Assumption: Initial cost for institutional controls

Normal distribution with parameters:

Mean	$50,000
Standard Dev.	$12,500

Mean value in simulation was $50,009

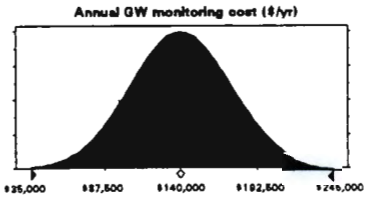


Assumption: Annual GW monitoring cost ($/yr)

Normal distribution with parameters:

Mean	$140,000
Standard Dev.	$35,000

Mean value in simulation was $140,003

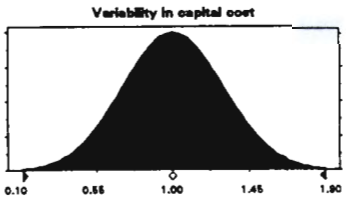


Assumption: Variability in capital cost

Normal distribution with parameters:

Mean	1.00
Standard Dev.	0.30

Mean value in simulation was 1.00

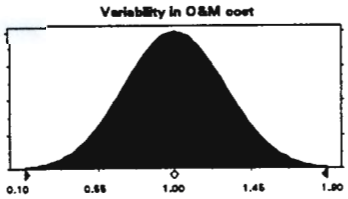


Assumption: Variability in O&M cost

Normal distribution with parameters:

Mean	1.00
Standard Dev.	0.30

Mean value in simulation was 1.00

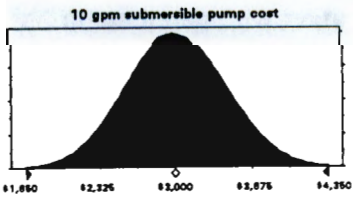


Assumption: 10 gpm submersible pump cost

Normal distribution with parameters:

Mean	$3,000
Standard Dev.	$450

Mean value in simulation was $3,000

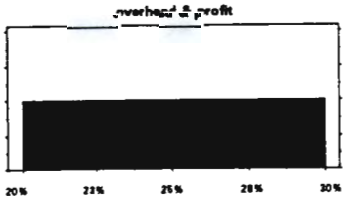


Assumption: overhead & profit

Uniform distribution with parameters:

Minimum	20%
Maximum	30%

Mean value in simulation was 25%

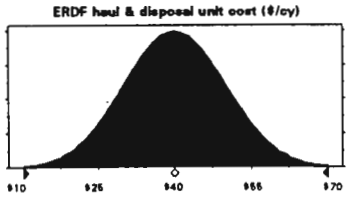


Assumption: ERDF haul & disposal unit cost ($/cy)

Normal distribution with parameters:

Mean	$40
Standard Dev.	$10

Mean value in simulation was $40

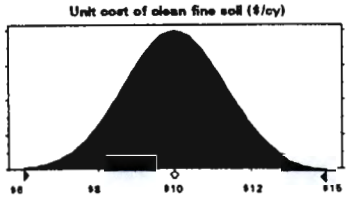


Assumption: Unit cost of clean fine soil ($/cy)

Normal distribution with parameters:

Mean	$10
Standard Dev.	$2

Mean value in simulation was $10

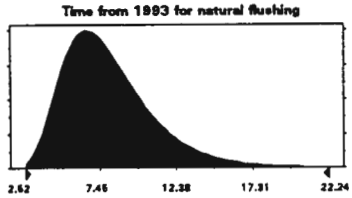


Assumption: Time from 1993 for natural flushing

Lognormal distribution with parameters:

Mean	8.00
Standard Dev.	3.00

Mean value in simulation was 8.01

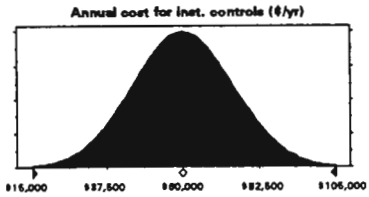


Assumption: Annual cost for inst. controls ($/yr)

Normal distribution with parameters:

Mean	$60,000
Standard Dev.	$15,000

Mean value in simulation was $59,983

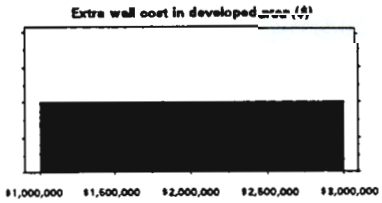


Assumption: Extra wall cost in developed area ($)

Uniform distribution with parameters:

Minimum	$1,000,000
Maximum	$3,000,000

Mean value in simulation was $2,000,010



End of Assumptions

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