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

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Executive Summary

The objective of this data quality assessment (DQA) is to determine whether the data can support risk assessment and selection of remedial alternatives. The scope of this report is to summarize DQA activities performed to evaluate the results of groundwater samples taken from wells in the 200-UP-1 Groundwater Operable Unit over the last five years. The requirements for the sampling program are found in the *Remedial Investigation/ Feasibility Study Work Plan for the 200-UP-1 Groundwater Operable Unit, Hanford Site, Richland, Washington* (DOE/RL-92-76). Regulatory action limits were provided by the 200-UP-1 Risk Assessment Task and are documented in the remedial investigation/ feasibility study (RI/FS) final report (pending). The DQA process follows general guidelines for data quality assessment established by the U.S. Environmental Protection Agency (EPA) in *Guidance for Data Quality Assessment, Practical Methods for Data Analysis* (EPA/600/R-96/084).

The assessment is based on three levels of evaluation: verification, validation, and data usability. Data verification is the process of evaluating the completeness, correctness, and conformance/compliance of a specific data set against the method, procedural, or contractual requirements. Data validation is an analyte- and sample-specific process that extends the evaluation of data beyond method, procedural, or contractual compliance (i.e., data verification) to determine the analytical quality of a specific data set. Finally, the usability assessment is a determination of the adequacy of the data to support a particular environmental decision and is based upon the verification and validation results.

The 200-UP-1 data set included over 68,000 analysis results from samples of 103 wells for 259 different constituents over the period from October 2003 to March 2009. In addition, nearly 158,000 individual quality control results were generated in support of the chemical analyses. In general, the DQA provides support for the conclusion that the 200-UP-1 data set quality is sufficient for use in making environmental decisions specifically for supporting risk evaluations, selection of remedial alternatives, and use within contaminant fate and transport calculations. Comparison of the 200-UP-1 data set with the overall Hanford Site groundwater data set as described in the annual Hanford groundwater reports showed that the 200-UP-1 data is at least as good, in terms of accuracy, precision, and blank contamination, as the overall site groundwater data set.

Both field and laboratory performance parameters are equal to or better than those for the Hanford Site groundwater data overall.

The following limitations or data weaknesses were observed.

1. The vast majority of the sample results were below laboratory reporting limits (nondetects). For many constituents, these reporting limits exceeded applicable regulatory action limits. This limits the ability to use the data to determine whether or not that particular constituent is present at low levels above the regulatory action limit. This was particularly important for some non-RI/FS contaminants of concern (COC). Although some RI/FS COCs exhibited significant percentages of nondetects at levels exceeding action limits, there remained useful data.

2. Some data (one radiochemistry sample and several anion samples) were rejected by the independent third-party data validator. Users of anion data (particularly nitrate and nitrite) should be cognizant of possible impacts of potential holding time issues with their data.

3. Most of the reported values for the 200-UP-1 groundwater constituents are below the laboratory reporting limits (nondetects). The following constituents exhibited high percentages of nondetects and high percentages of detection limits that exceed the applicable regulatory action limit: antimony, arsenic, iodine-129, 1,1-dichloroethene, 1,2-dichloroethane, 1,4-dioxane, carbon tetrachloride, tetrachloroethene, and trichloroethene. Data users must look carefully at data detection limits relative to action limits when using these data.

4. Lead results should be considered in view of high variability in the field duplicates and the fact that there were no field split samples reported for lead.

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Terms

AEA	*Atomic Energy Act of 1954*
ARAR	applicable or relevant and appropriate requirement
BOD	biological oxygen demand
CAP	Contract Analytical Program
CERCLA	*Comprehensive Environmental Response, Compensation, and Liability Act of 1980*
COC	contaminant of concern
COPC	contaminant of potential concern
DOE-RL	U.S. Department of Energy, Richland Operations Office
DQA	Data Quality Assessment
DQO	data quality objective
EPA	U.S. Environmental Protection Agency
ERDF	Environmental Restoration Disposal Facility
FY	fiscal year
HEIS	Hanford Environmental Information System database
IDF	Integrated Disposal Facility
IDL	instrument detection limit
LCS	laboratory control standard
MCL	maximum contaminant level
MDL	method detection limit
MS/MSD	matrix spike/matrix spike duplicate
N/A	not applicable
NRDWL	Nonradioactive Dangerous Waste Landfill
OU	operable unit
PNNL	Pacific Northwest National Laboratory
PQL	practical quantitation limit
PRG	preliminary remediation goals
PUREX	Plutonium-Uranium Extraction (plant or process)

QA	quality assurance
QC	quality control
RCRA	*Resource Conservation and Recovery Act of 1976*
RD/RAWP	Remedial Design/Remedial Action Work Plan
RDR	Remedial Design Report
RI/FS	Remedial Investigation/Feasibility Study
RPD	relative percent difference
SAP	Sampling and Analysis Plan
SVOA/SVOC	semivolatile organic analysis/semivolatile organic compound
TEDF	Treated Effluent Disposal Facility
TPH	total petroleum hydrocarbons
TSD	treatment, storage, and disposal
VOA/VOC	volatile organic compound/volatile organic analysis
WMA	Waste Management Area

1 Introduction

This data quality assessment (DQA) report assesses laboratory data for groundwater samples obtained from 103 wells in the 200-UP-1 Groundwater Operable Unit (OU) for the period from October 1, 2003, through March 31, 2009.

The 200-UP-1 OU encompasses groundwater contaminant plumes beneath the southern third of the Hanford site 200 West Area and adjacent portions of the surrounding 600 Area. The operable unit lies within the larger, informally defined 200-UP-1 groundwater interest area (see Figure 1-1). Three *Resource Conservation and Recovery Act of 1976* (RCRA) sites are located within 200-UP-1.

Large-scale waste disposal at the 200-UP-1 groundwater interest area began during the early 1950s when plutonium separation operations began at the reduction and oxidation (REDOX) plant or S Plant and uranium recovery operations began at U Plant. In general, the high-level radioactive waste was stored in underground storage tanks while other liquid waste streams were sent to ponds and cribs. Groundwater plumes of nitrate, tritium, iodine-129 formed from the pond and crib effluent disposal activities and high downward mobility. These plumes expanded as effluent disposal operations continued. Effluent disposal to the ponds and cribs ended during the 1990s. At present, the groundwater plumes from theses sources are dispersing naturally. However, constituents of lower mobility in the vadose zone beneath the ponds and cribs may potentially reach the water table in the future and affect groundwater quality.

Some of the underground storage tanks within the U and S-SX tank farms have leaked in the past, resulting in contamination of the vadose zone underneath the tanks. Some of this contamination has migrated downward and reached the water table. Currently groundwater plumes of nitrate, technetium-99, and chromium from the tank farms are generally growing in a real extent, and exhibit increasing constituent concentrations. In addition, carbon tetrachloride is migrating into the 200-UP-1 groundwater interest area from the adjacent 200-ZP-1 groundwater interest area.

Groundwater monitoring in the 200-UP-1 groundwater interest area is conducted under three regulatory drivers: the *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* (CERCLA), the RCRA, and the *Atomic Energy Act of 1954* (AEA). CERCLA governs the 200-UP-1 OU and the Environmental Restoration Disposal Facility (ERDF). CERCLA requires monitoring conducted to characterize and track all contaminants of concern or potential concern within the operable unit, and to evaluate the performance of the pump-and-treat system that removes technetium-99 and uranium from groundwater. The RCRA interim assessment monitoring for hazardous constituents is performed at single-shell tank Waste Management Areas (WMA) U and S-SX, and interim detection monitoring under RCRA is performed at the 216-S-10 Pond and Ditch WMA. Monitoring of radionuclides at these three WMA sites is governed by the AEA.

Groundwater assessment monitoring was conducted at the 216-U-12 Crib under RCRA but was discontinued in 2008 when this site was reclassified as a RCRA past-practice site in June 2007. Groundwater in the vicinity of the crib is currently monitored as part of the CERCLA 200-UP-1 OU.

The analytical data for all groundwater monitoring samples and their associated field quality-control samples are maintained in the Hanford Environmental Information System (HEIS); the data are summarized in annual groundwater monitoring reports. The most recent of these reports is *Hanford Site Groundwater Monitoring for Fiscal Year 2008* (DOE/RL-2008-66, Rev. 0). From this point forward in this DQA, these reports are called the "annual groundwater reports."

Technetium-99, uranium, tritium, iodine-129, nitrate and carbon tetrachloride are the contaminants of greatest significance in groundwater. In addition to these constituents, high-priority contaminants of

concern include Strontium-90, trichloroethene, chloroform, chromium, cadmium and arsenic. Technetium-99, nitrate, and chromium plumes from the tank farms are generally growing in areal extent, while the more extensive nitrate, iodine-129 and tritium plumes are dispersing naturally.

Groundwater sampling within the 200-UP-1 groundwater operable unit is performed in accordance with the *200-UP-1 Groundwater Remedial Design/Remedial Action Work Plan,* which contains a Sampling and Analysis Plan, (DOE/RL-97-36). The RCRA treatment, storage, and disposal (TSD) monitoring is performed in accordance with facility-specific RCRA monitoring plans.

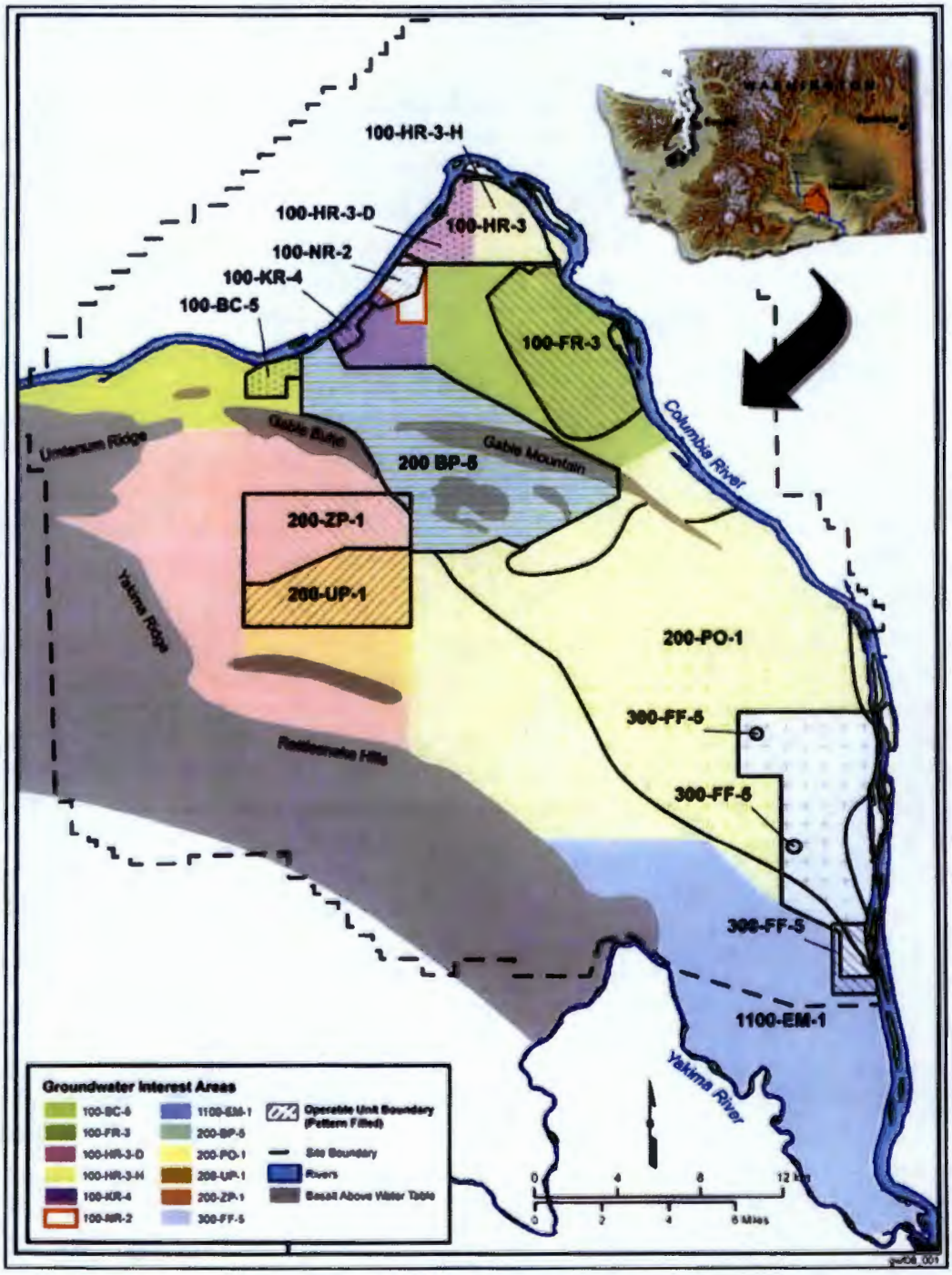

Figure 1-1. Location of the 200-UP-1 Groundwater OU at the Hanford Site (PNNL, 2007)

1.1 Monitoring Wells Selection

A total of 103 wells were selected for inclusion in this DQA. The well selection process is described in the Remedial Investigation/Feasibility Study (RI/FS) Report and Appendix A.

The wells selected for sampling in the RI/FS Work Plan include those from the monitoring well network of the 200-UP-1 Groundwater OU, as established in the RI/FS Work Plan SAP (DOE/RL 92-76) as well as RCRA monitoring wells from the U, S-SX, and 216-S-10 WMAs.

1.2 Target Analytes

The 200-UP-1 RI/FS work Plan (DOE/RL-92-76) includes a Sampling and Analysis Plan (SAP) as Appendix A. This SAP includes a series of contaminants of concern identified through data quality objectives processes conducted in 1992 and also in 2003. These DQO processes resulted in a comprehensive list of contaminants of potential concern (COPC) that was revised to a final list of 55 contaminants of concern (COC), which is shown in Table 1-1.

In addition to target analytes for RI/FS characterization or remedial design/ remedial action work plan (RD/RAWP) process monitoring, additional constituents have been reported through method-based analysis. The data set used for this DQA includes 259 individual analytical constituents.

1.3 Action Levels

Action levels are derived from readily available sources of chemical-specific applicable or relevant and appropriate requirement (ARARs) or risk-based preliminary remediation goals (PRGs) developed using U.S. Environmental Protection agency (EPA) health criteria and default exposure assumptions. All sources of chemical-specific ARARs and PRGs for all constituents are listed in the RI/FS report. The action level represents the lowest of the available values for each analyte evaluated. Of the 259 constituents for which chemical analysis data are available, 237 have calculated action levels.

Potential chemical-specific ARARs include concentration limits set known as maximum contaminant level (MCL) by federal environmental regulations. These MCLs, secondary MCLs, and non-zero MCL goals established under the *Safe Drinking Water Act of 1974*, ambient water quality criteria established under the *Clean Water Act of 1977*, and Washington State regulations (WAC 173-340-720, "Groundwater Cleanup Standards"; WAC 173-340-730, "Surface Water Cleanup Standards"; and WAC 173-201A, "Water Quality Standards for Surface Waters of the State of Washington").

PRGs were revisited as part of the final RI/FS preparation process. More recent state limits and additional potentially-applicable regulatory limits were introduced. These limits are referred to as Target Action Limits in the RI/FS report, to differentiate them from previously identified remediation goals.

The risk-based concentration table for residential tap waters was used as the source of PRGs. These values were obtained from the "Regional Screening Levels for Chemical Contaminants at Superfund Sites" website (http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/index.htm). PRGs for chemicals with carcinogenic effects correspond to a 10^{-6} incremental risk of an individual developing cancer over a lifetime as a result of exposure to the potential carcinogen from all significant exposure pathways for a given medium. Target action limits for chemicals with non-cancer effects correspond to a hazard index of one, which is the level of exposure to a chemical from all significant exposure pathways in a given medium below which it is unlikely for even sensitive populations to experience adverse health effects. The direct-contact exposure pathway for groundwater considered exposure from ingestion, inhalation of vapors, and dermal contact. The residential tap waters value was used only when a chemical-specific ARAR was not available.

These updated Target Action Limits, along with their basis, appear in the UP-1 RI/FS report and Table 1-2.

Table 1-1. Comprehensive List of Final Contaminants of Concern for the 200-UP-1 OU

Radioisotopes	Metals	Volatile Organics	Non-Metals
Carbon-14	Antimony	Acetone	Ammonium ion
Iodine-129	Arsenic	1-Butanol	Ammonia
Selenium-79	Cadmium	Carbon disulfide	Ammonium nitrate
Strontium-90	Chromium(total)	Carbon Tetrachloride	Cyanide
Technetium-99	Chromium (Hexavalent)	Chloroform	Nitrate
Tritium	Cobalt	1,4-dioxane	Nitrite
Neptunium-237	Iron	Ethyl acetate	Sulfide
Protactinium-231	Lead	Methylene Chloride	
Uranium-234	Lithium	Methyl ethyl ketone	
Uranium-235	Magnesium	4-methyl-2-pentanone (hexone, MIBK)	**Semi-volatile Organics**
Uranium-238	Manganese	1,1-dichloroethylene	Cresols
Cesium-137	Mercury	1,2-dichloroethane	Kerosene
Cobalt-60	Uranium	Toluene	Phenol
	Vanadium	1,1,1-trichloroethane	Phenols (total)
		Triochloroethene	
		Tetrochloroethene	
		Xylene (total)	

Source: DOE/RL-92-76, Rev. 1.

Table 1-2. List of Target Constituents and Action Levels for the 200-UP-1 Groundwater OU

Analyte Name	Analyte Class	Unit	Action Level	Action Level Basis	RI/FS COC?
Aluminum	Metal	µg/L	50	Federal MCL	
Antimony	Metal	µg/L	6.0	Federal MCL	y
Arsenic	Metal	µg/L	0.058	Groundwater Method B	y
Barium	Metal	µg/L	2,000	Groundwater Method B	
Beryllium	Metal	µg/L	4.0	Federal MCL	
Bismuth	Metal	–	–	–	
Boron	Metal	µg/L	3,200	Groundwater Method B	
Cadmium	Metal	µg/L	5.0	Federal MCL	y
Calcium	Metal	–	–	–	
Chromium	Metal	µg/L	100	Federal MCL	y
Cobalt	Metal	µg/L	4.8	Groundwater Method B	y
Copper	Metal	µg/L	640	Groundwater Method B	
Hexavalent Chromium	Metal	µg/L	48	Groundwater Method B	y
Iron	Metal	µg/L	300	Federal MCL	y
Lead	Metal	µg/L	15	Federal MCL	y
Lithium	Metal	µg/L	32	Groundwater Method B	y
Magnesium	Metal	–	–	–	y
Manganese	Metal	µg/L	50	Federal MCL	y
Mercury	Metal	µg/L	2.0	Federal MCL	y
Molybdenum	Metal	µg/L	80	Groundwater Method B	
Nickel	Metal	µg/L	100	WAC 246-290	

Table 1-2. List of Target Constituents and Action Levels for the 200-UP-1 Groundwater OU

Analyte Name	Analyte Class	Unit	Action Level	Action Level Basis	RI/FS COC?
Potassium	Metal	–	–	–	
Selenium	Metal	µg/L	50	Federal MCL	
Silicon	Metal	–	–	–	
Silver	Metal	µg/L	80	Groundwater Method B	
Sodium	Metal	–	–	–	
Strontium	Metal	µg/L	9,600	Groundwater Method B	
Thallium	Metal	µg/L	1.1	Groundwater Method B	
Tin	Metal	µg/L	9,600	Groundwater Method B	
Uranium	Metal	µg/L	30	Federal MCL	y
Vanadium	Metal	µg/L	112	Groundwater Method B	y
Zinc	Metal	µg/L	4,800	Groundwater Method B	
Oil and grease	Oil/Grease	–	–	–	
Dinoseb(2-secButyl-4,6-dinitrophenol)	PEST	µg/L	7.0	Federal MCL	
Antimony-125	RAD	pCi/L	300	Federal MCL	
Beryllium-7	RAD	–	–	–	
Carbon-14	RAD	pCi/L	2,000	Federal MCL	y
Cesium-134	RAD	pCi/L	80	Federal MCL	
Cesium-137	RAD	pCi/L	200	Federal MCL	y
Cobalt-60	RAD	pCi/L	100	Federal MCL	y
Europium-152	RAD	pCi/L	200	Federal MCL	
Europium-154	RAD	pCi/L	60	Federal MCL	

Table 1-2. List of Target Constituents and Action Levels for the 200-UP-1 Groundwater OU

Analyte Name	Analyte Class	Unit	Action Level	Action Level Basis	RI/FS COC?
Europium-155	RAD	pCi/L	600	Federal MCL	
Gross alpha	RAD	pCi/L	15	Federal MCL	
Gross beta	RAD	–	–	–	
Iodine-129	RAD	pCi/L	1.0	Federal MCL	y
Neptunium-237	RAD	pCi/L	15	Federal MCL	y
Potassium-40	RAD	–	–	–	
Protactinium-231	RAD	pCi/L	15	Federal MCL	y
Radium-226	RAD	pCi/L	5.0	Federal MCL	
Ruthenium-106	RAD	pCi/L	30	Federal MCL	
Selenium-79	RAD	–	–	–	y
Strontium-90	RAD	pCi/L	8.0	Federal MCL	y
Technetium-99	RAD	pCi/L	900	Federal MCL	y
Total alpha energy emitted from Radium	RAD	–	–	–	
Tritium	RAD	pCi/L	20,000	Federal MCL	y
Uranium-234	RAD	–	–	–	y
Uranium-235	RAD	–	–	–	y
Uranium-238	RAD	–	–	–	y
1,2,4-Trichlorobenzene	SVOC	µg/L	70	Federal MCL	
1,4-Dichlorobenzene	SVOC	µg/L	1.8	Groundwater Method B	
1-Methyl-2-pyrrolidinone	SVOC	–	–	–	
2,3,4,6-Tetrachlorophenol	SVOC	µg/L	480	Groundwater Method B	

Table 1-2. List of Target Constituents and Action Levels for the 200-UP-1 Groundwater OU

Analyte Name	Analyte Class	Unit	Action Level	Action Level Basis	RI/FS COC?
2,4,5-Trichlorophenol	SVOC	µg/L	800	Groundwater Method B	
2,4,6-Trichlorophenol	SVOC	µg/L	4.0	Groundwater Method B	
2,4-Dichlorophenol	SVOC	µg/L	48	Groundwater Method B	
2,4-Dimethylphenol	SVOC	µg/L	320	Groundwater Method B	
2,4-Dinitrophenol	SVOC	µg/L	32	Groundwater Method B	
2,4-Dinitrotoluene	SVOC	µg/L	32	Groundwater Method B	
2,6-Dichlorophenol	SVOC	–	–	–	
2,6-Dinitrotoluene	SVOC	µg/L	16	Groundwater Method B	
2-Butoxyethanol	SVOC	µg/L	4,000	Groundwater Method B	
2-Chloronaphthalene	SVOC	µg/L	1,280	Groundwater Method B	
2-Chlorophenol	SVOC	µg/L	40	Groundwater Method B	
2-Methylnaphthalene	SVOC	µg/L	32	Groundwater Method B	
2-Methylphenol (cresol, o-)	SVOC	µg/L	400	Groundwater Method B	y
2-Nitroaniline	SVOC	µg/L	24	Groundwater Method B	
2-Nitrophenol	SVOC	–	–	–	
3,3'-Dichlorobenzidine	SVOC	µg/L	0.19	Groundwater Method B	
3,5-Di-tert-butyl-4-hydroxybenzaldehyde	SVOC	–	–	–	
3+4 Methylphenol (cresol, m+p)	SVOC	–	–	–	y
3-Nitroaniline	SVOC	µg/L	2.1	Groundwater Method B	
4,6-Dinitro-2-methylphenol	SVOC	µg/L	1.6	Groundwater Method B	
4-Bromophenylphenyl ether	SVOC	–	–	–	

Table 1-2. List of Target Constituents and Action Levels for the 200-UP-1 Groundwater OU

Analyte Name	Analyte Class	Unit	Action Level	Action Level Basis	RI/FS COC?
4-Chloro-3-methylphenol	SVOC	µg/L	800	Groundwater Method B	
4-Chloroaniline	SVOC	µg/L	64	Groundwater Method B	
4-Chlorophenylphenyl ether	SVOC	–	–	–	
4-Methylphenol (cresol, p-)	SVOC	µg/L	40	Groundwater Method B	
4-Nitroaniline	SVOC	µg/L	2.1	Groundwater Method B	
4-Nitrophenol	SVOC	µg/L	128	Groundwater Method B	
Acenaphthene	SVOC	µg/L	960	Groundwater Method B	
Acenaphthylene	SVOC	µg/L	960	Groundwater Method B	
Anthracene	SVOC	µg/L	2,400	Groundwater Method B	
Benzo(a)anthracene	SVOC	µg/L	0.12	Groundwater Method B	
Benzo(a)pyrene	SVOC	µg/L	0.012	Groundwater Method B	
Benzo(b)fluoranthene	SVOC	µg/L	0.12	Groundwater Method B	
Benzo(ghi)perylene	SVOC	µg/L	480	Groundwater Method B	
Benzo(k)fluoranthene	SVOC	µg/L	0.88	Groundwater Method B	
Benzothiazole	SVOC	–	–	–	
Bis(2-chloro-1-methylethyl)ether	SVOC	µg/L	1.3	Groundwater Method B	
Bis(2-Chloroethoxy)methane	SVOC	µg/L	0.040	Groundwater Method B	
Bis(2-chloroethyl) ether	SVOC	µg/L	0.040	Groundwater Method B	
Bis(2-ethylhexyl) phthalate	SVOC	µg/L	6.0	Federal MCL	
Butylbenzylphthalate	SVOC	µg/L	3,200	Groundwater Method B	
Carbazole	SVOC	µg/L	4.4	Groundwater Method B	

Table 1-2. List of Target Constituents and Action Levels for the 200-UP-1 Groundwater OU

Analyte Name	Analyte Class	Unit	Action Level	Action Level Basis	RI/FS COC?
Chrysene	SVOC	µg/L	8.8	Groundwater Method B	
Dibenz[a,h]anthracene	SVOC	µg/L	0.88	Groundwater Method B	
Dibenzofuran	SVOC	µg/L	32	Groundwater Method B	
Diethylphthalate	SVOC	µg/L	12,800	Groundwater Method B	
Dimethyl phthalate	SVOC	µg/L	16,000	Groundwater Method B	
Di-n-butylphthalate	SVOC	µg/L	1,600	Groundwater Method B	
Di-n-octylphthalate	SVOC	µg/L	320	Groundwater Method B	
Fluoranthene	SVOC	µg/L	640	Groundwater Method B	
Fluorene	SVOC	µg/L	640	Groundwater Method B	
Hexachlorobenzene	SVOC	µg/L	0.055	Groundwater Method B	
Hexachlorobutadiene	SVOC	µg/L	0.56	Groundwater Method B	
Hexachlorocyclopentadiene	SVOC	µg/L	50	Federal MCL	
Hexachloroethane	SVOC	µg/L	3.1	Groundwater Method B	
Indeno(1,2,3-cd)pyrene	SVOC	µg/L	0.12	Groundwater Method B	
Naphthalene	SVOC	µg/L	160	Groundwater Method B	
Nitrobenzene	SVOC	µg/L	16	Groundwater Method B	
n-Nitrosodi-n-dipropylamine	SVOC	µg/L	0.013	Groundwater Method B	
n-Nitrosodiphenylamine	SVOC	µg/L	18	Groundwater Method B	
Pentachlorophenol	SVOC	µg/L	0.73	Groundwater Method B	
Phenanthrene	SVOC	µg/L	2,400	Groundwater Method B	
Phenol	SVOC	µg/L	2,400	Groundwater Method B	y

Table 1-2. List of Target Constituents and Action Levels for the 200-UP-1 Groundwater OU

Analyte Name	Analyte Class	Unit	Action Level	Action Level Basis	RI/FS COC?
Phenols	SVOC	–	–	–	y
Pyrene	SVOC	µg/L	480	Groundwater Method B	
Total cresols[a]	SVOC	–	–	–	y
Total petroleum hydrocarbons—kerosene range[b]	SVOC	µg/L	500	Groundwater Method A	y
Tributyl phosphate	SVOC	µg/L	16	Groundwater Method B	
Tris-2-chloroethyl phosphate	SVOC	–	–	–	
Total petroleum hydrocarbons—diesel range[b]	TPH	µg/L	500	Groundwater Method B	y
Total petroleum hydrocarbons—gasoline range	TPH	µg/L	1,000	Groundwater Method B	
(m+p)-Xylene	VOC	µg/L	1,600	Groundwater Method B	
1,1,1,2-Tetrachloroethane	VOC	µg/L	1.7	Groundwater Method B	
1,1,1-Trichloroethane	VOC	µg/L	200	Federal MCL	y
1,1,2,2-Tetrachloroethane	VOC	µg/L	0.22	Groundwater Method B	
1,1,2-Trichloroethane	VOC	µg/L	0.77	Groundwater Method B	
1,1-Dichloroethane	VOC	µg/L	800	Groundwater Method B	
1,1-Dichloroethene	VOC	µg/L	0.073	Groundwater Method B	y
1,2,3-Trichloropropane	VOC	µg/L	0.0063	Groundwater Method B	
1,2-Dibromo-3-chloropropane	VOC	µg/L	0.031	Groundwater Method B	
1,2-Dibromoethane	VOC	µg/L	0.044	Groundwater Method B	
1,2-Dichlorobenzene	VOC	µg/L	600	Federal MCL	
1,2-Dichloroethane	VOC	µg/L	0.48	Groundwater Method B	y
1,2-Dichloroethene (Total)	VOC	µg/L	72	Groundwater Method B	

Table 1-2. List of Target Constituents and Action Levels for the 200-UP-1 Groundwater OU

Analyte Name	Analyte Class	Unit	Action Level	Action Level Basis	RI/FS COC?
1,2-Dichloropropane	VOC	µg/L	0.64	Groundwater Method B	
1,3-Dichlorobenzene	VOC	µg/L	240	Groundwater Method B	
1,4-Dioxane	VOC	µg/L	4.0	Groundwater Method B	y
1-Butanol	VOC	µg/L	800	Groundwater Method B	y
1-Propanol	VOC	–	–	–	
2-Butanone	VOC	µg/L	4,800	Groundwater Method B	y
2-Chloroethyl vinyl ether	VOC	–	–	–	
2-Ethyl-1-hexanol	VOC	–	–	–	
2-Hexanone	VOC	µg/L	640	Groundwater Method B	
2-Pentanone	VOC	–	–	–	
2-Pentanone, 4-Methyl	VOC	µg/L	640	Groundwater Method B	y
2-Picoline	VOC	–	–	–	
2-Propanol	VOC	–	–	–	
Acetone	VOC	µg/L	7,200	Groundwater Method B	y
Acetonitrile	VOC	–	–	–	
Acrolein	VOC	µg/L	4.0	Groundwater Method B	
Allyl chloride	VOC	µg/L	800	Groundwater Method B	
Benzene	VOC	µg/L	0.80	Groundwater Method B	
Bromodichloromethane	VOC	µg/L	0.71	Groundwater Method B	
Bromoform	VOC	µg/L	5.5	Groundwater Method B	
Bromomethane	VOC	µg/L	11	Groundwater Method B	

Table 1-2. List of Target Constituents and Action Levels for the 200-UP-1 Groundwater OU

Analyte Name	Analyte Class	Unit	Action Level	Action Level Basis	RI/FS COC?
Carbon disulfide	VOC	µg/L	800	Groundwater Method B	y
Carbon tetrachloride	VOC	µg/L	0.34	Groundwater Method B	y
Chlorobenzene	VOC	µg/L	100	Federal MCL	
Chloroethane	VOC	–	–	–	
Chloroform	VOC	µg/L	7.2	Groundwater Method B	y
Chloromethane	VOC	µg/L	3.4	Groundwater Method B	
Chloroprene	VOC	µg/L	320	Groundwater Method B	
cis-1,2-Dichloroethylene	VOC	µg/L	70	Federal MCL	
cis-1,3-Dichloropropene	VOC	µg/L	0.24	Groundwater Method B	
Cyclohexane	VOC	–	–	–	
Dibromochloromethane	VOC	µg/L	0.52	Groundwater Method B	
Dibromomethane	VOC	µg/L	80	Groundwater Method B	
Dichlorodifluoromethane	VOC	µg/L	1,600	Groundwater Method B	
Diethyl ether	VOC	µg/L	1,600	Groundwater Method B	
Ethanol	VOC	–	–	–	
Ethyl acetate	VOC	µg/L	72,000	Groundwater Method B	y
Ethyl cyanide	VOC	–	–	–	
Ethyl methacrylate	VOC	µg/L	720	Groundwater Method B	
Ethylbenzene	VOC	µg/L	700	Federal MCL	
Ethylene glycol	VOC	µg/L	16,000	Groundwater Method B	
Hexane	VOC	µg/L	480	Groundwater Method B	

Table 1-2. List of Target Constituents and Action Levels for the 200-UP-1 Groundwater OU

Analyte Name	Analyte Class	Unit	Action Level	Action Level Basis	RI/FS COC?
Iodomethane	VOC	–	–	–	
Isobutyl alcohol	VOC	µg/L	2,400	Groundwater Method B	
Isophorone	VOC	µg/L	46	Groundwater Method B	
Methacrylonitrile	VOC	µg/L	0.80	Groundwater Method B	
Methane	VOC	–	–	–	
Methanol	VOC	µg/L	4,000	Groundwater Method B	
Methyl methacrylate	VOC	µg/L	11,200	Groundwater Method B	
Methylene chloride	VOC	µg/L	5.0	Federal MCL	y
m-Xylene	VOC	µg/L	1,600	Groundwater Method B	
n-Butylbenzene	VOC	µg/L	320	Groundwater Method B	
o-Xylene	VOC	µg/L	1,600	Groundwater Method B	
Styrene	VOC	µg/L	1.5	Groundwater Method B	
Tetrachloroethene	VOC	µg/L	0.081	Groundwater Method B	y
Tetrahydrofuran	VOC	–	–	–	
Toluene	VOC	µg/L	640	Groundwater Method B	y
trans-1,2-Dichloroethylene	VOC	µg/L	100	Federal MCL	
trans-1,3-Dichloropropene	VOC	µg/L	0.24	Groundwater Method B	
trans-1,4-Dichloro-2-butene	VOC	–	–	–	
Trichloroethene	VOC	µg/L	0.49	Groundwater Method B	y
Trichloromonofluoromethane	VOC	µg/L	2,400	Groundwater Method B	
Vinyl acetate	VOC	µg/L	8,000	Groundwater Method B	

Table 1-2. List of Target Constituents and Action Levels for the 200-UP-1 Groundwater OU

Analyte Name	Analyte Class	Unit	Action Level	Action Level Basis	RI/FS COC?
Vinyl chloride	VOC	µg/L	0.029	Groundwater Method B	
Xylenes (total)	VOC	µg/L	1,600	Groundwater Method B	y
Alkalinity	Water Quality	–	–	–	
Ammonia	Water Quality	–	–	–	y
Bromide	Water Quality	–	–	–	
Dissolved oxygen	Water Quality	–	–	–	
Oxidation Reduction Potential	Water Quality	–	–	–	
pH Measurement	Water Quality	–	–	–	
Specific Conductance	Water Quality	–	–	–	
Temperature	Water Quality	–	–	–	
Total dissolved solids	Water Quality	–	–	–	
Total organic carbon	Water Quality	–	–	–	
Total organic halides	Water Quality	–	–	–	
Turbidity	Water Quality	–	–	–	
Ammonium ion	WetChem	–	–	–	y
Chloride	WetChem	µg/L	250,000	Federal MCL	
Cyanide	WetChem	µg/L	200	Federal MCL	y
Fluoride	WetChem	µg/L	960	Groundwater Method B	
Iron-II Ion	WetChem	–	–	–	
Nitrate (asn)[c]	WetChem	µg/L	10,000	Federal MCL	y
Nitrite (asn)[c]	WetChem	µg/L	1,000	Federal MCL	y

Table 1-2. List of Target Constituents and Action Levels for the 200-UP-1 Groundwater OU

Analyte Name	Analyte Class	Unit	Action Level	Action Level Basis	RI/FS COC?
Nitrogen in Nitrite and Nitrate[c]	WetChem	--	10,000	--	y
Phosphate	WetChem	--	--	--	
Phosphorus	WetChem	µg/L	0.32	Groundwater Method B	
Sulfate	WetChem	µg/L	250,000	Federal MCL	
Sulfide	WetChem	--	--	--	y
Total Inorganic Carbon	WetChem	--	--	--	

Notes:

Shaded rows indicate the constituent is a Final COC for the 200-UP-1 OU.

a. COC "Cresols" represented by "0-Cresol," "M-P Cresol," and "Total Cresols."

b. COC "Kerosene" represented by "TPH-diesel" and "TPH-kerosene."

c. COCs "Nitrate" and "Nitrite" are represented for "Nitrate as N," and "Nitrite as N" and "Nitrogen in Nitrite and Nitrate."

Dups	=	duplicates	TPH	=	total petroleum hydrocarbons
MCL	=	maximum contaminant level	VOA	=	volatile organic analysis
PEST	=	pesticide analysis	VOC	=	volatile organic compound
RAD	=	radiochemistry analysis	WetChem	=	wet chemistry analysis
SVOA	=	semivolatile organic analysis	y	=	yes
SVOC	=	semivolatile organic compound			

2 Purpose

The purpose of this DQA is to achieve the following goals:

- Evaluate the quality of the data collected to support the RI/FS activities for the 200-UP-1 Groundwater OU.
- Ensure that the data are of sufficient pedigree and representativeness to provide an appropriate description of site conditions.
- Specifically assess the usability of the data and for UP-1 RI/FS-related activities including risk assessment, and remedial alternative evaluation.

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3 Scope

The DQA completes the data life cycle (i.e., planning, implementation, and assessment) that was initiated by the 200-UP-1 RI/FS data quality objectives (DQO) process.

The DQA process involves the scientific evaluation of sampling and laboratory analysis, performed an accordance with a SAP to achieve stated DQOs. This DQA was applied to chemical and radionuclide analysis of UP-1 groundwater. Data were assessed against requirements identified 200-UP-1 RI/FS SAP. This DQA was performed in general accordance with concepts provided in the EPA guide (EPA/240/B-06/002) and the applicable internal DQA procedure. Activities described in this procedure fall into three general categories: verification, validation, and data usability assessment.

Data verification: is the process of evaluating the completeness, correctness, and conformance/compliance of a specific data set against the method, procedural, or contractual requirements. It includes confirmation that the specified sampling and analytical requirements have been completed. This includes verification that the number, type and location of all samples identified in the SAP have been collected and that all required measurements and analyses were performed.

Data validation: is an analyte- and sample-specific process that extends the evaluation of data beyond method, procedural, or contractual compliance (i.e., data verification) to determine the analytical quality of a specific data set. Data validation includes a determination, where possible, of the reasons for any failure to meet method, procedural, or contractual requirements, and an evaluation of the impact of such failure on the overall data set. It includes confirmation that the particular requirements for a specific intended use are fulfilled. This requires understanding of the applicable DQOs associated with the data collection. If there is no DQO summary report available, then, typically, all specific requirements are identified in the SAP. This includes review of sampling and laboratory reports to confirm that the appropriate methods, procedures, and contract requirements have been met. Typically, a specified percentage of the project data are subjected to third-party independent validation. The scope of this validation task is specified through the subcontract scope of work. If there is no independent validation report, then the necessary validation components must be included in the scope of the DQA and included in the DQA final report.

Usability assessment: is a determination of the adequacy of the data to support a particular environmental decision and is based upon the verification and validation results. The assessment relates to the adequacy of data to support a specific and defined data need. The usability step involves assessing whether the process execution and the resulting data meet project quality objectives.

A total of 103 UP-1 wells were included in this DQA. The well selection process is described in the RI/FS report. A list of the 103 wells is included as Appendix A. Five years of monitoring data, from October 1, 2003 through March 31, 2009, represent the DQA data domain. The data set includes data for 259 unique constituents and other analytical parameters, and over 68,000 individual results.

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4 Data Verification

This section describes data verification activities, including identification of project objectives and requirements and evaluating the complete implementation of the identified sampling design.

4.1 Project Objectives

The primary project objectives for the data discussed in this report are to support the UP-1 OU RI/FS by refining the preliminary site conceptual model, supporting an evaluation of risk, and guiding evaluation of remedial alternatives. To ensure that this purpose would be met, DQOs and associated quality control criteria were developed. The EPA, the Washington State Department of Ecology, and U.S. Department of Energy, Richland Operations Office (DOE-RL) personnel participated in several DQO process for the 200-UP-1 Groundwater OU and generally concurred with the results.

Development of the DQOs is discussed in the RI/FS Work Plan and DQO Summary Reports (DOE/RL-92-76). Although the DQA is based on EPA guidelines, actual decision tests for this project are specific to the 200-UP-1 Groundwater OU RI/FS requirements as described in the RI/FS final report.

This section of the DQA summarizes the DQOs and the resulting sample design.

4.1.1 Statement of Problem

The primary objectives of the DQO process for the 200-UP-1 Groundwater OU were to determine the environmental measurements necessary to refine the preliminary conceptual site model, support an evaluation of risk, and support evaluation of remedial alternatives.

The primary question to be resolved was whether the data from the groundwater wells are of sufficient quality to be used in the RI/FS decision-making process. Within this larger question are the additional concerns for quality control demonstrations, sufficiency of the data, quantity, and circumstances of outliers, and data trends. The data set that addresses this question consists of the analytical data for COPCs from 103 groundwater wells, as described earlier. The COPCs are provided in Table 1-1.

4.1.2 Decision Rules

A key output of the DQO process is a set of "decision rules." The decision rules define how the data will be applied to guide and justify key project decisions. This process identifies the COPCs and the associated action levels, decisions to be made, principal questions that must be answered to make those decisions, and the data and analytical requirements needed to answer the questions. Decision rules are generally "if…then" statements indicating what action will be taken when a prescribed condition is met. Decision rules incorporate the parameters of interest (e.g., COPCs), the scale of the decision (e.g., geographic area), the action level (e.g., COPC concentration), and the consequences that could result from the decision. The decision rules developed in the DQO processes for the 200-UP-1-OU are given in Table 4-1.

Table 4-1. Decision Rules from the 200-UP-1 Data Quality Objectives Process

DR No.	Population Parameter	Sample Statistic	Variable		Unit or Scale of Decision Making	Relationship	Action Level	AA No. 1	Relationship	AA No. 2
			Attribute	Unit of Measure						
1	If the concentration of all potential COPCs in GW (Table 1-9, 1-10)	As estimated by representative values from historical analytical and process data or through modeling source terms	Of the COPCs estimated in pCi/l or other appropriate units		In the GW within the geographic boundaries over next 0.5 years	Are reliably known	Based on professional judgment of DOE, the regulators, and contractor staff	Gather no more data	or	Gather additional data
2	If saturated zone model input parameters (Table 3-4)	As estimated by representative values	Of the modeling input parameters measured in appropriate units		For the soil and GW within the geographic unit over next 2 years	Are adequately known[b]	Based on professional judgment of DOE, regulators and contractor staff	Gather no more data	or	Gather additional data
3	If the horizontal and vertical distribution of COPCs in GW	As estimated by spatially defined analytical results in the GW	Of the COPCs in appropriate units		For the soil and groundwater within the geographic boundaries[a] over next 0-3 years	Are adequately known[b]	Based on professional judgment of DOE, regulators and contractor staff	Gather no more data	or	Gather additional data
4	If the data required to evaluate candidate remedial action alternatives	As defined by representative values	Of the COPC concentration and/or strata characteristics in the appropriate units		For a specific COPC plume within the geographic boundaries over the next 2 years	Are available for comparison to	The operational requirements of candidate remedial actions	Evaluate remedial action alternatives	or	Gather additional data
5	If the COPC risk level in GW over the next 1,000 years	As estimated by measurement or modeling and approved risk assessment procedures	Of the COPCs in pCi/L or µg/L		For the groundwater within the geographic boundaries[a] over next 2 years	Greater than (>)	The action levels in Table A1-10	Monitor and/or remediate	or	Conduct only long term monitoring

Table 4-1. Decision Rules from the 200-UP-1 Data Quality Objectives Process

DR No.	Population Parameter	Sample Statistic	Variable		Unit or Scale of Decision Making	Relationship	Action Level	AA No. 1	Relationship	AA No. 2
			Attribute	Unit of Measure						
6	If additional data required to choose a final remedial action alternative	As determined by representative values	Of the COPC concentration and/or strata characteristics in the appropriate units		For a specific COPC plume within the geographic boundaries over the next 3 years	Are not available for comparison to	The operational requirements of the final remedial action alternatives	Obtain additional data through treatability tests or other means as appropriate	or	Choose remedial action
7	If the total number of GW wells	As determined by the existing well network	In the 200-UP-1 OU		For a specific GW contaminant plume within the geographic boundaries over the next 3+ years	Equal to or greater than (≥)	Minimum required by PNNL's geostatistical model	Use existing wells to monitor remedial action	or	Install additional monitoring wells
8	If the post remedial action GW concentration	As estimated by analytical measurements	Of the COPCs in pCi/L or µg/L		For a specific groundwater contaminant plume within the geographic boundaries over the next 0-3 years	Greater than (>)	The established remedial action objectives	Continue to implement remedial alternative	or	Cease remediation

a. Geographic boundaries are defined as the groundwater within the 200-UP-1 OU.

b. These decisions require consideration of multiple inputs and professional judgment. There is no quantitative measurement level for a statistical comparison.

AA = alternative action

DOE = U.S. Department of Energy

DR = decision rule

GW = groundwater

PNNL = Pacific Northwest National Laboratory

4.1.3 Uncertainty Limits

Allowable tolerances for analytical and sampling error were developed during the DQO process. These address the potential site remediation requirements and goals and set preliminary action levels for the remediation project.

Table 4-2 summarizes the precision and accuracy criteria from the RI/FS Work Plan SAP.

Table 4-2. Summary of Performance Requirements

Analysis Type	Methods	Precision	Accuracy
Organics	SW846 8260, 8270, 8081	Procedurally defined	Procedurally defined
Inorganics	SW846 6010/6020, EPA 300	≤25%	75-125%
Radiochemistry	Radiochemistry methods	≤30%	70-130%

4.2 Implementation of the Sample Design

Some of the 200-UP-1 groundwater data being assessed by this DQA have been collected in accordance with the RI/FS Work Plan SAP, some by the Remedial Design/Remedial Action Work Plan SAP (DOE/RL-97-36), and some in accordance with individual TSD detection and/or assessment monitoring plans. As the data were originally collected for various purposes, it is not critical to evaluate the extent of implementation against the requirements of these documents. Rather the adequacy of the data set in terms of comprehensiveness must be evaluated by the individual data user, based on the unique requirements of the application (e.g., baseline risk assessment).

4.2.1 Comparability

The overall data set includes analyses from October 2003 to March 2009. Although data were collected in accordance with various different SAPs, all data were collected in accordance with HASQARD and the testing specified and used the SW 846 (EPA, 1997a), based methods along with current radiochemical methods. All these methods have been specified on a site-wide basis for work at Hanford for more than 10 years; therefore, the data should be compatible and comparable over time.

4.2.2 Field QC

Table 4-3 summarizes the applicable field quality control requirements found in the RI/FS SAP. The number of field quality control (QC) samples collected is consistent with, and in most cases, exceeds the number required to be collected, as described in the RI/FS Work Plan SAP. The number of field duplicates exceeds the 5 percent frequency, and the number of blanks exceeds the blanks frequency. Further discussion on the field QC is provided in Section 5.5.

Table 4-3. Field Quality Control Requirements

Sample Type	Frequency	Purpose
Duplicate	5% (1 sample in 20)	To check the precision of the laboratory analyses and field sampling
Equipment rinsate	One per 10 well trips	To check the effectiveness of the decontamination process, not applicable for dedicated or disposable equipment is used
Field transfer blank	One per day well trips when volatile organics are samples	To check for contamination during transport

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5 Data Validation

This section describes data validation activities, including formal validation, data-set review, development and evaluation of data trend charts, evaluation of field and laboratory QC data, and evaluation of annual groundwater monitoring reports.

5.1 Review Data Quality

The Groundwater Project generated 68,632 distinct analytical results from the 103 target 200-UP-1 OU wells from October 1, 2003 through March 31, 2009. As required by the RI/FS SAP, the analytical data were evaluated in accordance with EPA guidance (EPA/600/R-96/084) to ensure that the QA objectives of the project were achieved. This evaluation consisted of the following activities:

- Formal validation of 5 percent of a randomly selected segment of the data
- Supplemental data evaluation including the following tasks:
  - Review of the detection limits against regulatory action levels
  - Evaluation of data trend charts to identify trends, outliers, and anomalies
  - Evaluation of the annual groundwater monitoring reports
- Evaluation of the Field QC sample data
- Evaluation of the Laboratory QC data

The results of these activities are summarized in the following sections.

5.2 Formal Data Validation

A third-party independent data validation was performed by Analytical Quality Associates, Inc., of Albuquerque, NM. The RI/FS SAP identified the quantity and the level of data validation to be completed for 200-UP-1 analytical data, and contains the details for this requirement. Based on a per-method survey of the analytical results, at least five percent of the characterization data by method was selected for samples analyzed between October 1, 2006, and March 25, 2009, and validated to a Level C, per HNF-20433, and HNF-20434.

The majority of the data did not require qualification. However, qualifiers were applied to some of the analytical results, based on lack of traceability to standards, holding time exceedences, blank contamination, lack of QC data, QC data out-of-tolerance, or method blank contamination. Qualified results included results from volatiles, semivolatiles, metals, radchem (radionuclides), and anions methods.

Nearly all of the qualifiers were either "J" indicating the result should be considered an estimated rather than absolute quantitative value, or "UJ" indicating that the sample was not detected but the absolute detection limit should be considered an estimate.

The validation did result in some data rejections:

- One set of two radiochemistry samples were rejected due to lack of standard traceability. All the results were nondetects. A "UR" flag was applied.
- One volatiles sample was rejected entirely for exceeding 2X the applicable holding time. All reported results were nondetects. A "UR" flag was applied.
- Several anions samples were rejected due to exceeding 2X the applicable holding time. Nitrate and phosphate results were nondetect and were flagged "UR."

A detailed summary of the validation outcome follows.

5.2.1 Sample Holding Times

Sample results were flagged "J" if the holding time was exceeded but samples were analyzed prior to 2X the holding time. Samples were flagged "R" if the samples exceeded twice the applicable holding time. Nine samples were rejected due to severe holding time exceedances. Table 5-1 lists these rejected samples.

Table 5-1. UP-1 Data Rejected by Independent Validator

Well	Date	Parameter	Result	UNITS
699-36-66A	3/18/04	NO3	4.8 D	mg/l
		PO4	0.25U	mg/l
699-35-66A	3/23/05	PO4	0.25U	mg/l
	3/23/05	PO4	0.25U	mg/l
699-36-67	3/19/04	NO3	14.4D	mg/l
		PO4	0.25U	mg/l
699-36-67	3/23/05	PO4	0.25U	mg/l
	3/23/05	PO4	0.25U	mg/l
699-37-68	3/24/05	NO3	25.8	mg/l
		PO4	0.25U	mg/l
699-36-70A	3/18/04	NO3	16.8	mg/l
		PO4	0.25U	mg/l
299-W19-9	8/17/04	NO3	18.4D	mg/l
299-W15-35	9/25/07	Sr-90	U	pCi/L
299-W15-105	9/25/07	C-14	Various	pCi/L
		Np-237		
		Se-79		
		Sr-90		
		Be-7		
		Co-60		
		Cs-134		
		Cs-137		
		Eu-152		
		Eu-254		
		Eu-155		
		K-40		
		Ru-106		
		Sb-125		

5.2.2 Method Blanks

Positive detects exceeding five times the method detection limit (MDL) in method blanks affected the following constituents, which were flagged (B-flag) in HEIS. Table 5-2 lists the constituents and their frequency of positive blanks.

Table 5-2. Qualifiers Applied for Positive Blanks

Constituent	Number of positive blanks
K-40	1
Gross beta	7
Anions	1
Methylene chloride	10
Acetone	5
Toluene	2
Iron	1
Zinc	26
Mercury	1
Technetium-99	2
Lithium	1

All other method blank results were acceptable.

5.2.3 Field Rinsate Blanks or Equipment Blanks

No field rinsate or equipment blanks were validated.

5.2.4 Accuracy, Precision, Contamination, and Completeness

Thirty-one samples (volatiles, nitrate, nitrite, phosphate, and BOD) were rejected, wholly or in part, due to severe holding time exceedances. Two radiochemistry samples were rejected due to lack of traceability of the standards used to quantitate the result. Table 5-1 lists the rejected sample results.

There were no major deficiencies identified in the validated semivolatiles, pesticides, or inorganics data.

Many minor deficiencies were identified which resulted in the application of J or UJ flags. Overall completeness is estimated at 98 percent. All flags have been applied/corrected in HEIS.

Data users should pay attention to applied flags within HEIS and review the laboratory QC for sample results, which are specifically relied upon, particularly for those parameters for which some validated data were found to be rejectable. All of the biological oxygen demand (BOD) results validated were rejected. The presumption should be that all BOD results within the UP-1 data set are suspect and unusable unless specifically validated. While the remainder of the rejected data does not represent a large percentage of the validated results, if any single volatile, nitrate, nitrite, or phosphate result within the UP-1 data set is relied upon, particularly if it is a nondetect result, it should be validated.

5.2.4.1 Volatiles

A major deficiency included holding time for Trip Blank B1B3R5 leading to UR flag. There were other samples which also were found to exceed twice holding time (B19TT4, B19TT5, B19TT7, B19TT9, B19TX5, B19V12, and B1B3R5). Where a sample exceeded twice the holding time, but a positive value was reported, the qualifier was J and not R, indicating that, despite the excessive holding time, some amount of the constituent was positively identified and could be used if understood that this should be considered a minimum value.

Minor deficiencies leading to qualification (J or UJ) of samples results were due to:

- Holding time
- Positive blanks
- Minor accuracy
- Precision QC violations (high/low surrogate recovery, high/low laboratory control standard [LCS] recovery, poor LCS/LCSD precision, low matrix spike/matrix spike duplicate [MS/MSD] recovery, poor MS/MSD precision)
- Non-representation of QC data (lack of MS/MSD or MS/MSD that did not include specific analyte)

In some cases where there was a small positive analytical value reported and there was a similar value reported in the blank, the result was qualified with the qualifier U or UJ. Completeness was 99 percent due to the rejected results. All flags have been applied/corrected in HEIS.

5.2.4.2 Semivolatiles

No major deficiencies were reported.

Minor deficiencies leading to qualification (J or UJ) were for non-representation of QC data (lack of MS/MSD or MS/MSD that did not include specific analyte), precision (phenol), holding time (WTPH-diesel), or low surrogate recovery (WTPH-gasoline).

Completeness was 100 percent. All flags have been applied/corrected in HEIS.

5.2.4.3 Pesticides

No major or minor deficiencies were reported. Completeness was 100 percent. All flags have been applied/corrected in HEIS.

5.2.4.4 Inorganics

No major deficiencies were reported.

Minor deficiencies leading to qualification of samples (J or UJ) were for positive laboratory blanks (Iron, Mercury, Zinc, and Lithium) or lack of matrix-specific precision and accuracy data (Technetium-99). The laboratory incorrectly applied a U flag to two Technetium values (B1PM74, B1PM75).

Completeness was 100 percent. All flags have been applied/corrected in HEIS.

5.2.4.5 General Chemistry

Major deficiencies leading to the rejection of nitrate, nitrite, and/or phosphate results, (samples B18KR1, B18KP7, B18KP9, B1CD08, B1CCY4, B1CCY7, B1CD05, B1CD11, B19TW5, and B1CD08), and BOD results (samples B1R2J8, B1R2J9, B1R2K0, B1R2K1, B1R2K2, B1R2K3, B1R2K4, B1R2K5,

B1R2K6, B1R2K7, and B1R2K8), were reported due to holding times exceeding twice the applicable limit.

Minor deficiencies leading to qualification of sample results (J or UJ) were for holding time, positive laboratory blanks, poor accuracy/precision (low MS recovery, poor MS/MSD precision), or lack of precision/accuracy QC data (lack of MS/MSD, lack of laboratory duplicate).

Completeness was 0 percent for BOD, approximately 94 percent for anions, and 100 percent for all other methods. All flags have been applied/corrected in HEIS.

5.2.4.6 Radiochemistry

Major deficiencies leading to rejection of samples (B1P6B4, B1NHB9, also known as B1PYL1 and B1PYJ1, respectively), were applied due to lack of traceability of standards.

Minor deficiencies leading to qualification of sample results (J or UJ) were for holding time, positive laboratory blanks, missing laboratory blank, poor duplicate precision, lack of accuracy/precision QC data (lack of matrix spike, lack of LCS, lack of matrix-specific precision data), and a chemical recovery infraction (high tracer recovery).

Completion percentage for gamma spectroscopy, carbon-14, neptunium-237, selenium-79, and strontium-90 were between 80 and 96 percent. All other methods were 100 percent.

5.3 Supplementary Data Evaluation—Detection Limits

The data set consists of 68,362 individual analytical results. Of these, the vast majority were non-detects. Table 5-3 is a constituent-by-constituent listing of the numbers of results per constituent and the number and percent of nondetects. This table also shows the number and percent of the nondetect results where the reporting limit exceeded the regulatory action limit from Table 1-2.

Several constituents, including some RI/FS COPC constituents exhibit large percentages of nondetect values where the reporting limit exceeds the identified regulatory threshold. Positive detected results can be compared with the threshold to evaluate whether or not the constituent exceeds the limit. However, nondetect results are only useful for comparison to regulatory action levels if the reporting limit is below the applicable action limit.

Data for 13 constituents are all non-detects and all reporting limits are greater than the applicable regulatory action limit. These are 3,3 dichlorobenzidene, Benzo(a)anthracene, Benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, dibenz(a,h)anthracene, indeno(1,2,3-cd)pyrene, bis-(2-chloro-1-methylethyl) ether, bis2-chloroethyl ether, diethyl ether, hexachlorobenzene, hexachlorobutadiene, and methanol. None of these are RI/FS COCs but are constituents that were reported as method-based analytes.

Several RI/FS constituents displayed a large percentage of detection limits that exceed regulatory action limits. These data must be considered carefully when using the data set for regulatory decision making, particularly when using the data to demonstrate achievement of a remediation goal. These constituents include antimony, arsenic, iodine-129, 1,1-dichloroethene, 1,2-dichloroethane, 1,4-dioxane, carbon tetrachloride, tetrachloroethene, and trichloroethene.

Table 5-3. Detection Limit Comparisons

Analyte Name	Analyte Class	Number of Entries	Number of Nondetects	Percent Nondetect	Number of Nondetects Exceeding Action Limit[a]	Percent of Nondetects Exceeding Action Limit
Aluminum	Metal	486	234	48.1	28	12
Antimony	Metal	1,225	1,162	94.9	1,054	90.7
Arsenic	Metal	357	120	33.6	120	100
Barium	Metal	1,249	0	0	0	0
Beryllium	Metal	1,225	1,114	90.9	3	0.3
Bismuth	Metal	44	38	86.4	0[b]	0
Boron	Metal	60	11	18.3	0	0
Cadmium	Metal	1,229	1,198	97.5	4	0.3
Calcium	Metal	1,225	0	0	0	0
Chromium	Metal	1,266	446	35.2	0	0
Cobalt	Metal	1,225	1,077	87.9	244	22.7
Copper	Metal	1,225	1,075	87.8	0	0
Hexavalent Chromium	Metal	149	59	39.6	0	0
Iron	Metal	1,225	527	43	0	0
Lead	Metal	261	246	94.3	17	6.9
Lithium	Metal	169	53	31.4	0	0
Magnesium	Metal	1,225	0	0	0	0
Manganese	Metal	1,229	603	49.1	0	0
Mercury	Metal	183	166	90.7	0	0
Molybdenum	Metal	60	0	0	0	0

Table 5-3. Detection Limit Comparisons

Analyte Name	Analyte Class	Number of Entries	Number of Nondetects	Percent Nondetect	Number of Nondetects Exceeding Action Limit[a]	Percent of Nondetects Exceeding Action Limit
Nickel	Metal	1,225	888	72.5	0	0
Potassium	Metal	1,225	44	3.6	0[b]	0
Selenium	Metal	114	47	41.2	0	0
Silicon	Metal	60	0	0	0	0
Silver	Metal	1,225	1,123	91.7	0	0
Sodium	Metal	1,225	0	0	0	0
Strontium	Metal	1,182	0	0	0	0
Thallium	Metal	60	50	83.3	39	78
Tin	Metal	96	83	86.5	0	0
Uranium	Metal	956	50	5.2	0	0
Vanadium	Metal	1,249	26	2.1	0	0
Zinc	Metal	1,245	584	46.9	0	0
Oil and grease	Oil/Grease	1	0	0	NA	NA
4,4'-DDD (Dichlorodiphenyldichloroethane)	PEST	4	4	100	0	0
4,4'-DDE (Dichlorodiphenyldichloroethylene)	PEST	4	4	100	0	0
4,4'-DDT (Dichlorodiphenyltrichloroethane)	PEST	4	4	100	0	0
Aldrin	PEST	4	4	100	0	0
Alpha-BHC	PEST	4	4	100	0	0
beta-1,2,3,4,5,6-Hexachlorocyclohexane (beta-BHC)	PEST	4	4	100	0	0
Chlordane	PEST	4	4	100	0	0

Table 5-3. Detection Limit Comparisons

Analyte Name	Analyte Class	Number of Entries	Number of Nondetects	Percent Nondetect	Number of Nondetects Exceeding Action Limit[a]	Percent of Nondetects Exceeding Action Limit
Delta-BHC	PEST	4	4	100	0	0
Dieldrin	PEST	4	4	100	0	0
Dinoseb(2-secButyl-4,6-dinitrophenol)	PEST	55	53	96.4	0	0
Endosulfan I	PEST	4	4	100	0	0
Endosulfan II	PEST	4	4	100	0	0
Endosulfan sulfate	PEST	4	4	100	0	0
Endrin	PEST	4	4	100	0	0
Endrin aldehyde	PEST	4	4	100	0	0
Gamma-BHC (Lindane)	PEST	4	4	100	0	0
Heptachlor	PEST	4	2	50	0	0
Heptachlor epoxide	PEST	4	4	100	0	0
Methoxychlor	PEST	4	4	100	0	0
Toxaphene	PEST	4	4	100	0	0
Antimony-125	RAD	146	146	100	0	0
Beryllium-7	RAD	146	146	100	0[b]	0
Carbon-14	RAD	150	133	88.7	0	0
Cesium-134	RAD	146	146	100	0	0
Cesium-137	RAD	162	162	100	0	0
Cobalt-60	RAD	164	164	100	0	0
Europium-152	RAD	139	139	100	0	0

Table 5-3. Detection Limit Comparisons

Analyte Name	Analyte Class	Number of Entries	Number of Nondetects	Percent Nondetect	Number of Nondetects Exceeding Action Limit[a]	Percent of Nondetects Exceeding Action Limit
Europium-154	RAD	146	146	100	0	0
Europium-155	RAD	146	146	100	0	0
Gross alpha	RAD	181	132	72.9	3	2.3
Gross beta	RAD	170	3	1.8	0[b]	0
Iodine-129	RAD	559	455	81.4	240	52.7
Neptunium-237	RAD	97	92	94.8	0	0
Potassium-40	RAD	146	146	100	0[b]	0
Protactinium-231	RAD	80	79	98.8	1	1.3
Radium-226	RAD	5	5	100	0	0
Ruthenium-106	RAD	146	146	100	2	1.4
Selenium-79	RAD	137	112	81.8	0[b]	0
Strontium-90	RAD	179	160	89.4	0	0
Technetium-99	RAD	1,439	223	15.5	1	0.4
Total alpha energy emitted from Radium	RAD	48	48	100	0[b]	0
Tritium	RAD	628	146	23.2	0	0
Uranium-234	RAD	41	0	0	0	0
Uranium-235	RAD	41	34	82.9	0[b]	0
Uranium-238	RAD	152	5	3.3	0[b]	0
1,2,4-Trichlorobenzene	SVOA	56	56	100	0	0
1,4-Dichlorobenzene	SVOA	695	685	98.6	18	2.6

Table 5-3. Detection Limit Comparisons

Analyte Name	Analyte Class	Number of Entries	Number of Nondetects	Percent Nondetect	Number of Nondetects Exceeding Action Limit[a]	Percent of Nondetects Exceeding Action Limit
1-Methyl-2-pyrrolidinone	SVOA	6	0	0	0	0
2,3,4,6-Tetrachlorophenol	SVOA	55	49	89.1	0	0
2,4,5-Trichlorophenol	SVOA	72	70	97.2	0	0
2,4,6-Trichlorophenol	SVOA	72	70	97.2	7	10
2,4-Dichlorophenol	SVOA	152	150	98.7	0	0
2,4-Dimethylphenol	SVOA	72	70	97.2	0	0
2,4-Dinitrophenol	SVOA	72	70	97.2	0	0
2,4-Dinitrotoluene	SVOA	56	56	100	0	0
2,6-Dichlorophenol	SVOA	55	53	96.4	0[b]	0
2,6-Dinitrotoluene	SVOA	17	17	100	0	0
2-Butoxyethanol	SVOA	4	0	0	0	0
2-Chloronaphthalene	SVOA	16	16	100	0	0
2-Chlorophenol	SVOA	111	109	98.2	0	0
2-Ethylhexanoic acid	SVOA	1	0	0	NA	NA
2-Methylnaphthalene	SVOA	17	17	100	0	0
2-Methylphenol (cresol, o-)	SVOA	152	147	96.7	0	0
2-Nitroaniline	SVOA	17	17	100	0	0
2-Nitrophenol	SVOA	152	150	98.7	0[b]	0
3,3'-Dichlorobenzidine	SVOA	17	17	100	17	100
3,5-Di-tert-butyl-4-hydroxybenzaldehyde	SVOA	1	0	0	0	0

Table 5-3. Detection Limit Comparisons

Analyte Name	Analyte Class	Number of Entries	Number of Nondetects	Percent Nondetect	Number of Nondetects Exceeding Action Limit[a]	Percent of Nondetects Exceeding Action Limit
3+4 Methylphenol (cresol, m+p)	SVOA	133	131	98.5	0[b]	0
3-Nitroaniline	SVOA	17	17	100	16	94.1
4,6-Dinitro-2-methylphenol	SVOA	72	68	94.4	60	88.2
4-Bromophenylphenyl ether	SVOA	17	17	100	0[b]	0
4-Chloro-3-methylphenol	SVOA	111	109	98.2	0	0
4-Chloroaniline	SVOA	17	17	100	0	0
4-Chlorophenylphenyl ether	SVOA	17	17	100	0[b]	0
4-Methylphenol (cresol, p-)	SVOA	14	14	100	0	0
4-Nitroaniline	SVOA	17	17	100	16	94.1
4-Nitrophenol	SVOA	111	107	96.4	0	0
Acenaphthene	SVOA	56	56	100	0	0
Acenaphthylene	SVOA	17	17	100	0	0
Anthracene	SVOA	17	17	100	0	0
Benzo(a)anthracene	SVOA	17	17	100	17	100
Benzo(a)pyrene	SVOA	17	17	100	17	100
Benzo(b)fluoranthene	SVOA	17	17	100	17	100
Benzo(ghi)perylene	SVOA	17	17	100	0	0
Benzo(k)fluoranthene	SVOA	17	17	100	17	100
Benzothiazole	SVOA	81	81	100	0[b]	0
Bis(2-chloro-1-methylethyl)ether	SVOA	17	17	100	16	94.1

Table 5-3. Detection Limit Comparisons

Analyte Name	Analyte Class	Number of Entries	Number of Nondetects	Percent Nondetect	Number of Nondetects Exceeding Action Limit[a]	Percent of Nondetects Exceeding Action Limit
Bis(2-Chloroethoxy)methane	SVOA	17	17	100	17	100
Bis(2-chloroethyl) ether	SVOA	17	17	100	17	100
Bis(2-ethylhexyl) phthalate	SVOA	97	89	91.8	0	0
Bisphenol A	SVOA	1	0	0	NA	NA
Butylbenzylphthalate	SVOA	17	17	100	0	0
Carbazole	SVOA	17	17	100	0	0
Chrysene	SVOA	17	17	100	0	0
Dibenz[a,h]anthracene	SVOA	17	17	100	17	100
Dibenzofuran	SVOA	17	17	100	0	0
Diethylphthalate	SVOA	17	17	100	0	0
Dimethyl phthalate	SVOA	17	16	94.1	0	0
Di-n-butylphthalate	SVOA	17	17	100	0	0
Di-n-octylphthalate	SVOA	17	17	100	0	0
Ethyl 4-ethoxybenzoate	SVOA	1	0	0	NA	NA
Fluoranthene	SVOA	17	17	100	0	0
Fluorene	SVOA	17	17	100	0	0
Hexachlorobenzene	SVOA	17	17	100	17	100
Hexachlorobutadiene	SVOA	17	17	100	17	100
Hexachlorocyclopentadiene	SVOA	17	17	100	0	0
Hexachloroethane	SVOA	17	17	100	16	94.1

Table 5-3. Detection Limit Comparisons

Analyte Name	Analyte Class	Number of Entries	Number of Nondetects	Percent Nondetect	Number of Nondetects Exceeding Action Limit[a]	Percent of Nondetects Exceeding Action Limit
Indeno(1,2,3-cd)pyrene	SVOA	17	17	100	17	100
Naphthalene	SVOA	97	97	100	0	0
Nitrobenzene	SVOA	17	17	100	0	0
n-Nitrosodi-n-dipropylamine	SVOA	56	56	100	56	100
n-Nitrosodiphenylamine	SVOA	17	17	100	0	0
Pentachlorophenol	SVOA	152	150	98.7	126	84
Phenanthrene	SVOA	17	17	100	0	0
Phenol	SVOA	152	143	94.1	0	0
Phenols	SVOA	66	59	89.4	0[b]	0
Pyrene	SVOA	56	56	100	0	0
Total cresols	SVOA	48	48	100	0[b]	0
Total petroleum hydrocarbons—kerosene range	SVOA	90	90	100	0	0
Tributyl phosphate	SVOA	81	80	98.8	0	0
Tricosane	SVOA	1	0	0	NA	NA
Tris-2-chloroethyl phosphate	SVOA	81	81	100	0[b]	0
Total petroleum hydrocarbons—diesel range	TPH	91	91	100	0	0
Total petroleum hydrocarbons—gasoline range	TPH	78	76	97.4	0	0
(m+p)-Xylene	VOA	2	2	100	0	0
1,1,1,2-Tetrachloroethane	VOA	130	130	100	0	0
1,1,1-Trichloroethane	VOA	761	751	98.7	0	0

Table 5-3. Detection Limit Comparisons

Analyte Name	Analyte Class	Number of Entries	Number of Nondetects	Percent Nondetect	Number of Nondetects Exceeding Action Limit[a]	Percent of Nondetects Exceeding Action Limit
1,1,2,2-Tetrachloroethane	VOA	227	226	99.6	147	65
1,1,2-Trichloroethane	VOA	761	757	99.5	354	46.8
1,1-Dichloroethane	VOA	761	744	97.8	0	0
1,1-Dichloroethene	VOA	771	756	98.1	581	76.9
1,2,3-Trichloropropane	VOA	130	130	100	130	100
1,2-Dibromo-3-chloropropane	VOA	130	130	100	130	100
1,2-Dibromoethane	VOA	130	130	100	130	100
1,2-Dichlorobenzene	VOA	19	19	100	0	0
1,2-Dichloroethane	VOA	761	745	97.9	357	47.9
1,2-Dichloroethene (Total)	VOA	226	225	99.6	0	0
1,2-Dichloropropane	VOA	227	222	97.8	98	44.1
1,3-Dichlorobenzene	VOA	19	19	100	0	0
1,4-Dioxane	VOA	403	400	99.3	251	62.8
1-Butanol	VOA	617	611	99	0	0
1-Propanol	VOA	2	2	100	0[b]	0
2-Butanone	VOA	816	795	97.4	0	0
2-Chloroethyl vinyl ether	VOA	1	1	100	0[b]	0
2-Ethyl-1-hexanol	VOA	4	0	0	0	0
2-Hexanone	VOA	227	222	97.8	0	0
2-Pentanone	VOA	5	5	100	0[b]	0

Table 5-3. Detection Limit Comparisons

Analyte Name	Analyte Class	Number of Entries	Number of Nondetects	Percent Nondetect	Number of Nondetects Exceeding Action Limit[a]	Percent of Nondetects Exceeding Action Limit
2-Pentanone, 4-Methyl	VOA	761	744	97.8	0	0
2-Picoline	VOA	81	81	100	0[b]	0
2-Propanol	VOA	1	0	0	0	0
Acetone	VOA	819	710	86.7	0	0
Acetonitrile	VOA	135	133	98.5	0[b]	0
Acrolein	VOA	130	127	97.7	3	2.4
Allyl chloride	VOA	130	129	99.2	0	0
Benzene	VOA	840	817	97.3	432	52.9
Bromodichloromethane	VOA	227	195	85.9	98	50.3
Bromoform	VOA	227	225	99.1	0	0
Bromomethane	VOA	226	211	93.4	0	0
Carbon disulfide	VOA	761	709	93.2	0	0
Carbon tetrachloride	VOA	844	78	9.2	51	65.4
Chlorobenzene	VOA	564	560	99.3	0	0
Chloroethane	VOA	227	224	98.7	0[b]	0
Chloroform	VOA	830	123	14.8	0	0
Chloromethane	VOA	230	200	87	53	26.5
Chloroprene	VOA	130	128	98.5	0	0
cis-1,2-Dichloroethylene	VOA	712	694	97.5	0	0
cis-1,3-Dichloropropene	VOA	227	220	96.9	99	45

Table 5-3. Detection Limit Comparisons

Analyte Name	Analyte Class	Number of Entries	Number of Nondetects	Percent Nondetect	Number of Nondetects Exceeding Action Limit[a]	Percent of Nondetects Exceeding Action Limit
Cyclohexane	VOA	5	5	100	0[b]	0
Dibromochloromethane	VOA	227	226	99.6	99	43.8
Dibromomethane	VOA	130	130	100	0	0
Dichlorodifluoromethane	VOA	130	120	92.3	0	0
Diethyl ether	VOA	2	2	100	2	100
Ethanol	VOA	2	2	100	0[b]	0
Ethyl acetate	VOA	88	88	100	0	0
Ethyl cyanide	VOA	664	661	99.5	0[b]	0
Ethyl methacrylate	VOA	130	128	98.5	0	0
Ethylbenzene	VOA	705	701	99.4	0	0
Ethylene glycol	VOA	2	2	100	0	0
Hexane	VOA	7	7	100	0	0
Iodomethane	VOA	130	122	93.8	0[b]	0
Isobutyl alcohol	VOA	130	127	97.7	0	0
Isophorone	VOA	17	17	100	0	0
Methacrylonitrile	VOA	130	129	99.2	53	41.1
Methane	VOA	16	9	56.3	0[b]	0
Methanol	VOA	2	2	100	2	100
Methyl methacrylate	VOA	130	129	99.2	0	0
Methylene chloride	VOA	817	706	86.4	1	0.1

Table 5-3. Detection Limit Comparisons

Analyte Name	Analyte Class	Number of Entries	Number of Nondetects	Percent Nondetect	Number of Nondetects Exceeding Action Limit[a]	Percent of Nondetects Exceeding Action Limit
m-Xylene	VOA	5	5	100	0	0
n-Butylbenzene	VOA	6	6	100	0	0
o-Xylene	VOA	7	7	100	0	0
Styrene	VOA	227	222	97.8	53	23.9
Tetrachloroethene	VOA	821	723	88.1	685	94.7
Tetrahydrofuran	VOA	605	596	98.5	0[b]	0
Toluene	VOA	840	809	96.3	0	0
trans-1,2-Dichloroethylene	VOA	712	693	97.3	0	0
trans-1,3-Dichloropropene	VOA	227	225	99.1	100	44.4
trans-1,4-Dichloro-2-butene	VOA	130	125	96.2	0[b]	0
Trichloroethene	VOA	847	461	54.4	326	70.7
Trichloromonofluoromethane	VOA	186	186	100	0	0
Vinyl acetate	VOA	130	123	94.6	0	0
Vinyl chloride	VOA	761	756	99.3	756	100
Xylenes (total)	VOA	761	757	99.5	0	0
Alkalinity	Water Quality	738	1	0.1	0[b]	0
Ammonia	Water Quality	33	22	66.7	0[b]	0
Bromide	Water Quality	174	121	69.5	0[b]	0
Hardness	Water Quality	30	0	0	0	0
pH Measurement	Water Quality	60	0	0	0	0

Table 5-3. Detection Limit Comparisons

Analyte Name	Analyte Class	Number of Entries	Number of Nondetects	Percent Nondetect	Number of Nondetects Exceeding Action Limit[a]	Percent of Nondetects Exceeding Action Limit
Specific Conductance	Water Quality	15	0	0	0	0
Temperature	Water Quality	10	0	0	0	0
Total dissolved solids	Water Quality	65	0	0	0	0
Total organic carbon	Water Quality	281	129	45.9	0[b]	0
Total organic halides	Water Quality	304	92	30.3	0[b]	0
Total suspended solids	Water Quality	3	3	100	0	0
Turbidity	Water Quality	10	0	0	0	0
Ammonium ion	WetChem	64	31	48.4	0[b]	0
Biochemical Oxygen Demand	WetChem	30	26	86.7	NA	NA
Chloride	WetChem	1252	0	0	0	0
Cyanide	WetChem	95	84	88.4	0	0
Fluoride	WetChem	1239	6	0.5	0	0
Nitrate	WetChem	1385	4	0.3	0	0
Nitrite	WetChem	1252	568	45.4	0	0
Phosphate	WetChem	75	67	89.3	0[b]	0
Phosphorus	WetChem	55	27	49.1	27	100
Sulfate	WetChem	1252	0	0	0	0
Sulfide	WetChem	85	81	95.3	0[b]	0
Total Inorganic Carbon	WetChem	16	0	0	0	0

Table 5-3. Detection Limit Comparisons

Analyte Name	Analyte Class	Number of Entries	Number of Nondetects	Percent Nondetect	Number of Nondetects Exceeding Action Limit[a]	Percent of Nondetects Exceeding Action Limit

Notes:

Shaded entries are RI/FS COCs.

a. Comparison made using larger value of reporting limit, minimum detectable activity, or result for nondetects where a U flag was placed on a value that exceeded the reporting limit.

b. No-Action level listed in Table 2, 200-UP-1 OU Summary of Federal and State Water Quality Criteria and Action Levels.

IDL = instrument detection limit

NA = not applicable, analyte not listed in Table 1-2, List of Target Constituents and Action levels for the 200-UP-1 Operable Unit

PEST = pesticide analysis

RAD = radiochemistry analysis

RPD = relative percent difference

SVOA = semivolatile organic analysis

TPH = total petroleum hydrocarbons

VOA = volatile organic analysis

WetChem = wet chemistry analysis

5.4 Supplementary Data Evaluation—Groundwater Reports Review

The Groundwater Project collects samples annually to address characterization and monitoring requirements, as needed, to address the needs for the various compliance programs at the Hanford Site (i.e., RCRA, CERCLA, AEA). The results from the analyses of these samples are evaluated and compiled into an annual Hanford Site Groundwater Monitoring Report. The report includes an appendix that provides an overview of the QA/QC information generated to support these programs.

Review of the 2008 Annual Report provides some information regarding the overall quality and performance of the groundwater sampling and analytical activities. As the 200-UP-1 data were gathered using the same planning, procedures and laboratories as the Hanford Site Groundwater program at large, it is useful to compare the performance metrics of the 200-UP-1 data to the overall Hanford site Groundwater data set.

Table 5-4 summarizes the QA/QC results for groundwater monitoring over the time period considered in this DQA report along with the analogous results for the 200-UP-1 data set. Results are not provided for all QA/QC parameters for all years due to the variations in how the data are compiled in each annual report. Citations are provided for each annual report for readers who wish to review the details for a specific year.

As seen in Table 5-4, the 200-UP-1 data set was equivalent or better than the site-wide data set in terms of field and laboratory QC performance.

Table 5-4. QA/QC Results for Groundwater Monitoring (January 1, 2004-December 31, 2008)

Reporting Year	FY 2004	FY 2005	FY 2006	FY 2007	FY 2008	
Groundwater Monitoring Report Citation	**PNNL-15070**	**PNNL-15670**	**PNNL-16346**	**DOE/RL-2008-01**	**DOE/RL-2008-66**	**200-UP-1 Data**
Results of National Performance Evaluation Studies—Percent of acceptable results				95%	98%	N/A
Field Blanks—Acceptable results	97%	97%	96%	97%	96%	96%
Field Duplicate—Acceptable results	99%	98%	98%	98%	97%	98%
Split sample—Acceptable results					89%	98%
Holding Times Met—Percent of non-radiological samples	95%	97%	95%	96%	99%	Not calculated
Laboratory Quality Control Results within acceptance limits (combined)					97%	98%
Method blanks					98%	98%
Laboratory control samples					99%	99%
Matrix spike/matrix duplicates					96%	98%
Surrogates					99%	98%
Request for data review—Analytical results		919	611	1,470	1,677	N/A

FY = fiscal year
N/A = not available

5.4.1.1 Hanford Site Groundwater QC and QA

The Hanford groundwater program includes several QA elements that serve to verify the overall quality of the sampling and analysis activities and to highlight potential problems for corrective action, including the following:

- **Proficiency Testing Program Studies** involving the provision of blind known standards to all Hanford contract laboratories. These programs are administered by independent third-party organizations and the results are available to data users on the Hanford site.
- **Double-Blind Studies** involve providing known standards to the laboratory disguised as samples. These provide a measure of both inter- and intra-laboratory precision and accuracy. The studies also help groundwater staff troubleshoot analytical problems identified through data reviews and QC evaluations.
- **Laboratory Audits** are performed either independently from the Hanford Site or as part of a DOE Contract Analytical Program (CAP) national audit team.
- **Lab QA/QC evaluation** is performed on the entire Hanford data set annually and reported as part of the annual groundwater reports.

Review of the results of these evaluations did not identify any issues that could negatively affect the 200-UP-1 data that had not already been evaluated and resolved, either with qualification flags or re-run samples.

5.4.1.2 Analytical Troubleshooting

If the results of any of the data QC or QA reviews indicate a potential anomaly in the results, Requests for Data Review (RDR) are initiated by project scientists. During evaluations of RDR submittals, trends may be observed that warrant further investigation by the groundwater support staff. In 2008, approximately 2 percent of analytical RDRs were documented as having a problem. Roughly half of the issues occurred prior to receipt at the laboratories. The majority were due to missed hold times, samples received outside of temperature specifications, chain of custody issues, and incorrect sample preservation. RDR resolution includes appropriate qualification flags applied to the affected data within HEIS.

5.5 Field Quality Control

During the period of this assessment (October 1, 2003 through March 31, 2009) a total of 24,342 field QC results were generated, approximately 35 percent as many the total groundwater samples collected. These consisted of 3,963 field duplicate results, 951 field split results, and 19,422 blanks results, consisting of a combination of field transfer blanks, equipment rinsate blanks, full trip blanks, and trip blanks. Table 5-5 provides a breakdown of these results by analyte and field QC type.

Table 5-5. Summary of Field QC Sample Analyses

Analyte Name	Analyte Class	Field Dups.	Field Dups. Out	% Field Dups. Out	Splits	Splits Out	% Splits Out	Blanks	Positive Blanks	% Positive Blanks	RI/FS COC?
Aluminum	Metal	25		0.0	4		0.0	79	10	12.7	
Antimony	Metal	75		0.0	16		0.0	490		0.0	y
Arsenic	Metal	27		0.0	3		0.0	49		0.0	y
Barium	Metal	75		0.0	16		0.0	490		0.0	
Beryllium	Metal	75		0.0	16		0.0	490		0.0	
Bismuth	Metal										
Boron	Metal										
Cadmium	Metal	75		0.0	16		0.0	490		0.0	y
Calcium	Metal	75		0.0	16		0.0	490	150	30.6	
Chromium	Metal	75	4	5.3	16		0.0	491	10	2.0	y
Cobalt	Metal	75		0.0	16		0.0	490	8	1.6	y
Copper	Metal	75		0.0	16		0.0	490	9	1.8	
Hexavalent Chromium	Metal	14	1	7.1				29		0.0	y
Iron	Metal	75		0.0	16	4	25.0	490	8	1.6	y
Lead	Metal	17	12	70.6				84		0.0	y
Lithium	Metal	8		0.0				44		0.0	y
Magnesium	Metal	75		0.0	16		0.0	490	68	13.9	y

Table 5-5. Summary of Field QC Sample Analyses

Analyte Name	Analyte Class	Field Dups.	Field Dups. Out	% Field Dups. Out	Splits	Splits Out	% Splits Out	Blanks	Positive Blanks	% Positive Blanks	RI/FS COC?
Manganese	Metal	75	2	2.7	16		0.0	490	3	0.6	y
Mercury	Metal	15		0.0				84		0.0	y
Molybdenum	Metal										
Nickel	Metal	75	1	1.3	16		0.0	490		0.0	
Potassium	Metal	75		0.0	16		0.0	490	3	0.6	
Selenium	Metal										
Silicon	Metal										
Silver	Metal	75		0.0	16		0.0	484	18	3.7	
Sodium	Metal	75		0.0	16		0.0	490	75	15.3	
Strontium	Metal	75		0.0	16	2	12.5	490		0.0	
Thallium	Metal										
Tin	Metal										
Uranium	Metal	63	3	4.8	39		0.0	140	7	5.0	y
Vanadium	Metal	75	1	1.3	16		0.0	490	12	2.4	y
Zinc	Metal	75	2	2.7	16		0.0	490	33	6.7	
Oil and grease	Oil/Grease							1	1	100.0	
Dinoseb(2-secButyl-4,6-dinitrophenol)	PEST	10		0.0				18		0.0	

Table 5-5. Summary of Field QC Sample Analyses

Analyte Name	Analyte Class	Field Dups.	Field Dups. Out	% Field Dups. Out	Splits	Splits Out	% Splits Out	Blanks	Positive Blanks	% Positive Blanks	RI/FS COC?
Antimony-125	RAD	10		0.0				38		0.0	
Beryllium-7	RAD	10		0.0				38		0.0	
Carbon-14	RAD	6		0.0	1		0.0	17		0.0	y
Cesium-134	RAD	10		0.0				38		0.0	
Cesium-137	RAD	10		0.0				38		0.0	y
Cobalt-60	RAD	10		0.0				38		0.0	y
Europium-152	RAD	10		0.0				38		0.0	
Europium-154	RAD	10		0.0				38		0.0	
Europium-155	RAD	10		0.0				38		0.0	
Gross alpha	RAD	12		0.0	1		0.0	38		0.0	
Gross beta	RAD	11		0.0	1	1	100.0	33		0.0	
Iodine-129	RAD	39	1	2.6	7		0.0	121		0.0	y
Neptunium-237	RAD	6		0.0				16		0.0	y
Potassium-40	RAD	10		0.0				38	1	2.6	
Protactinium-231	RAD	5		0.0				10		0.0	y
Radium-226	RAD										
Ruthenium-106	RAD	10		0.0				38		0.0	

Table 5-5. Summary of Field QC Sample Analyses

Analyte Name	Analyte Class	Field Dups.	Field Dups. Out	% Field Dups. Out	Splits	Splits Out	% Splits Out	Blanks	Positive Blanks	% Positive Blanks	RI/FS COC?
Selenium-79	RAD	9		0.0				37		0.0	y
Strontium-90	RAD	15		0.0	3		0.0	6		0.0	y
Technetium-99	RAD	72	2	2.8	43		0.0	217	1	0.5	y
Total alpha energy emitted from Radium	RAD				1		0.0				
Tritium	RAD	42	1	2.4	3	1	33.3	129	9	7.0	y
Uranium-234	RAD	3	1	33.3				9		0.0	y
Uranium-235	RAD	3		0.0				9		0.0	y
Uranium-238	RAD	3	1	33.3				9		0.0	y
1,2,4-Trichlorobenzene	SVOC	2		0.0				16		0.0	
1,4-Dichlorobenzene	SVOC	6		0.0				65		0.0	
1-Methyl-2-pyrrolidinone	SVOC										
2,3,4,6-Tetrachlorophenol	SVOC	10		0.0				18		0.0	
2,4,5-Trichlorophenol	SVOC	10		0.0				8		0.0	
2,4,6-Trichlorophenol	SVOC	10		0.0				18		0.0	
2,4-Dichlorophenol	SVOC	16		0.0	7		0.0	39		0.0	
2,4-Dimethylphenol	SVOC	10		0.0				18		0.0	
2,4-Dinitrophenol	SVOC	10		0.0				18		0.0	

Table 5-5. Summary of Field QC Sample Analyses

Analyte Name	Analyte Class	Field Dups.	Field Dups. Out	% Field Dups. Out	Splits	Splits Out	% Splits Out	Blanks	Positive Blanks	% Positive Blanks	RI/FS COC?
2,4-Dinitrotoluene	SVOC	2		0.0				16		0.0	
2,6-Dichlorophenol	SVOC	10		0.0				15		0.0	
2,6-Dinitrotoluene	SVOC										
2-Butoxyethanol	SVOC										
2-Chloronaphthalene	SVOC										
2-Chlorophenol	SVOC	10		0.0	7		0.0	34		0.0	
2-Methylnaphthalene	SVOC										
2-Methylphenol (cresol, o-)	SVOC	16		0.0	7		0.0	41		0.0	y
2-Nitroaniline	SVOC										
2-Nitrophenol	SVOC	16		0.0	7		0.0				
3,3'-Dichlorobenzidine	SVOC										
3,5-Di-tert-butyl-4-hydroxybenzaldehyde	SVOC										
3+4 Methylphenol (cresol, m+p)	SVOC	16		0.0	7		0.0	40		0.0	y
3-Nitroaniline	SVOC										
4,6-Dinitro-2-methylphenol	SVOC	10		0.0				18		0.0	
4-Bromophenylphenyl ether	SVOC	12		0.0							
4-Chloro-3-methylphenol	SVOC				7		0.0	34		0.0	

Table 5-5. Summary of Field QC Sample Analyses

Analyte Name	Analyte Class	Field Dups.	Field Dups. Out	% Field Dups. Out	Splits	Splits Out	% Splits Out	Blanks	Positive Blanks	% Positive Blanks	RI/FS COC?
4-Chloroaniline	SVOC										
4-Chlorophenylphenyl ether	SVOC										
4-Methylphenol (cresol, p-)	SVOC	2		0.0				2		0.0	
4-Nitroaniline	SVOC										
4-Nitrophenol	SVOC	12		0.0	7		0.0	34		0.0	
Acenaphthene	SVOC	2		0.0				16		0.0	
Acenaphthylene	SVOC										
Anthracene	SVOC										
Benzo(a)anthracene	SVOC										
Benzo(a)pyrene	SVOC										
Benzo(b)fluoranthene	SVOC										
Benzo(ghi)perylene	SVOC										
Benzo(k)fluoranthene	SVOC							19		0.0	
Benzothiazole	SVOC	6		0.0							
Bis(2-chloro-1-methylethyl)ether	SVOC										
Bis(2-Chloroethoxy)methane	SVOC										
Bis(2-chloroethyl) ether	SVOC										

Table 5-5. Summary of Field QC Sample Analyses

Analyte Name	Analyte Class	Field Dups.	Field Dups. Out	% Field Dups. Out	Splits	Splits Out	% Splits Out	Blanks	Positive Blanks	% Positive Blanks	RI/FS COC?
Bis(2-ethylhexyl) phthalate	SVOC	6		0.0				19		0.0	
Butylbenzylphthalate	SVOC										
Carbazole	SVOC										
Chrysene	SVOC										
Dibenz[a,h]anthracene	SVOC										
Dibenzofuran	SVOC										
Diethylphthalate	SVOC										
Dimethyl phthalate	SVOC										
Di-n-butylphthalate	SVOC										
Di-n-octylphthalate	SVOC										
Fluoranthene	SVOC										
Fluorene	SVOC										
Hexachlorobenzene	SVOC										
Hexachlorobutadiene	SVOC										
Hexachlorocyclopentadiene	SVOC										
Hexachloroethane	SVOC										
Indeno(1,2,3-cd)pyrene	SVOC										

Table 5-5. Summary of Field QC Sample Analyses

Analyte Name	Analyte Class	Field Dups.	Field Dups. Out	% Field Dups. Out	Splits	Splits Out	% Splits Out	Blanks	Positive Blanks	% Positive Blanks	RI/FS COC?
Naphthalene	SVOC	6		0.0				19		0.0	
Nitrobenzene	SVOC										
n-Nitrosodi-n-dipropylamine	SVOC	2		0.0				16		0.0	
n-Nitrosodiphenylamine	SVOC										
Pentachlorophenol	SVOC	16		0.0	7		0.0	41		0.0	
Phenanthrene	SVOC										
Phenol	SVOC	16		0.0	7			41		0.0	y
Phenols	SVOC	4		0.0				12		0.0	y
Pyrene	SVOC	2		0.0				16		0.0	
Total cresols	SVOC	2		0.0				8		0.0	
Total petroleum hydrocarbons—kerosene range	SVOC	5		0.0				11		0.0	y
Tributyl phosphate	SVOC	6		0.0				19		0.0	
Tris-2-chloroethyl phosphate	SVOC	6		0.0				19		0.0	
Total petroleum hydrocarbons—diesel range	TPH	6		0.0				19		0.0	y
Total petroleum hydrocarbons—gasoline range	TPH	7		0.0				19		0.0	
(m+p)-Xylene	VOC										

Table 5-5. Summary of Field QC Sample Analyses

Analyte Name	Analyte Class	Field Dups.	Field Dups. Out	% Field Dups. Out	Splits	Splits Out	% Splits Out	Blanks	Positive Blanks	% Positive Blanks	RI/FS COC?
1,1,1,2-Tetrachloroethane	VOC	5		0.0				17		0.0	
1,1,1-Trichloroethane	VOC	49		0.0	13		0.0	260		0.0	y
1,1,2,2-Tetrachloroethane	VOC	5		0.0	1		0.0	17		0.0	
1,1,2-Trichloroethane	VOC	50		0.0	13		0.0	260		0.0	
1,1-Dichloroethane	VOC	49		0.0	13		0.0	260		0.0	
1,1-Dichloroethene	VOC	39		0.0	13		0.0	186		0.0	y
1,2,3-Trichloropropane	VOC	5		0.0				17		0.0	
1,2-Dibromo-3-chloropropane	VOC	5		0.0				17		0.0	
1,2-Dibromoethane	VOC	5		0.0				17		0.0	
1,2-Dichlorobenzene	VOC										
1,2-Dichloroethane	VOC	49		0.0	13		0.0	260		0.0	y
1,2-Dichloroethene (Total)	VOC	5		0.0				17		0.0	
1,2-Dichloropropane	VOC	5		0.0	1		0.0	17		0.0	
1,3-Dichlorobenzene	VOC	49		0.0	23		0.0	251		0.0	
1,4-Dioxane	VOC	26		0.0				160		0.0	y
1-Butanol	VOC	44		0.0	7		0.0	216		0.0	y
1-Propanol	VOC							11		0.0	

Table 5-5. Summary of Field QC Sample Analyses

Analyte Name	Analyte Class	Field Dups.	Field Dups. Out	% Field Dups. Out	Splits	Splits Out	% Splits Out	Blanks	Positive Blanks	% Positive Blanks	RI/FS COC?
2-Butanone	VOC	49		0.0	18		0.0	260		0.0	y
2-Chloroethyl vinyl ether	VOC										
2-Ethyl-1-hexanol	VOC										
2-Hexanone	VOC	5		0.0	1		0.0	17		0.0	
2-Pentanone	VOC										
2-Pentanone, 4-Methyl	VOC	49		0.0	13		0.0	260	1	0.4	y
2-Picoline	VOC	6		0.0				19		0.0	
2-Propanol	VOC										
Acetone	VOC	49	4	8.2	18		0.0	260	19	7.3	y
Acetonitrile	VOC	5		0.0				17		0.0	
Acrolein	VOC	5		0.0				17		0.0	
Allyl chloride	VOC	5		0.0				17		0.0	
Benzene	VOC	49		0.0	13		0.0	260		0.0	
Bromodichloromethane	VOC	5		0.0	1		0.0	17		0.0	
Bromoform	VOC	5		0.0	1		0.0	17		0.0	
Bromomethane	VOC	5		0.0	1		0.0	17		0.0	
Carbon disulfide	VOC	49	3	6.1	13		0.0	260		0.0	y

Table 5-5. Summary of Field QC Sample Analyses

Analyte Name	Analyte Class	Field Dups.	Field Dups. Out	% Field Dups. Out	Splits	Splits Out	% Splits Out	Blanks	Positive Blanks	% Positive Blanks	RI/FS COC?
Carbon tetrachloride	VOC	48	4	8.3	18	4	22.2	259	41	15.8	y
Chlorobenzene	VOC	25		0.0	5		0.0	124		0.0	
Chloroethane	VOC	5		0.0	1		0.0	17		0.0	
Chloroform	VOC	49	2	4.1	18	1	5.6	260	1	0.4	y
Chloromethane	VOC	5	1	20.0	1		0.0	17	1	5.9	
Chloroprene	VOC	5		0.0				17		0.0	
cis-1,2-Dichloroethylene	VOC	49		0.0	12		0.0	260		0.0	
cis-1,3-Dichloropropene	VOC	5		0.0	1		0.0	17		0.0	
Cyclohexane	VOC										
Dibromochloromethane	VOC	5		0.0	1		0.0	17		0.0	
Dibromomethane	VOC	5		0.0				17		0.0	
Dichlorodifluoromethane	VOC	5		0.0				17		0.0	
Diethyl ether	VOC							1		0.0	
Ethanol	VOC							1		0.0	
Ethyl acetate	VOC	5		0.0				25		0.0	y
Ethyl cyanide	VOC	49		0.0	7		0.0	260		0.0	
Ethyl methacrylate	VOC	5		0.0				17		0.0	

Table 5-5. Summary of Field QC Sample Analyses

Analyte Name	Analyte Class	Field Dups.	Field Dups. Out	% Field Dups. Out	Splits	Splits Out	% Splits Out	Blanks	Positive Blanks	% Positive Blanks	RI/FS COC?
Ethylbenzene	VOC	49		0.0	12		0.0	191		0.0	
Ethylene glycol	VOC										
Hexane	VOC										
Iodomethane	VOC	5		0.0				17		0.0	
Isobutyl alcohol	VOC	5		0.0				17		0.0	
Isophorone	VOC										
Methacrylonitrile	VOC	5		0.0				17		0.0	
Methane	VOC										
Methanol	VOC							1		0.0	
Methyl methacrylate	VOC	5		0.0				17		0.0	
Methylene chloride	VOC	49	2	4.1	18		0.0	258	71	27.5	y
m-Xylene	VOC										
n-Butylbenzene	VOC										
o-Xylene	VOC										
Styrene	VOC	5		0.0	1		0.0	17		0.0	
Tetrachloroethene	VOC	49		0.0	18		0.0	260		0.0	y
Tetrahydrofuran	VOC	44		0.0	7		0.0	216		0.0	

Table 5-5. Summary of Field QC Sample Analyses

Analyte Name	Analyte Class	Field Dups.	Field Dups. Out	% Field Dups. Out	Splits	Splits Out	% Splits Out	Blanks	Positive Blanks	% Positive Blanks	RI/FS COC?
Toluene	VOC	49		0.0	13		0.0	60		0.0	y
trans-1,2-Dichloroethylene	VOC	49		0.0	12		0.0	60		0.0	
trans-1,3-Dichloropropene	VOC	5		0.0	1		0.0	17		0.0	
trans-1,4-Dichloro-2-butene	VOC	5		0.0				17		0.0	
Trichloroethene	VOC	49	1	2.0	18		0.0	60		0.0	y
Trichloromonofluoromethane	VOC	5		0.0	5		0.0	17		0.0	
Vinyl acetate	VOC							17		0.0	
Vinyl chloride	VOC	49		0.0	13		0.0	60		0.0	
Xylenes (total)	VOC	49		0.0	13		0.0	60		0.0	y
Alkalinity	Water Quality	44		0.0				200		0.0	
Ammonia	Water Quality	3		0.0							y
Bromide	Water Quality	6		0.0				26		0.0	
Dissolved oxygen	Water Quality										
Oxidation Reduction Potential	Water Quality										
pH Measurement	Water Quality										
Specific Conductance	Water Quality	1		0.0							
Temperature	Water Quality										

Table 5-5. Summary of Field QC Sample Analyses

Analyte Name	Analyte Class	Field Dups.	Field Dups. Out	% Field Dups. Out	Splits	Splits Out	% Splits Out	Blanks	Positive Blanks	% Positive Blanks	RI/FS COC?
Total dissolved solids	Water Quality	1		0.0							
Total organic carbon	Water Quality				33		0.0	226	8	3.5	
Total organic halides	Water Quality				4		0.0	318	32	10.1	
Turbidity	Water Quality										
Ammonium ion	WetChem	3		0.0				17		0.0	y
Chloride	WetChem	70	2	2.9	14	1	7.1	271	61	22.5	
Cyanide	WetChem	6		0.0				19		0.0	y
Fluoride	WetChem	70	2	2.9	14	6	42.9	268		0.0	
Iron-II Ion	WetChem										
Nitrate (asn)	WetChem	71	2	2.8	30	3	10.0	294	11	3.7	y
Nitrite (asn)	WetChem	69	5	7.2	14		0.0	252		0.0	y
Nitrogen in Nitrite and Nitrate	WetChem										y
Phosphate	WetChem							18		0.0	
Phosphorus	WetChem										
Sulfate	WetChem	70	1	1.4	14		0.0	271		0.0	
Sulfide	WetChem	5		0.0				14		0.0	y
Total Inorganic Carbon	WetChem										

Table 5-5. Summary of Field QC Sample Analyses

Analyte Name	Analyte Class	Field Dups.	Field Dups. Out	% Field Dups. Out	Splits	Splits Out	% Splits Out	Blanks	Positive Blanks	% Positive Blanks	RI/FS COC?
Totals		**3,963**	**61**	**1.5**	**951**	**23**	**2.4**	**19,422**	**672**	**3.5**	

PEST = pesticide analysis
RAD = radiochemistry analysis
SVOA = semivolatile organic analysis
SVOC = semivolatile organic compound
TPH = total petroleum hydrocarbons
VOA = volatile organic analysis
VOC = volatile organic compound
WetChem = wet chemistry analysis
Y = yes

5.5.1 Field Duplicate Samples

The analysis precision requirement is ±25% for all RI/FS COPCs, as documented in the RI/FS Work Plan SAP. The usual measure of precision is the relative percent difference (RPD) between duplicate pairs. The RPD is calculated for a field duplicate sample only when one result or the other is at least five times the detection limit. Table 5-5 shows field duplicate results by constituent.

There are 3,963 pairs of field duplicates, and all RI/FS COCs had some duplicate data. Of these, 61 (1.5 percent) had RPDs that exceeded the required criteria of 25 percent. One constituent, lead, exhibited a high percentage of unacceptable duplicate performance (71 percent).

5.5.2 Split Samples

Field split samples are collected from a sampling location on the same day and time and submitted to two different laboratories for analysis. The purpose of such samples is to monitor the comparability of the data generated by different laboratories. The acceptance criteria are an RPD of the two laboratory's results of 20 percent or less. The 200-UP-1 data set contained 951 pairs of split samples, of which 23 (2.4 percent) exceeded 25 percent RPD. Table 5-5 shows field split results by constituent.

Only two constituents exhibited high percentages of split data exceeding the QC criteria: gross beta (100 percent) and fluoride (43 percent). There were no laboratory splits for lead, lithium, mercury, cesium-137, cobalt-60, neptunium-237, uranium-234, uranium-235, uranium-238, phenols, TPA, 1,4-dioxane, ethyl acetate, ammonia/ammonium, cyanide, nitrite or sulfide.

5.5.2.1 Field Blank Samples

Three types of field blanks were gathered during the collection of 200-UP-1 groundwater samples, field transfer and trip blanks. Equipment rinsate blanks are water samples used in the final rinse of sampling equipment before the equipment is reused to collect another sample. These blanks are not required for sampling events using disposable or dedicated sampling equipment.

Field transfer blanks are generated by pouring laboratory water into sample containers in the field during a sampling event to detect any contaminants that may be introduced into groundwater during the bottle-filling activities. Trip blanks are clean water samples that are prepared in the lab and taken into the field with the sampling crew. Trip blanks are a measure of potential contamination associated with sample collection and transportation to the laboratory.

For the purpose of the DQA, all blank results were pooled. Table 5-5 displays the blank data by constituent. There were 19,422 individual blank results, of which 672 exceeded the QC threshold of twice the MDL or minimum detectable activity. Constituents with high percentages of positive blanks include oil and grease (100 percent), calcium (31 percent), and methylene chloride (28 percent).

5.6 Laboratory Quality Control

This section summarizes the review of the laboratory QC associated with the data set from the past five years. Laboratory contamination, accuracy, completeness, and comparability are evaluated.

The data set consists of 178,019 laboratory QC results. This includes 51,737 blanks, 17,820 duplicates, 43,137 laboratory control standards, 44,771 matrix spikes, and 20,554 surrogate recovery results. Of these, 21,622 (12 percent) could not be evaluated because the data set did not include a reference to the associated MDL or minimum detectable activity data which were necessary for evaluation. These lab QC results are applicable to the data set but cannot be associated with specific well sample results. However,

these results represent only 5.7 percent of the total data set (2004-2009). Table 5-2 summarizes data from 200-UP-1 with no associated QC batch.

The laboratory QC elements were evaluated against the criteria listed in Table 5-6.

Table 5-6. Laboratory QC Acceptance Criteria

QC Element	Acceptance Criteria
Lab Duplicates	Lab duplicates with a result greater than 5X the MDL or MDA must have RPD <20% to be considered acceptable.
Lab Blanks	Lab blank limit is 2X the MDL or IDL. However, for common laboratory contaminants such as acetone, methylene chloride, 2-butanone, toluene, and phthalate esters, the QC limit is 5X the MDL.
Laboratory Control Samples	LCS percent recovery must be between the laboratory provided minimum control limit and maximum control limit.
Lab Spikes	Lab spikes where the sample result is <4X the spiking concentration are evaluated by comparing the percent recovery with the minimum and maximum control limits provided by the laboratory. In addition, where the sample result is <4X the spiking concentration, the MS/MSD RPD must have RPD <20 percent.

IDL = instrument detection limit
LCS = laboratory control standard
MDA = minimum detectable activity (radchem analysis)
MS = matrix spike
MSD = matrix spike duplicate
RPD = relative percent difference between two values
QC = quality control

5.6.1 Laboratory Contamination

Hanford laboratory contracts require that method blanks be analyzed with each batch of up to 20 samples. A total of 51,737 lab blanks were reported with the lab QC associated with the UP-1 data set. This represents 76 percent of the number of sample results. This easily meets the QC requirement is a minimum of 1 per analytical batch or 1 in 20. There were 19,922 lab blank results with no identified minimum detectable concentration or minimum detectable activity. These blanks were not evaluated. This left 31,815 laboratory blanks that were evaluated as part of this DQA.

Of these lab blanks, 612, or 1.9 percent displayed an unacceptable positive result indicating potential laboratory contamination. Table 5-7 shows the distribution of these positive blanks.

Table 5-7. Distribution of Laboratory Blank Results Exceeding QC Criteria

Method Class	Positive Blanks
Metals	239
Volatiles	239
Anions	125
Semivolatiles	4
Uranium	4

5.6.2 Precision

The laboratory precision is determined by the difference between duplicate sample results or between MS/MSD pairs. Normally, sample duplicates are used for metals and anions while MS/MSD are used for organic analyses.

There were 17,820 laboratory duplicate pairs. This represents 26.1 percent of the total number of UP-1 results. This exceeds the minimum 1-in-20 QC requirement. Some laboratory duplicate minimum detection limit or minimum detectable activity were not available within HEIS and, therefore, were not evaluated by this DQA.

Only 330 (2.0 percent) out of 16,300 exceeded the 20 percent RPD requirement. Table 5-8 shows the distribution of these QC exceedances.

Table 5-8. Distribution of Laboratory Duplicate Relative Percent Differences Exceeding QC Criteria

Method/Method Class	Lab Duplicate Pairs RPD >20%
Volatiles	225
Anions	71
Radchem	20
Semivolatiles	6
Total Organic Halides	4
Total Dissolved Solids	3

5.6.3 Accuracy

Two types of QC are used to assess accuracy. The laboratory control sample (LCS) is used to assess the performance of the laboratory with respect to the method and the accuracy of the laboratory preparation and analysis processes. The matrix spikes are used to assess the accuracy of the published method on the sample matrix and evaluate matrix effects that may bias the data.

There were 43,137 LCS results reported for the UP-1 data set, 29 of which were not accompanied by MDL or minimum detectable activity and were not included in the evaluation.

Of the 43,108 remaining LCS results, 539 (1.3 percent) exceeded QC requirements. Table 5-9 shows the distribution of these exceedances. Of the 539 exceedances, only 18 recoveries were greater than 200 percent. All of these were for individual volatile or semivolatile constituents.

Table 5-9. Distribution of Laboratory Control Standard Recovery Results Outside of QC Criteria

Method Class	LCS Recovery Outside +/- 20%
Volatiles	308
Semivolatiles	95
Anions	54
Metals	44
General Chemistry	6

LCS = Laboratory Control Standard

Laboratory spike recovery is also used as a measure of laboratory accuracy. For the UP-1 data set, there were 44,771 individual spiked-sample results, of which 151 did not have associated MDLs or minimum detectable activity data and were not evaluated. Of the remaining 44,620 values, 2002 (4.5 percent) exceeded the minimum/maximum control limits set up by the laboratory. Table 5-10 shows the distribution of these spike recovery failures. Table 5-11 contains the samples where matrix spike recovery was between 0-10 percent. The data should not be used for regulatory decision-making.

Table 5-10. Distribution of Laboratory Matrix Spike Results Outside of QC Criteria

Method Class	Spike Recovery Outside Laboratory Limits
Volatiles	1,242
Semivolatiles	384
Anions	297
Metals	50
General Chemistry	15
Radiochemistry	15

Finally, organic analytes inject a compound that is not likely to be contained in an environmental sample (a surrogate) into each sample as a measure of overall method performance on that specific sample. The UP-1 data set contained 20,554 individual surrogate results. Of these, 513 (2.3 percent) were outside of the laboratory-specified acceptability criteria.

Table 5-11. Samples Exhibiting Laboratory Matrix Spike Recovery of Less than 10%

Constituent	Sample with 0–10% Spike Recovery
Potassium	B1P9M7
Trochloroethylene	B1DL51
Volatile Organic Constituents	B1V276
2-chloroethyl-vinyl ether	B1V677
Carbon disulfide	B1V692
Semivolatile Organic Constituents	B18JN0
TOX	B1JBT8, B1LRT1
Nitrate	B1DKY7, B1FP10,
Nitrite	B1KF96, B1KBC6, B1KCP7, B1KT08, B1KCY5, B1LP99, B1KT08, B1LP88, B1L297
Chloride	B1FP10
Fluoride	B1KT08

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6 Data Usability

Data from each category of information is summarized. These categories include QC review from the following:

- Five percent of the characterization data between October 1, 2003, and March 31, 2009, was selected for formal validation
- Five previous years of data from the annual groundwater report
- Summary of all field QC from October 2003 to March 2009
- Summary of all laboratories QC from October 2003 to March 2009
- Summary of the detection limit evaluation

6.1 Formal Validation

There were no major deficiencies identified in the validated semivolatiles, pesticides, or inorganics data.

Thirty-one samples (volatiles, nitrate, nitrite, phosphate, and BOD) were rejected, wholly or in part, due to severe holding time accidences. Two radiochemistry samples were rejected due to lack of traceability of the standards used to quantitate the result. Table 5.1 lists the rejected sample results.

Many minor deficiencies were identified which resulted in the application of J or UJ flags.

Overall completeness is estimated at 98 percent. All flags identified during the validation process have been applied/corrected in HEIS.

Data users should pay attention to applied flags within HEIS and review the laboratory QC for sample results, which are specifically relied upon, particularly for those parameters for which some validated data were found to be rejectable. All of the BOD results validated were rejected. The presumption should be that all BOD results within the UP-1 data set are suspect and unusable unless specifically validated. While the remainder of the rejected data does not represent a large percentage of the validated results, if any single volatile, nitrate, nitrite, or phosphate result within the UP-1 data set is relied upon, particularly if it is a nondetect result, it should be validated.

6.2 Annual Groundwater Report Review

Comparison of the 200-UP-1 data set with the overall Hanford Site groundwater data set as described in the annual Hanford groundwater reports showed that the 200-UP-1 data is at least as good, in terms of accuracy, precision, and blank contamination, as the overall site groundwater data set. Both field and laboratory performance parameters are equal to or better than those for the Hanford site groundwater data as a whole.

6.3 Summary of All Field QC

Field QC consisted of field blanks, field duplicates, and field splits. Performance overall was very good as summarized in Table 6-1.

Table 6-1. Summary of All Field QC Results for the 200-UP-1 Groundwater Data Set

Field QC Element	Total Number of QC Values in the Data Set	Number of Values Outside of Acceptance Criteria	Percent of Field QC Meeting Acceptance Criteria
Field Duplicates	3,963 pairs	61	98.5%
Field Splits	951 pairs	23	97.6%
Field Blanks	19,422 blanks	672	96.5%

While the overall performance was very good, there are specific observed deficiencies that should be taken into account by any data user.

Duplicate performance for the following constituents exceeded 25 percent unacceptable:

- Lead (12 of 17 or 70.6 percent unacceptable)
- U-234 and U-238 (1 of 3 or 33.3 percent unacceptable)

Split performance for the following constituents exceeded 25 percent unacceptable, although neither are COPCs:

- Gross beta (1 of 1 or 100 percent unacceptable)
- Fluoride (6 of 14 or 42.9 percent unacceptable)

Positive reported values (reported detections generally greater than twice MDL, except for certain common lab contaminants, which are evaluated at five-times the MDL) were seen in greater than 25 percent of the blanks for the following constituents:

- Calcium (150 of 490 or 30.6 percent positive blanks)
- Oil and Grease (1 of 1 or 100 percent positive blanks)
- Methylene chloride (71 of 258 or 27.5 percent positive blanks)

Data users who are using data reported for any of the above-listed parameters should look specifically at the well-specific and constituent-specific field QC to validate the use of the individual data points.

6.4 Summary of All Laboratory QC

Laboratory QC includes lab blanks, duplicates, laboratory control standards, matrix spikes, and surrogates. Overall, the laboratory performance was very good, as summarized in Table 6-2.

Table 6-2. Summary of Laboratory QC for the 200-UP-1 Data Set

Field QC Element	Total Number of QC Values in the Data Set	Number of Values Outside of Acceptance Criteria	Percent of Field QC Meeting Acceptance Criteria
Lab blanks	31,815	612	98.1
Lab duplicates*	17,820 pairs	330	98.0
Laboratory control standard	43,108	539	98.7
Matrix spike recovery	44,620	2,002	95.5
Surrogates	20,554	513	97.7

* Includes matrix spike/matrix spike duplicate pair.

Although the laboratory performance overall was excellent, there are some isolated data batches that exhibited problems. These would be qualified as appropriate in the HEIS database. Data users that rely on single data results should ensure they understand the qualifiers identified in HEIS and validate that laboratory batch data associated with the specific result is also good.

6.5 Detection Limits

Using nondetect data to demonstrate performance to a specific threshold requires the laboratory reporting limit to be less than the threshold. The 200-UP-1 data set contains nondetect data for many constituents that do not meet this criterion. Table 6-3 shows the constituents for which over 25 percent of the nondetects exceeded the identified risk-based potentially-applicable action limits defined in Section 1.

Table 6-3. Potential Detection Limit Issues for 200-UP-1 Groundwater Data

Constituent	Percent of Results that are Nondetect	Percent of Nondetect Values that Exceed Action Limit
Identified COPCs		
Antimony	94.9	90.7
Arsenic	33.6	100
Iodine-129	81.4	52.7
1,1-dichloroethene	98.1	76.9
1,2-dichloroethane	97.9	47.9
1,4-dioxane	99.3	62.8
Carbon Tetrachloride	9.2	65.4
Tetrachloroethene	88.1	94.7
Trichloroethene	54.4	70.7
Opportunistic Analytes		
Thallium	83.3	78.0
3,3'-dichlorobenzidine	100	100
3-nitroaniline	100	94.1

Table 6-3. Potential Detection Limit Issues for 200-UP-1 Groundwater Data

Constituent	Percent of Results that are Nondetect	Percent of Nondetect Values that Exceed Action Limit
4,6-dinitro-2-methylphenol	94.4	88.2
4-nitroaniline	100	94.1
Benzo(a)anthracene	100	100
Benzo(a)pyrene	100	100
Benzo(b)fluoranthene	100	100
Benzo(k)fluoranthene	100	100
Bis(2-chloro-1-methylethyl)ether	100	94.1
Bis(2-chloroethoxy)methane	100	100
Bis(20chloroethyl)ether	100	100
Dibenz(a,h)anthracene	100	100
Hexachlorobenzene	100	100
Hexachlorobutadiene	100	100
Hexachloroethane	100	94.1
Indeno(1,2,3-cd)pyrene	100	100
n-nitrosodi-n-propylamine	100	100
Pentachlorophenol	98.7	84.0
1,1,2,2-tetrachloroethane	99.6	65.0
1,1,2-trichloroethane	99.5	46.8
1,2,3-trichloropropane	100	100
1,2-dibromo-3-chloropropane	100	100
1,2-dibromoethane	100	100
1,2-dichloropropane	97.8	44.1
Benzene	97.3	52.9
Bromodichloromethane	85.9	50.3
Chloromethane	87.0	26.5
Cis-1,2-dichloropropene	96.9	45.0
Dibromochloromethane	99.6	43.8
Diethyl ether	100	100
Methacrylonitrile	99.2	41.1
Methanol	100	100
Trans-1,3-dichloropropene	99.1	44.4
Vinyl chloride	99.3	100
Phosphorus	49.1	100

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Appendix A

List of Groundwater Wells

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Table A-1. List of 200-UP-1 Groundwater Operable Unit Wells

Well ID	Well Name
C5102	299-W14-71
B2748*	299-W15-34
B2753	299-W15-37
B2755*	299-W15-39
C3955*	299-W15-43
A4932	299-W18-15
A4933	299-W18-21
A4934	299-W18-22
A4942	299-W18-30
A4943	299-W18-31
A5450	299-W18-33
C3395	299-W18-40
C4966	299-W19-101
C4967	299-W19-104
C4968	299-W19-105
C5193	299-W19-107
A4945	299-W19-12
A7743	299-W19-18
A9517	299-W19-34A
A9513	299-W19-34B
A9515	299-W19-35
B2461	299-W19-36
B2465	299-W19-37
B2460	299-W19-39
A4958	299-W19-4
B2464	299-W19-40
B8551	299-W19-41
B8553	299-W19-42
C3381	299-W19-43
C3393	299-W19-44
C3394	299-W19-45

Table A-1. List of 200-UP-1 Groundwater Operable Unit Wells

Well ID	Well Name
C3958	299-W19-46
C4258	299-W19-47
C4300	299-W19-48
C4695	299-W19-49
C4696	299-W19-50
A7737	299-W19-9
C4639	299-W21-2
A7835	299-W22-10
A7843	299-W22-20
A4968	299-W22-26
A4975	299-W22-44
A4976	299-W22-45
A4977	299-W22-46
C4667	299-W22-47
B8812	299-W22-48
B8813	299-W22-49
C4969	299-W22-69
C4970	299-W22-72
B8552	299-W22-79
C3115	299-W22-80
C3123	299-W22-81
C3124	299-W22-82
C3126	299-W22-83
C3398	299-W22-84
C3399	299-W22-85
C4971	299-W22-86
C4977	299-W22-87
C4978	299-W22-88
A7834	299-W22-9
A7884	299-W23-10
A4983**	299-W23-14

Table A-1. List of 200-UP-1 Groundwater Operable Unit Wells

Well ID	Well Name
A4984	299-W23-15
B8809	299-W23-19
C3112	299-W23-20
C3113	299-W23-21
A4987	299-W23-4
A7883	299-W23-9
B8817	299-W26-13
B8828	299-W26-14
A5410	299-W27-2
A5076	699-19-58
A5099	699-25-70
C4298	699-30-66
A5128	699-32-62
A5130	699-32-72A
C4975	699-32-76
C4973	699-33-74
C4974	699-33-75
C4976	699-33-76
C4972	699-34-72
A5139	699-35-66A
A5140	699-35-70
A5141	699-35-78A
A5144	699-36-61A
C6219	699-36-66B
B2733	699-36-67
A9901	699-36-70A
C4299	699-36-70B
C5704	699-37-66
B2732	699-37-68
A5148	699-38-65
A9516	699-38-68A

Table A-1. List of 200-UP-1 Groundwater Operable Unit Wells

Well ID	Well Name
A5149	699-38-70
C4236	699-38-70B
C4256	699-38-70C
A5158	699-40-62
C4235	699-40-65
A5429	699-S29-E16A
A5394	699-S37-E14
A9238	699-S40-E13A
A5398	699-S40-E14
A5400	699-S41-E12

* Well data are included in the overall data set evaluated. However, they are not UP-1 wells or within the UP-1 area of interest.

** There is no data for Well 299-W23-14. This well has been dry since late 2002.

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