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Draft A

Groundwater Quality Assessment Plan for the Single-Shell Tank Waste Management Area A-AX

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

U.S. DEPARTMENT OF ENERGY

Richland Operations Office

P.O. Box 550
Richland, Washington 99352

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Executive Summary

Waste Management Area (WMA) A-AX, which incorporates the A and AX Tank Farms, is regulated under the *Revised Code of Washington* (RCW) 70.105, "Hazardous Waste Management Act," and its implementing requirements in *Washington Administrative Code* (WAC) 173-303-400, "Dangerous Waste Regulations," "Interim Status Facility Standards." The Washington State Department of Ecology (Ecology) has been authorized by the U.S. Environmental Protection Agency, in accordance with *Authorized State Hazardous Waste Programs*, to conduct its hazardous waste regulatory program in lieu of the *Resource Conservation and Recovery Act of 1976* (RCRA), including the requirements in 40 *Code of Federal Regulations* (CFR) 265, Subpart F, "Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities," "Ground-Water Monitoring." The WMA A-AX is also subject to the requirements of the *Hanford Federal Facility Agreement and Consent Order* (Tri-Party Agreement) (Ecology et al., 1989), with Ecology identified as the lead regulatory agency for the unit.

The WMA A-AX was placed in assessment monitoring in 2005 due to elevated specific conductance, and a "first determination" groundwater quality assessment plan was implemented in 2006 (PNNL-15315, *RCRA Assessment Plan for Single-Shell Tank Waste Management Area A-AX at the Hanford Site*). The first determination plan continued to be implemented until replacement well 299-E25-236 was installed in 2008 and an additional year of monitoring data were collected and assessed for the completed well network. An assessment report of the findings was issued in August 2010 (SGW-47538, *Groundwater Quality Assessment Report for Waste Management Area A-AX: First Determination*), and it was concluded that the tank farm had impacted groundwater quality with dangerous waste or dangerous waste constituents. This plan was written and will be implemented in order for continued RCRA groundwater quality assessment, as required by 40 CFR 265.93(d)(7), "Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities," "Preparation, Evaluation, and Response."

This document supersedes PNNL-15315 and updates the groundwater monitoring project management organization.

This plan describes the WMA A-AX facility and operating history, waste characteristics, the hydrogeology, previous monitoring at the WMA, groundwater and vadose zone contamination associated with the WMA, and the conceptual model for the WMA. The plan addresses the following:

- Adequacy of the wells monitoring the groundwater at WMA A-AX
- Sampling requirements and schedule
- Analytes, groundwater parameters, and analytical methods necessary to determine extent of contamination from WMA A-AX
- Procedures for evaluating groundwater quality data
- Reporting requirements

This assessment plan is the principal controlling document for conducting groundwater monitoring at WMA A-AX.

Contents

1 Introduction 1-1

2 Background 2-1

2.1 Facility Description and Operational History 2-1
2.2 Regulatory Basis 2-3
2.3 Waste Characteristics 2-4
2.4 Geology and Hydrology 2-5
2.5 Summary of Previous Groundwater Monitoring 2-7
2.5.1 Groundwater Contamination 2-7
2.5.2 Vadose Zone Contamination 2-8
2.6 Conceptual Model 2-10
2.6.1 Contaminant Source 2-10
2.6.2 Driving Forces 2-10
2.6.3 Migration 2-10
2.7 Data Quality Objectives 2-11

3 Groundwater Monitoring Program 3-1

3.1 Constituent List and Sampling Frequency 3-1
3.2 Well Network 3-4
3.3 Sampling and Analysis Protocol 3-6

4 Data Evaluation and Reporting 4-1

4.1 Data Review 4-1
4.2 Interpretation 4-1
4.3 Annual Determination of Monitoring Network 4-1
4.4 Reporting and Notification 4-1

5 References 5-1

Appendices

A Quality Assurance Project Plan ..... A-i

B Construction Information for Well 299-E25-236 ..... B-i

Figures

Figure 1-1. Location of WMA A-AX 1-2
Figure 2-1. WMA A-AX and Vicinity 2-2
Figure 2-2. Hanford Site Water Table Map for March 2009 and Inferred Flow Direction 2-6
Figure 2-3. Nickel Concentrations at Downgradient Wells 299-E25-40 and 299-E25-236 Compared to Upgradient Well 299-E24-33 at WMA A-AX 2-8

Tables

Table 2-1. Leak Volume Estimates in WMA A-AX SSTs 2-3
Table 2-2. Dangerous Wastes in the SST System (Dangerous Waste Permit Application Part A Form) 2-4
Table 2-3. DQO Parameters, Associated Regulatory Requirements, and Documentation for WMA A-AX 2-11
Table 3-1. Constituents on the RCRA Groundwater Monitoring List Potentially Present in the SST Farm System 3-1
Table 3-2. Monitoring Network, Constituent List, and Sampling Frequency for WMA A-AX 3-3
Table 3-3. WMA A-AX Well Depths and Water Table Elevation 3-5

Terms

CERCLA	*Comprehensive Environmental Response, Compensation, and Liability Act of 1980*
CFR	*Code of Federal Regulations*
DOE	U.S. Department of Energy
DQO	data quality objective
Ecology	Washington State Department of Ecology
EPA	U.S. Environmental Protection Agency
PUREX	Plutonium-Uranium Extraction (Plant)
QAPjP	quality assurance project plan
RCRA	*Resource Conservation and Recovery Act of 1976*
RCW	*Revised Code of Washington*
SST	single-shell tank
Tri-Party Agreement	*Hanford Federal Facility Agreement and Consent Order*
WAC	*Washington Administrative Code*
WMA	waste management area

1 Introduction

Since 1944, the Hanford Site's single-shell tanks (SSTs) have stored both radioactive and dangerous chemical waste generated from plutonium-production and separation activities. The 149 SSTs are recognized as dangerous waste management units and are regulated under the *Resource Conservation and Recovery Act of 1976* (RCRA), the *Revised Code of Washington* (RCW) 70.105 ("Hazardous Waste Management"), and its implementing requirements (*Washington Administrative Code* [WAC] 173-303, "Dangerous Waste Regulations"). Only the dangerous chemical waste is regulated by RCRA; the radioactive waste is regulated under the *Atomic Energy Act of 1954*.

The A and AX Tank Farms in the Hanford Site's 200 East Area comprises Waste Management Area (WMA) A-AX (Figure 1-1). A RCRA interim status detection groundwater monitoring program for the SSTs was implemented in 1989 (WHC-SD-EN-AP-012, *Interim Status Groundwater Monitoring Plan for the Single-Shell Tanks*), and detection monitoring began at WMA A-AX in 1991. A site-specific detection monitoring plan was written and implemented in 2001 (PNNL-13023, *RCRA Groundwater Monitoring Plan for Single-Shell Tank Waste Management Area A-AX at the Hanford Site*), and interim change notices were generated to make changes to interpretations in groundwater flow direction (PNNL-13023-ICN-1), to add additional wells to the network (PNNL-13023-ICN-2), and to change critical means (PNNL-13023-ICN-3). The WMA A-AX was placed into assessment status in 2005 due to elevated specific conductance in downgradient monitoring wells (PNNL-15315, *RCRA Assessment Plan for Single-Shell Tank Waste Management Area A-AX at the Hanford Site*). PNNL-15315 was written as a "first determination" plan, as allowed under 40 *Code of Federal Regulations* (CFR) 265.93(d)(5) ("Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities," "Preparation, Evaluation, and Response") to provide the owner/operator of the facility an opportunity to determine if dangerous waste from the regulated unit have entered groundwater. The plan (PNNL-15315) was not fully implemented until 2008, when well 299-E25-236 was installed to replace two wells in the WMA A-AX network that were damaged by corrosion and had to be abandoned.

After four quarters of groundwater monitoring data were collected from new well 299-E25-236, the results (as well as data from the other existing wells for the last 5 years) were used to determine if dangerous wastes or dangerous waste constituents from WMA A-AX had entered groundwater. One observation was that WMA A-AX was responsible for technetium-99 and nitrate groundwater contamination (DOE/RL-2008-66, *Hanford Site Groundwater Monitoring for Fiscal Year 2008*), but neither was a dangerous waste constituent regulated under RCRA. Technetium-99 is a radioactive element regulated under the *Atomic Energy Act of 1954*, and nitrate is not a dangerous waste constituent listed in Appendix 5 of WAC 173-303-080 and -100 (Ecology Publication 97-407, *Chemical Testing Methods for Designating Dangerous Waste: WAC 173-303-090 & -100* [which references 40 CFR 264, "Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities," Appendix IX, "Ground-Water Monitoring List"]). However, nickel, which is a dangerous waste constituent, was discovered in higher concentrations in two downgradient wells relative to concentrations in upgradient wells (SGW-47538, *Groundwater Quality Assessment Report for Waste Management Area A-AX: First Determination*). Therefore, the conclusion of the first determination was that WMA A-AX has contaminated the unconfined aquifer with a dangerous waste constituent. Groundwater monitoring will proceed to groundwater quality assessment under RCRA interim status (WAC 173-303-400[3], and by reference to 40 CFR 265.93[d][7]).

This document presents a revised groundwater assessment plan for WMA A-AX that supersedes the previous groundwater assessment plan (PNNL-15315). Background information is summarized herein and references are provided to other documents for more detailed information.

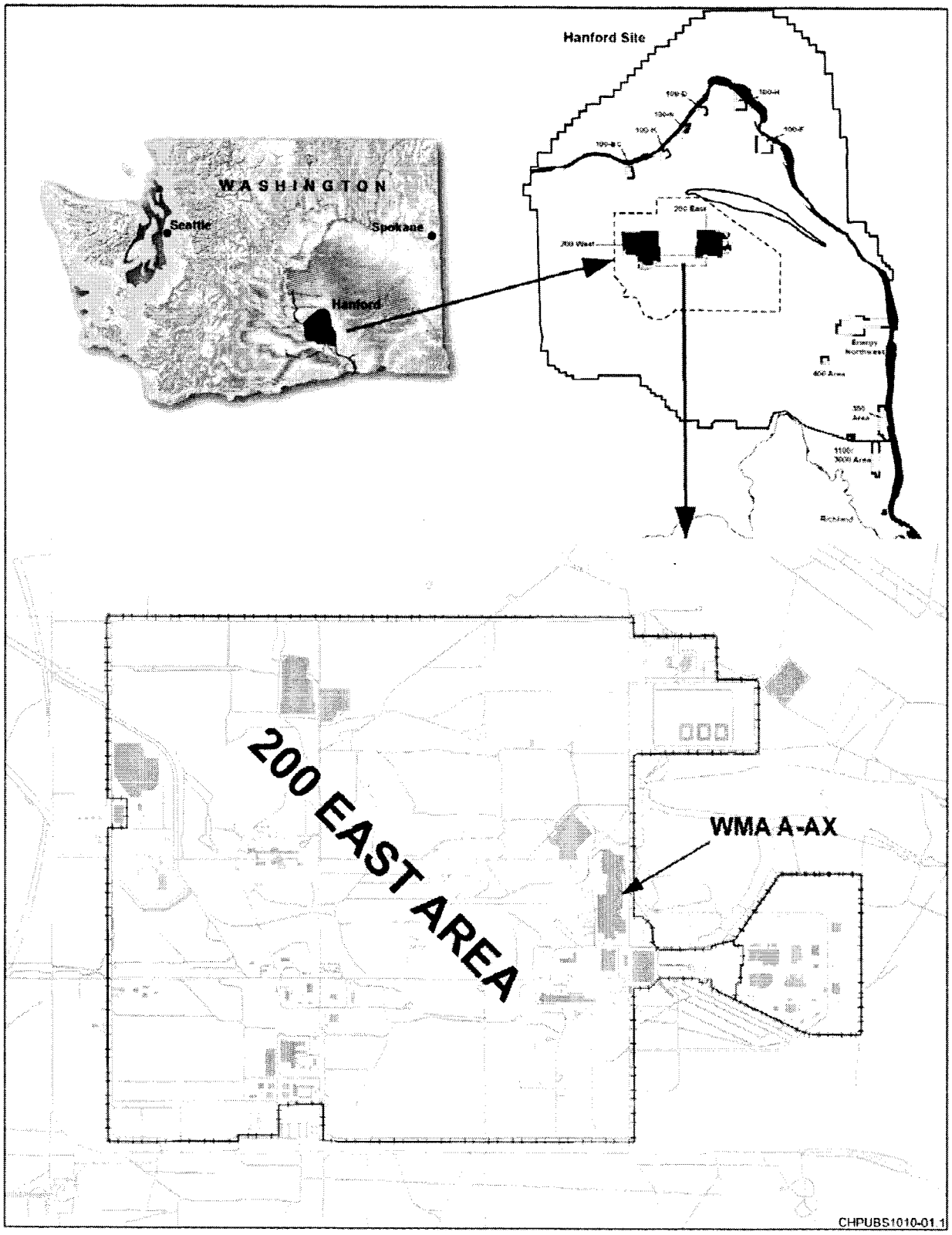


Figure 1-1. Location of WMA A-AX

The specific objective of this plan is to determine the concentration, rate, and extent of migration of dangerous waste constituents in the groundwater. This plan defines a network of groundwater monitoring wells; specifies the sampling frequency; and lists the dangerous constituents, indicators, and supporting constituents to be monitored in groundwater.

Chapter 2 summarizes background information and includes a description of WMA A-AX and the types of waste present, a brief history of the groundwater monitoring program, and a description of the geology and hydrogeology of the area. This information is incorporated into the site conceptual model to aid in development of the groundwater monitoring program. Chapter 3 describes the RCRA groundwater monitoring program, the wells monitored, sampling frequency and protocols, and the constituents analyzed. Chapter 4 describes data evaluation, interpretation, and reporting. A list of the references cited in this document is provided in Chapter 5. Appendix A provides the quality assurance project plan (QAPjP), and Appendix B includes construction information on replacement well 299-E25-236.

2 Background

This chapter provides a description of WMA A-AX, the regulatory requirements for groundwater monitoring, and waste characteristics. It also summarizes the hydrogeology beneath the WMA, outlines a conceptual model for contaminant migration, describes groundwater contamination in the uppermost aquifer, and addresses the data quality objectives (DQOs). Most of the information in this chapter is further discussed in the following documents:

- DOE/RL-88-21, *Hanford Facility Dangerous Waste Part A Permit Application*
- PNNL-13023, *RCRA Groundwater Monitoring Plan for Single-Shell Tank Waste Management Area A-AX at the Hanford Site* (and interim change notices)
- PNNL-15315, *RCRA Assessment Plan for Single-Shell Tank Waste Management Area A-AX at the Hanford Site*
- RPP-14430, *Subsurface Conditions Description of the C and A-AX Waste Management Area*
- RPP-16608, *Site-Specific Single-Shell Tank Phase 1 RCRA Facility Investigation/Corrective Measures Study Work Plan Addendum for Waste Management Areas C, A-AX, and U*
- RPP-23748, *Geology, Hydrogeology, Geochemistry, and Mineralogy Data Package for the Single-Shell Tank Waste Management Areas at the Hanford Site*
- RPP-35484, *Field Investigation Report for Waste Management Areas C and A-AX*
- RPP-RPT-46613, *Surface Geophysical Exploration of the A and AX Tank Farms*
- WHC-EP-0412, *Fate and Transport of Constituents Leaked from Tank 241-A-105*

2.1 Facility Description and Operational History

The WMA A-AX contains the A and AX Tank Farms, which include ten 100-series SSTs (Figure 2-1), as well as a variety of ancillary equipment designed to manage tank waste during operations, including seven inactive diversion boxes, waste transfer lines, and catch tanks. The A Tank Farm contains six SSTs constructed from 1954 to 1955. The AX Tank Farm contains four SSTs constructed from 1963 to 1964. These tanks had an operating capacity of 3,785,000 L (1 million gal) each. The tank dimensions are 23 m (75 ft) in diameter and 12 m (44 ft) tall. The tanks were installed below ground with the tops at least 1.8 m (6 ft) below grade to provide radiation shielding and protection for operating personnel. The 244-AR vault is located immediately west of the A Tank Farm, and the 242-A evaporator is located south of the A Tank Farm (Figure 2-1).

Waste sent to tanks in WMA A-AX came primarily from operations at the Plutonium-Uranium Extraction (PUREX) Plant and the B Plant waste fractionation process. The majority of the waste came from PUREX operations and included coating waste, acid waste, and organic wash waste (RRP-16608), which were neutralized and stored in the tanks. The WMA A-AX tanks were all generally removed from service in 1980.

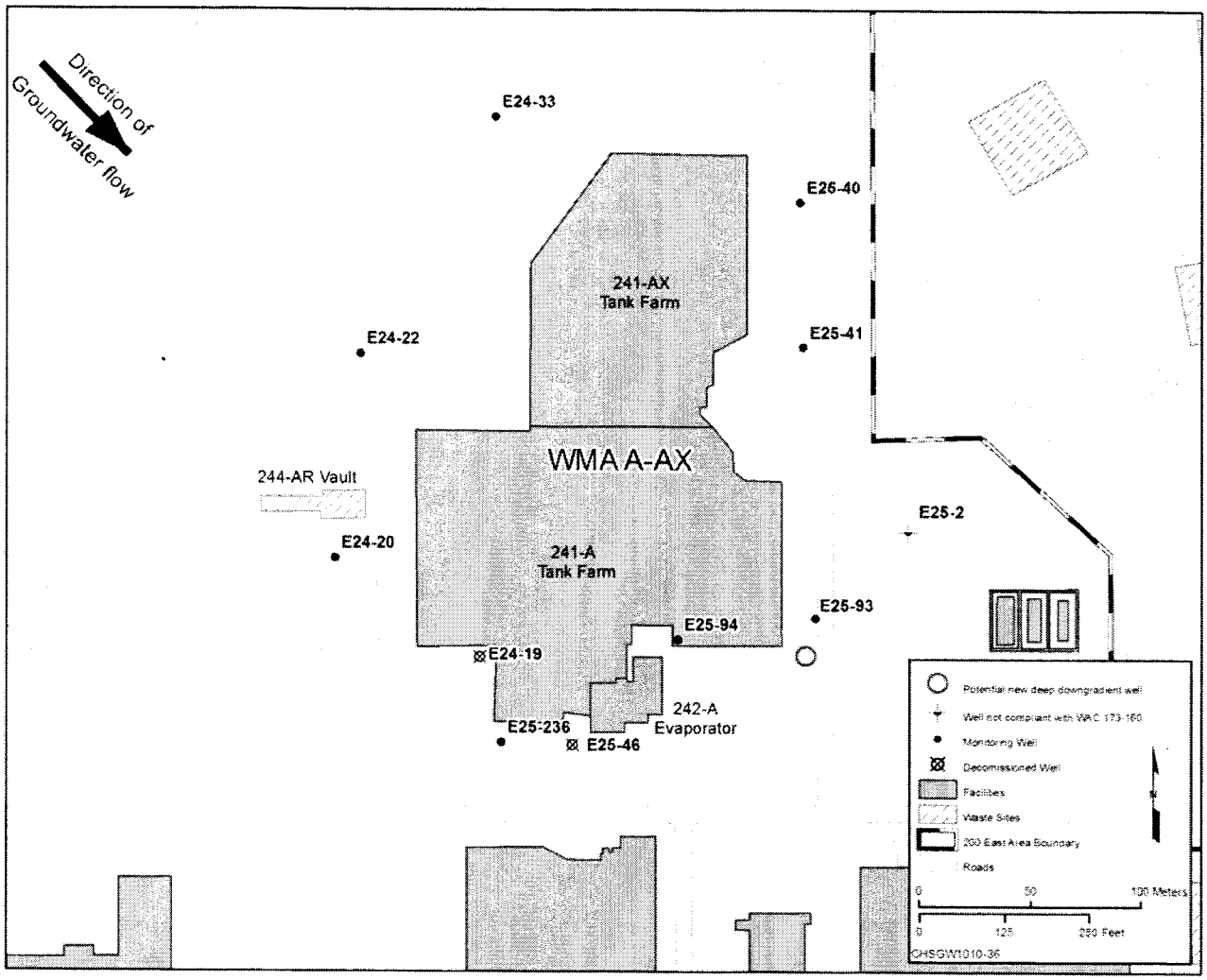


Figure 2-1. WMA A-AX and Vicinity

Information on the nature of waste received at each tank, along with estimates of waste volume that boiled off and the amounts of cooling water added, is provided in WHC-MR-0132, *A History of the 200 Area Tank Farms*. Specific tank waste additions and transfers through 1979, the last full year of active operation, are included in WHC-MR-0132. After this time, information on SST operations can be found in the HNF-EP-0182 reports, which are published monthly to report on tank status and farm operations. Appendix A in PNNL-13023 contains the current total waste inventory of hazardous and nuclear chemistry on a tank-by-tank basis. Inventories were estimated with the Hanford Site defined waste model (LA-UR-96-3860, *Hanford Tank Chemical and Radionuclide Inventories: HDW Model*). More recent information regarding the waste in the tanks is provided in RPP-16608.

Of the 10 tanks located within WMA A-AX, 5 of the tanks were confirmed or assumed leakers (HNF-EP-0182-131, *Waste Tank Summary Report for Month Ending February 28, 1999*). However more recent studies have provided evidence that two of the tanks that formerly were assumed to have leaked most likely did not leak (RPP-RPT-46613) (Table 2-1). In addition to tank leaks, a number of confirmed or suspected waste-loss events were due to the waste transfer piping systems (RPP-ENV-37956, *Hanford A and AX Farm Leak Assessment Report: 241-A-103, 241-A-104, 241-A-105, 241-AX-102, and 241-AX-104*). The primary contamination zones identified in WMA A-AX are

a localized cesium-137 activity zone near the bottom of two tanks in the A Tank Farm and three unplanned releases. The unplanned releases include one in the southern portion of the AX Tank Farm and two others in the western and southern portions of the A Tank Farm that are located near pipelines and diversion boxes.

Table 2-1. Leak Volume Estimates in WMA A-AX SSTs

Tank	Date Confirmed or Assumed Leak	Estimated Leak Volume (gal)
241-A-103	1987	0
241-A-104	1975	500 to 2,500
241-A-105	1963	2,000 to 40,000, plus cooling water
241-AX-102	1988	0
241-AX-104	1977	Not sufficient information

Source: RPP-RPT-46613, *Surface Geophysical Exploration of the A and AX Tank Farms*, Table 2-3.

Another potential source of waste discharged to the ground is the known discharge events to cribs within WMA A-AX. For instance, the 216-E-39 Crib, located about 53 m (175 ft) from well 299-E25-40 in the northern portion of the AX Tank Farm, received waste resulting from a 1966 spill of P2 (PUREX 2) (RHO-CD-673, *Handbook 200 Areas Waste Sites*). The waste resulted from a broken recirculating pump associated with tank AX-103 and contained 2,500 parts per million slurry and 100 parts per million of the supernate containing nickel. The volume of the spill is unknown, but records indicate that a fire hose was used to wash the waste into the crib. This discharge event provided a potential source of nickel waste to the vadose zone and possibly to the underlying aquifer.

2.2 Regulatory Basis

In May 1987, the U.S. Department of Energy (DOE) issued a final rule (10 CFR 962, "Byproduct Material"), stating that the hazardous waste components of the mixed waste are subject to RCRA regulations. In November 1987, the U.S. Environmental Protection Agency (EPA) authorized the Washington State Department of Ecology (Ecology) to regulate these hazardous waste components within the state of Washington (51 FR 24504, "EPA Clarification of Regulatory Authority Over Radioactive Mixed Waste"). In 1996, the Washington State Attorney General determined that the effective date for regulation of mixed waste in Washington State was August 19, 1987.

Groundwater monitoring is conducted at WMA A-AX in accordance with WAC 173-303-400(3) and, by reference, 40 CFR 265, Subpart F ("Ground-Water Monitoring"), which requires monitoring to determine whether dangerous waste or dangerous waste constituents from the waste site have entered the groundwater. The WMA was placed in assessment monitoring (40 CFR 265.93[d][4]) after elevated specific conductance in a downgradient monitoring well was observed and confirmed (PNNL-15315).

An assessment report of the initial findings was issued in August 2010 (SGW-47538), which concluded that the tank farm had impacted groundwater quality and that tank waste constituents present in the groundwater resulted from surface water infiltration in the northern portion of the WMA. As required by 40 CFR 265.93(d)(7)(i), assessment monitoring will continue under this monitoring plan.

2.3 Waste Characteristics

Table 2-2 lists the dangerous constituents found in the Dangerous Waste Permit Application Part A form (WA7890008967, *RCRA Permit, Dangerous Waste Portion for the Treatment, Storage, and Disposal of Dangerous Waste*). Mobile tank waste constituents identified in the groundwater included nitrate and some of the metals included in Table 2-2 (DOE/RL-2008-66; SGW-47538).

Table 2-2. Dangerous Wastes in the SST System (Dangerous Waste Permit Application Part A Form)

Dangerous Waste Code	Contaminant Description	Dangerous Waste Code	Contaminant Description
D001	Ignitable waste	D034	Hexachloroethane
D002	Corrosive waste	D035	Methyl ethyl ketone
D003	Reactive waste	D036	Nitrobenzene
D004	Arsenic	D038	Pyridine
D005	Barium	D039	Tetrachloroethene
D006	Cadmium	D040	Trichloroethene
D007	Chromium	D041	2,4,5-Trichlorophenol
D008	Lead	D043	Vinyl chloride
D009	Mercury	F001	1,1,1-Trichloroethane
D010	Selenium	F002	Methylene chloride
D011	Silver	F003	Acetone, methyl isobutyl ketone
D018	Benzene	F004	Cresol-m, -o, -p
D019	Carbon tetrachloride	F005	Methyl ethyl ketone
D022	Chloroform	WT01	Extremely hazardous waste/ toxic dangerous waste
D028	1,2-Dichloroethane	WT02	Dangerous waste/toxic dangerous waste
D029	1,1-Dichloroethylene	WP01	Extremely hazardous waste/ persistent dangerous waste
D030	2,4-Dinitrotoluene	WP02	Dangerous waste/persistent dangerous waste
D033	Hexachlorobutadiene		

Notes:

WA7890008967, *RCRA Permit, Dangerous Waste Portion for the Treatment, Storage, and Disposal of Dangerous Waste.*

Analytes associated with the "F001" through "F005" waste codes are from WHC-MR-0517, *Listed Waste History at Hanford Facility TSD Units.*

2.4 Geology and Hydrology

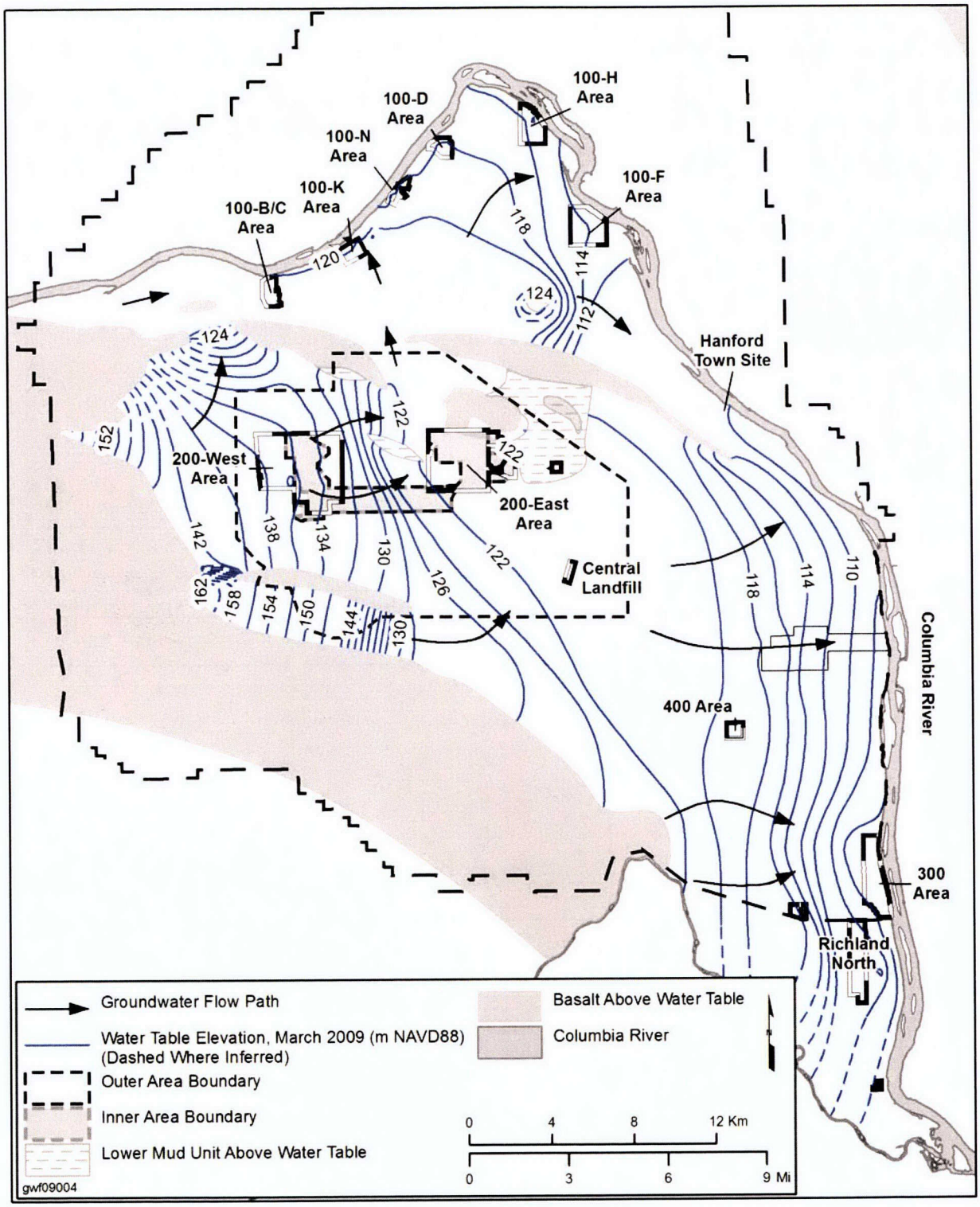
The stratigraphy beneath WMA A-AX consists of unconsolidated to semiconsolidated sediments overlying basalt bedrock of the Columbia River Basalt Group. The sedimentary units present (in descending sequence) are as follows:

- Sand and gravel backfill and scattered amounts of eolian silty sand
- Sand and gravel of the Hanford formation
- Silt to gravel deposits of the Cold Creek Unit
- Sand and gravel of Ringold Unit A (which overlies the basalt)

More detailed information about geology is provided in RPP-23748, RPP-35484, and RPP-14430. The SSTs were placed in the upper portions of the Hanford formation. The water table occurs within the Hanford formation (or possibly the upper portions of the Cold Creek unit), and the vadose zone beneath the WMA is approximately 88 m (290 ft) thick. The base of the aquifer is the contact between the Ringold Unit A, and the underlying basalt at about 111 m (365 ft) depth below ground surface. The unconfined aquifer is approximately 23 m (75 ft) thick. A more detailed description and summary of the geology of WMA A-AX is provided in PNNL-13023. Geology and subsurface hydrology from a more regional perspective are discussed in the *Remedial Investigation Report for the 200-PO-1 Groundwater Operable Unit* (DOE/RL-2009-85).

Figure 2-2 shows the March 2009 water table map for the Hanford Site. The water table in the vicinity of the 200 East Area and WMA A-AX is very flat. The estimated water table gradient in March 2009 was 0.00002, making it difficult to determine groundwater flow direction from water table elevation data. Historically, groundwater moved radially outward from a groundwater mound established beneath 216-B-3 Pond, which lies to the northeast of the WMA. Groundwater flow beneath WMA A-AX during this period was generally to the west. With the termination of discharges to the 216-B-3 Pond, this mound has largely dissipated, leading to a general decline in water levels throughout the 200 East Area and changed groundwater flow directions. Based on plume maps and recent efforts to decrease measurement error in determining water table elevations (Chapter 2 in DOE/RL-2010-11, *Hanford Site Groundwater Monitoring and Performance Report for 2009*), the flow direction at WMA A-AX is now likely to the southeast. The flow direction will likely remain southeasterly at the WMA because the flow obstacle of the Ringold lower mud unit (situated at the water table to the east near the 216-B-3 Pond) (see Figure 2-2) will prevent eastward flow through that area. Between 2007 and 2010, the water table elevation declined at an average rate of 0.06 to 0.08 m/year (0.20 to 0.26 ft/year) in the monitoring wells.

Analysis of water-level data collected during March 2009 indicates that the hydraulic gradient magnitude is approximately 0.00002, and the groundwater flow rate (i.e., average linear velocity) ranges between 0.13 and 0.40 m/day (0.43 and 1.3 ft/day), depending on the hydraulic conductivity and effective porosity (DOE/RL-2010-11, Appendix C, Table C-1). Using values believed to be most representative, 1,981 m/day (6,498 ft/day) (PNL-8337, *Summary and Evaluation of Available Hydraulic Property Data for the Hanford Site Unconfined Aquifer System*; WHC-SD-EN-TI-019, *Hydrogeologic Model for the 200 East Groundwater Aggregate Area*) for the hydraulic conductivity and 0.2 for the effective porosity, the groundwater flow rate most representative for this site is 0.2 m/day (0.65 ft/day).



Source: DOE/RL-2010-11, *Hanford Site Groundwater Monitoring and Performance Report for 2009.*

Figure 2-2. Hanford Site Water Table Map for March 2009 and Inferred Flow Direction

2.5 Summary of Previous Groundwater Monitoring

In 2006, the groundwater monitoring program for WMA A-AX was changed from indicator parameter evaluation to groundwater quality assessment (first determination) because specific conductance exceeded the critical mean value. In 2008, the well system was completed by installing replacement well 299-E25-236. Groundwater monitoring continued during 2009 under the groundwater assessment plan until a full year of groundwater monitoring data had been collected from the replacement well, as well as the previously existing wells. In the assessment report of the initial findings issued in August 2010 (SGW-47538), it was concluded that WMA A-AX may have impacted groundwater quality with nickel, which is a dangerous waste constituent (Appendix 5 of Ecology Publication 97-407 and referenced in WAC 173-303-080 and -100) and recommended that the WMA proceed to groundwater quality assessment in accordance with 40 CFR 265.93(d)(7). This groundwater monitoring plan presents the requirements for groundwater monitoring at WMA A-AX.

2.5.1 Groundwater Contamination

The following discussion is, in part, from DOE/RL-2010-11 and represents conditions in fiscal year 2009 for site-specific (or primary) groundwater constituents required by the former groundwater monitoring plan (PNNL-15315). Primary constituents included nitrate, sulfate, sodium, chromium, lead, and total organic carbon. The groundwater quality assessment results, as documented in SGW-47538, are also discussed.

Only nitrate exceeded drinking water standards (45 mg/L, or 10 mg/L N in nitrate). Chromium and lead were detected, but chromium was detected only at very low levels in three wells (one upgradient well). The detections for lead were all below Hanford Site background levels at the 95th percentile (DOE/RL-96-61, *Hanford Site Background: Part 3, Groundwater Background*). Sodium and sulfate were detected in all of the WMA A-AX samples and are naturally occurring constituents in Hanford Site groundwater. Detected sodium was at or below background levels. Sulfate concentrations were well above Hanford Site background levels, but upgradient wells had concentrations similar to downgradient wells. Total organic carbon was detected at concentrations as high as 1,400 µg/L in well 299-E24-22, but this is also an upgradient well.

Nitrate was detected in upgradient wells and in wells monitoring other waste sites upgradient, indicating that WMA A-AX is within a larger 200 East Area nitrate plume. Downgradient well 299-E25-93 had nitrate concentrations exceeding the drinking water standard, with an average of 54 mg/L during 2009. The higher concentrations at downgradient well 299-E25-93 compared with upgradient well concentrations indicate a possible source of nitrate within WMA A-AX. The trends for nitrate at upgradient wells 299-E24-22, 299-E24-20, and 299-E24-33 have been relatively stable since 2007.

An examination of monitoring results for secondary constituents for the last 5 years as part of the first determination groundwater quality assessment process revealed several other metals and anions that are also detected in groundwater at WMA A-AX, although at concentrations lower than drinking water standards (SGW-47538). (Note that secondary constituents include additional results beyond the primary constituents that are routinely provided by the analytical laboratory for the anion and metals analytical methods.) Two of the metal secondary constituents (barium and nickel) are dangerous waste constituents (Appendix 5 of Ecology Publication 97-407, and referenced in WAC 173-303-080 and -100) that appeared to be in higher concentrations in at least one downgradient well versus the concentrations in upgradient wells. Concentrations of detected barium are lower than Hanford Site background (105 µg/L at the 90th percentile), but nickel concentrations were detected above Hanford Site background (1.56 µg/L at the 90th percentile) in two downgradient wells (299-E25-40 and replacement well 299-E25-236). Figure 2-3 shows nickel concentrations at downgradient wells 299-E25-40 and 299-E25-236 and at

corresponding upgradient well 299-E24-33. Statistical testing using T-test of means, paired T-test, and signed-rank tests all indicate a statistically significant increase in nickel concentrations in downgradient well 299-E25-40 relative to concentrations in upgradient well 299-E24-33 (SGW-47538). The elevated concentrations of nickel in downgradient well 299-E25-40 (and apparently at well 299-E25-236) suggest that WMA A-AX has contaminated groundwater with dangerous waste constituents and that monitoring should proceed to groundwater quality assessment in accordance with 40 CFR 265.93(d)(7).

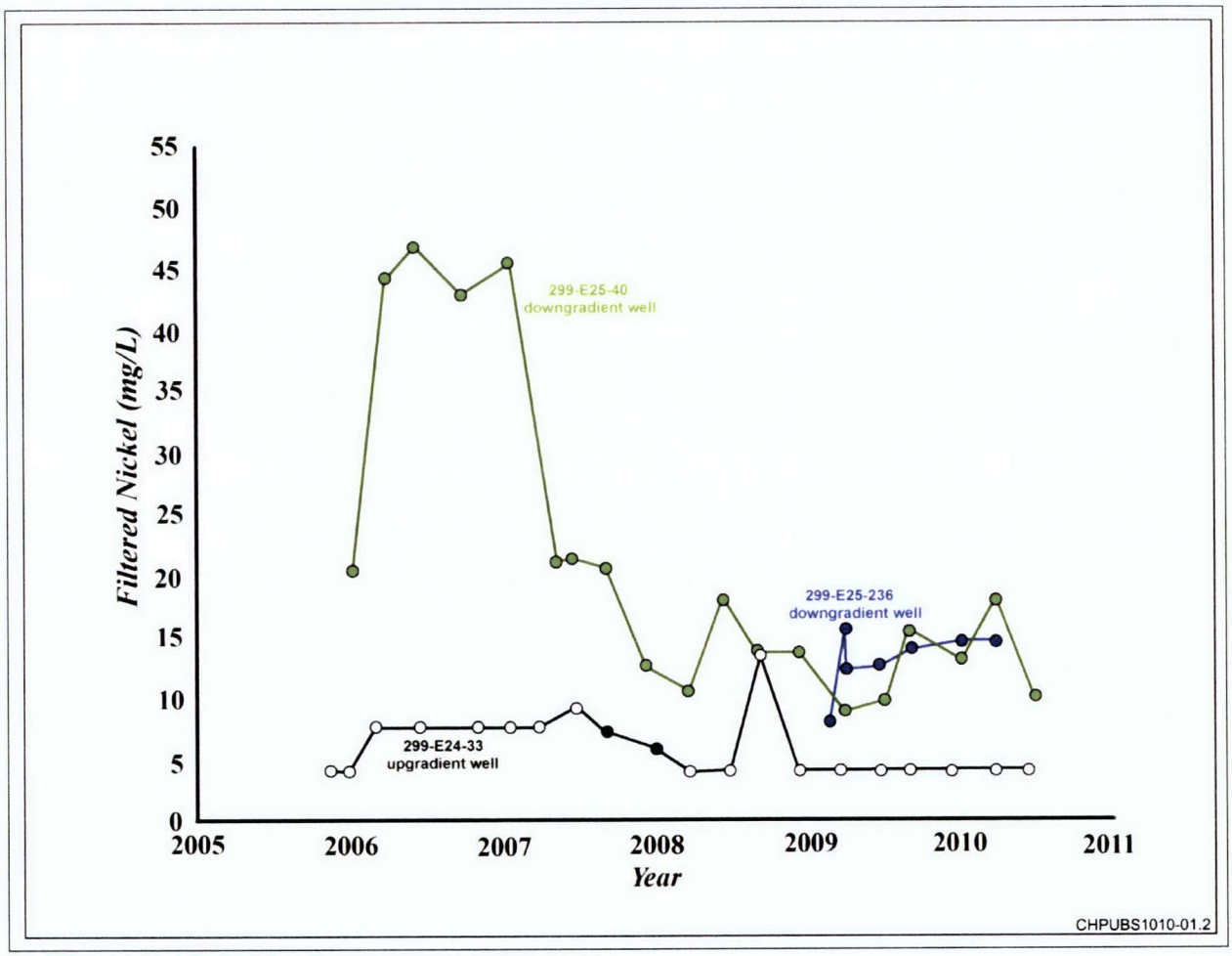


Figure 2-3. Nickel Concentrations at Downgradient Wells 299-E25-40 and 299-E25-236 Compared to Upgradient Well 299-E24-33 at WMA A-AX

2.5.2 Vadose Zone Contamination

The threat to groundwater posed by the tanks themselves has been significantly reduced for two reasons:

- All SSTs at the Hanford Site have been interim stabilized.
- Interim measures have been implemented to reduce the forces driving contamination downward to the groundwater (e.g., constructing berms around the tank farms to divert surface water runoff away from the facility, testing all nearby water lines and removing leaking water lines from service, and capping all vadose zone monitoring boreholes in the tank farms).

Past tank releases have left portions of the vadose zone contaminated. This contamination has the potential to move downward into the groundwater, especially if a driving force is present.

Two wells, 299-E24-19 and 299-E25-46 (see Figure 2-1), became corroded in the vadose zone portion of their casings at approximately 84 to 86 m (276 to 282 ft) below ground surface. This level is just above the water table in a section that is mostly sand with a silt layer approximately 1 m (3 ft) thick. The two wells were decommissioned in 2004 after corrosion was confirmed by a borehole video survey (PNNL-15070, *Hanford Site Groundwater Monitoring for Fiscal Year 2004*). Each well suffered extensive casing corrosion at the level of the silt zone that was discovered to have high moisture content. The groundwater at both well locations displayed high levels of dissolved chromium, nickel, and manganese (PNNL-13788; PNNL-14548). These dissolved metals may have come from the stainless-steel casing.

Pacific Northwest National Laboratory performed detailed analyses of vadose zone sediment samples collected in the vicinity of WMA A-AX and bentonite material similar that used to seal the corroded wells in an attempt to discover the cause of the rapid corrosion in the wells (PNNL-15141, *Investigation of Accelerated Casing Corrosion in Two Wells at Waste Management Area A-AX*). The laboratory tests provided the following conclusions regarding the cause of rapid corrosion:

1. The bentonite test sample was shown to be capable of generating localized vadose zone porewater with chloride concentrations in excess of 700 mg/L. The silt zone at the depths of 82 to 86 m (269 to 282.5 ft) and any perched water above it may have had sufficient moisture to leach chloride from the bentonite and corrode the casing.

2. Findings from analysis of the sidewall core samples from wells 299-E24-19 and 299-E25-46 demonstrate that the vadose zone was capable of generating porewater with sufficient chloride concentrations to cause corrosion of the stainless-steel well casing. It is likely that chloride leached from the bentonite material and/or carried as a constituent of the liquid waste stream caused the advanced well casing corrosion by way of crevice corrosion and stress corrosion cracking.

3. Analysis of split-spoon core samples collected from the boreholes during installation of wells 299-E25-94 and 299-E24-33 showed that common Hanford sediment constituents were not present at concentrations that could lead to the advanced corrosion found in failed wells.

PNNL-15141 concluded with the recommendation that Portland cement be used as an annulus sealing agent in groundwater monitoring wells in zones with high moisture content or in wells that have the potential to accumulate perched water.

In 2008, when replacement well 299-E25-236 was installed, four split-spoon core samples were collected between the depths of 82 and 85.5 m (269.6 to 280.5 ft) and chemically analyzed (PNNL-SA-18197, *Analytical Data Report for the Sediment Samples Collected from Well 299-E25-236 in the 200-PO-1 Operable Unit*). Results were similar to item 3 above; sediments were capable of generating porewater with sufficient chloride concentrations to cause corrosion of the stainless-steel well casing. The equivalent porewater concentrations ranged from 220 to 233 mg/L, which is higher than the 100 mg/L commonly considered concentrated enough to corrode stainless steel. Because bentonite was not present when well 299-E25-236 was drilled, chemical analysis of the split-spoon samples demonstrated that the vadose zone chemistry of the zone at 82 to 85.5 m (269.6 to 280.5 ft) was affected by a Hanford Site waste stream (possibly from WMA A-AX). The stainless-steel casing in well 299-E25-236 is not expected to experience any significant corrosion because the 82 to 85.5 m (269.6- to 280.5-ft) zone was sealed with Portland cement rather than bentonite.

2.6 Conceptual Model

The *RCRA Facility Investigation Report for Hanford Single-Shell Tank Waste Management Areas* (DOE/ORP-2008-01) summarizes a conceptual model of tank leak pathways to the groundwater, and Appendix A of that document presents the conceptual model in detail. The following summary is from DOE/ORP-2008-01, as well as PNNL-13023 and PNNL-15315.

2.6.1 Contaminant Source

Of the 10 tanks located within WMA A-AX, 3 tanks are confirmed or assumed to have leaked (RPP-RPT-46613). A maximum leak volume of 160,880 L (42,500 gal) has been reported for WMA A-AX tanks. Wastewater may also have resulted from waste transfer piping systems. Tank leak events and releases from transfer piping systems began with rapid discharge of some waste fluid volume into the subsurface from a point of entry likely having a small spatial extent (on the order of inches to rarely feet). This discharge temporarily increased the moisture content of the unsaturated soil, particularly at the point of entry. Points of entry included poorly sealed openings in the tank structure, ruptured areas of steel tank liners combined with nearby underlying concrete shell fractures, and breaks in waste transfer lines. Natural processes then redistributed the excess moisture within the vadose zone, eventually returning the soil to ambient conditions.

The migration process occurred, for the most part, in partially saturated soils because leak volumes were not sufficient to fill the soil pore spaces for an appreciable length of time or very far from the point of entry. This condition is referred to as "unsaturated flow." In addition to vertical flow, lateral flow occurred because soil layers with different hydraulic properties tend to be layered more or less horizontally by sediment deposition processes. Consequently, flow in the lateral direction could occur and be enhanced by the unsaturated conditions.

2.6.2 Driving Forces

External sources of water or other liquid may have acted to drive contamination downward. Infiltration of fresh water (as well as precipitation and unintentional, manmade releases such as leaking water lines) may move residual waste remaining in the soil downward to the groundwater. Another potential source of water was nearby wastewater disposal sites including the 216-A-8 Crib, 216-A-24 and 216-A-29 Ditches, and 216-B-3 Pond to the east; the 216-A-37-1 and -2 Cribs to the southeast; and the PUREX Cribs to the south. Perched water beneath these disposal sites may have migrated laterally beneath WMA A-AX, although this has not been confirmed.

As waste fluids are migrating within the vadose zone, numerous contaminants are reacting chemically with the vadose zone soil/water system to varying degrees. Water extracts of contaminants from sediments collected from sidewall core samples (wells 299-E24-29 and 299-E25-46) and split-spoon samples from well 299-E25-236 suggest that waste water from Hanford Site waste streams (not necessarily WMA A-AX) have entered the vadose zone and migrated to depths nearly as deep as the water table at WMA A-AX.

2.6.3 Migration

Upon reaching the groundwater, the plumes migrate toward the southeast with the groundwater flow. The groundwater flow velocity has been estimated at 0.2 m/day (0.65 ft/day) (see Section 2.4). PNNL-13023 discusses conceptual models of tank leak pathways to the groundwater at WMA A-AX in more detail.

2.7 Data Quality Objectives

The DQO process ensures that data gathered during an investigation are of the appropriate quantity and quality to meet specific objectives. The DQO parameters, regulatory interim status requirements, and associated reports supporting the regulatory requirements are outlined in Table 2-3.

Table 2-3. DQO Parameters, Associated Regulatory Requirements, and Documentation for WMA A-AX

DQO Parameter	Related Requirements	Plan Criteria and Associated Historical Documentation
Scope	**40 CFR 265.93, Preparation, Evaluation, and Response; as modified by WAC 173-303-400(3)(b) and -400(3)(c)(v).** (d)(7) If the owner or operator determines…that hazardous waste or hazardous waste constituents from the facility have entered the ground-water, then the owner or operator: (i) Must continue to make the determinations required under paragraph (d)(4) of this section… **40 CFR 265.93, Preparation, Evaluation, and Response; as modified by WAC 173-303-400(3)(b) and -400(3)(c)(v).** (d)(4) The owner or operator must implement the ground-water quality assessment plan which satisfies the requirements of paragraph (d)(3) of this section, and, at a minimum, determine: (i) The rate and extent of migration of the hazardous waste or hazardous waste constituents in the ground-water; and (ii) The concentrations of the hazardous waste or hazardous waste constituents in the ground-water. **40 CFR 265.93, Preparation, Evaluation, and Response; as modified by WAC 173-303-400(3)(b) and -400(3)(c)(v).** (d)(3) The plan to be submitted under 40 CFR 265.90(d)(1) or paragraph (d)(2) of this section must specify: (i) The number, location, and depth of wells; (ii) Sampling and analytical methods for those hazardous wastes or hazardous waste constituents in the facility; (iii) Evaluation procedures, including any use of previously gathered ground-water quality information; and (iv) A schedule of implementation.	PNNL-13023, *RCRA Groundwater Monitoring Plan for Single-Shell Tank Waste Management Area A-AX at the Hanford Site*, as modified by interim change notices PNNL-15315, *RCRA Assessment Plan for Single-Shell Tank Waste Management Area A-AX at the Hanford Site* This plan, Sections 3.1 and 3.2, Chapter 4, and Appendix A

Table 2-3. DQO Parameters, Associated Regulatory Requirements, and Documentation for WMA A-AX

DQO Parameter	Related Requirements	Plan Criteria and Associated Historical Documentation
Number and location of wells Point(s) of compliance	**40 CFR 265.93, Preparation, Evaluation, and Response; as modified by WAC 173-303-400(3)(b) and -400(3)(c)(v).** (d)(4) The owner or operator must implement the ground-water quality assessment plan which satisfies the requirements of paragraph (d)(3) of this section, and, at a minimum, determine: (i) The rate and extent of migration of the hazardous waste or hazardous waste constituents in the ground-water; and (ii) The concentrations of the hazardous waste or hazardous waste constituents in the ground-water.	PNNL-13023, *RCRA Groundwater Monitoring Plan for Single-Shell Tank Waste Management Area A-AX at the Hanford Site*, as modified by interim change notices PNNL-15315, *RCRA Assessment Plan for Single-Shell Tank Waste Management Area A-AX at the Hanford Site* This plan, Chapters 1 and 3, and Appendix A
Well configuration (depth and length of screened interval; well construction)	**40 CFR 265.91, Ground-Water Monitoring System.** (c) All monitoring wells must be cased in a manner that maintains the integrity of the monitoring well borehole. This casing must be screened or perforated, and packed with gravel or sand where necessary to enable sample collection at depths where appropriate aquifer flow zones exist. The annular space (i.e., the space between the borehole and well casing) above the sampling depth must be sealed with a suitable material (e.g., cement grout or bentonite slurry) to prevent contamination of samples and the ground-water. **Additional requirements from WAC 173-303-400 (3)(c)(v)(C).** Ground-water monitoring wells must be designed, constructed, and operated so as to prevent ground-water contamination. WAC 173-160 may be used as guidance in the installation of wells.	PNNL-13023, *RCRA Groundwater Monitoring Plan for Single-Shell Tank Waste Management Area A-AX at the Hanford Site*, as modified by interim change notices PNNL-15315, *RCRA Assessment Plan for Single-Shell Tank Waste Management Area A-AX at the Hanford Site* This plan, Section 3.2
Frequency of sampling Types of analysis or measurement Method detection limits or accuracy and precision Methods used to evaluate the collected data	**40 CFR 265.93, Preparation, Evaluation, and Response; as modified by WAC 173-303-400(3)(b) and -400(3)(c)(v).** (d)(7) If the owner or operator determines...that hazardous waste or hazardous waste constituents from the facility have entered the ground-water, then the owner or operator: (i) Must continue to make the determinations required under paragraph (d)(4) of this section <u>on a quarterly basis</u> until final closure of the facility, if the ground-water quality assessment plan was implemented prior to final closure of the facility; or (ii) May cease to make the determinations required under paragraph (d)(4) of this section, if the ground-water quality assessment plan was implemented during the post-closure care period.	PNNL-15315, *RCRA Assessment Plan for Single-Shell Tank Waste Management Area A-AX at the Hanford Site* This plan, Section 3.1, Chapter 4, and Appendix A

Table 2-3. DQO Parameters, Associated Regulatory Requirements, and Documentation for WMA A-AX

DQO Parameter	Related Requirements	Plan Criteria and Associated Historical Documentation
	40 CFR 265.93, Preparation, Evaluation, and Response; as modified by WAC 173-303-400(3)(b) and -400(3)(c)(v). (d)(4) The owner or operator must implement the ground-water quality assessment plan which satisfies the requirements of paragraph (d)(3) of this section, and, at a minimum, determine: (i) The rate and extent of migration of the hazardous waste or hazardous waste constituents in the ground-water; and (ii) The concentrations of the hazardous waste or hazardous waste constituents in the ground-water.	

Notes: The references cited in this table are listed in the reference section (Chapter 5) of this plan.

CFR = *Code of Federal Regulations*

DQO = data quality objective

WAC = *Washington Administrative Code*

3 Groundwater Monitoring Program

This chapter lists the wells monitored, constituents analyzed, and sampling frequency for WMA A-AX. Quality assurance and quality control requirements are provided in the QAPjP (Appendix A).

3.1 Constituent List and Sampling Frequency

The constituent list for groundwater sampling includes those analytes on the RCRA groundwater monitoring list that may be present in SST waste. To identify these analytes, the list of primary nonradiological constituents potentially present in SST waste (RPP-23403, *Single-Shell Tank Component Closure Data Quality Objectives*) was compared to those constituents listed in Appendix 5 of Ecology Publication 97-407 (which references 40 CFR 264, Appendix IX). Those constituents in RPP-23403 that are on the groundwater monitoring list (i.e., listed in Appendix 5 of Ecology Publication 97-407) are included in Table 3-1.

Table 3-1. Constituents on the RCRA Groundwater Monitoring List Potentially Present in the SST Farm System

Constituent	CAS ID	Constituent	CAS ID
Volatile Organic Compounds			
1,1,1-Trichloroethane	71-55-6	Chloroform	67-66-3
1,1,2,2-Tetrachloroethane	79-34-5	Ethylbenzene	100-41-4
1,1,2-Trichloroethane	79-00-5	Isobutanol	78-83-1
1,1-Dichloroethene	75-35-4	Methylene chloride	75-09-2
1,2-Dichloroethane	107-06-2	Tetrachloroethene	127-18-4
2-Butanone (methyl ethyl ketone)	78-93-3	Toluene	108-88-3
2-Propanone (acetone)	67-64-1	trans-1,3-Dichloropropene	10061-02-6
4-Methyl-2-pentanone (MIBK)	108-10-1	Trichloroethylene	79-01-6
Benzene	71-43-2	Trichlorofluoromethane	75-69-4
Carbon disulfide	75-15-0	Vinyl chloride (chloroethene)	75-01-4
Carbon tetrachloride	56-23-5	Xylenes	1330-20-7
Chlorobenzene	108-90-7		
Semivolatile Organic Compounds			
1,2,4-Trichlorobenzene	120-82-1	Aroclor-1260	11096-82-5
2,4,5-Trichlorophenol	95-95-4	Butylbenzylphthalate	85-68-7
2,4,6-Trichlorophenol	88-06-2	Di-n-butylphthalate	84-74-2
2,4-Dinitrotoluene	121-14-2	Di-n-octylphthalate	117-84-0
2-Chlorophenol	95-57-8	Fluoranthene	206-44-0
2-Methylphenol (o-cresol)	95-48-7	Hexachlorobutadiene	87-68-3

Table 3-1. Constituents on the RCRA Groundwater Monitoring List Potentially Present in the SST Farm System

Constituent	CAS ID	Constituent	CAS ID
3-Methylphenol (m-Cresol)	108-39-4	Hexachloroethane	67-72-1
4-Chloro-3-methylphenol (p-Chloro-m-cresol)	59-50-7	Naphthalene	91-20-3
4-Methylphenol (p-cresol)	106-44-5	Nitrobenzene	98-95-3
Acenaphthene	83-32-9	n-Nitroso-di-n-propylamine	621-64-7
Aroclor-1016	12674-11-2	n-Nitrosomorpholine	59-89-2
Aroclor-1221	11104-28-2	1,2-Dichlorobenzene (o-Dichlorobenzene)	95-50-1
Aroclor-1232	11141-16-5	2-Nitrophenol (o-Nitrophenol)	88-75-5
Aroclor-1242	53469-21-9	Pyrene	129-00-0
Aroclor-1248	12672-29-6	Pyridine	110-86-1
Aroclor-1254	11097-69-1		
Inorganic Constituents (Nonradiological)			
Antimony (Sb)	7440-36-0	Lead (Pb)	7439-92-1
Arsenic (As)	7440-38-2	Mercury (Hg)	7439-97-6
Barium (Ba)	7440-39-3	Nickel (Ni)	7440-02-0
Beryllium (Be)	7440-41-7	Selenium (Se)	7782-49-2
Cadmium (Cd)	7440-43-9	Silver (Ag)	7440-22-4
Chromium (Cr)	7440-47-3	Sulfide (S^{2-})	18496-25-8
Cobalt (Co)	7440-48-4	Thallium (Tl)	7440-28-0
Copper (Cu)	7440-50-8	Vanadium (V)	7440-62-2
Cyanide (CN^-)	57-12-5	Zinc (Zn)	7440-66-6

Notes: This table lists the primary nonradiological constituents provided in RPP-23403, *Single-Shell Tank Component Closure Data Quality Objectives*, which are also on the RCRA groundwater monitoring list (i.e., also listed in Appendix 5 of Ecology Publication 97-407, *Chemical Test Methods for Designating Dangerous Waste: WAC 173-303-090 & -100* [which references 40 CFR 264, "Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities," Appendix IX, "Ground-Water Monitoring List"]).

CAS = Chemical Abstract Service

CFR = *Code of Federal Regulations*

Ecology = Washington State Department of Ecology

ID = identification

RCRA = Resource *Conservation and Recovery Act of 1976*

As described in Section 2.5.1, of the 72 analytes listed in Table 3-1, only nickel was found in groundwater at concentrations above the Hanford Site background level (DOE/RL-96-61), above concentrations in upgradient wells, possibly attributed to releases from the WMA. In addition, nitrate is present in the groundwater and has been attributed to the WMA. Thus, nickel and the supporting constituent nitrate (along with the other supporting constituents alkalinity, major cations [metals], and major anions) are routinely sampled under RCRA in the network monitoring wells (Table 3-2). The supporting constituents provide information on general chemistry and allow for charge-balance computations to assess laboratory performance.

Table 3-2. Monitoring Network, Constituent List, and Sampling Frequency for WMA A-AX

Well	WAC Compliant	RCRA	Supporting Parameters				Field-Measured Parameters					Table 3-1 Analytes
		Nickel[a]	Nitrate	Alkalinity	Anions[b]	Metals[c]	pH	Specific Conductance	Temperature	Turbidity	Water Levels	
299-E24-20	C	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Once
299-E24-22	C	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Once
299-E24-33	C	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Once
299-E25-40	C	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Once
299-E25-41	C	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Once
299-E25-2	N[d]	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Once
299-E25-93	C	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Once
299-E25-94	C	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Once
299-E25-236	C	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Once
New Deep Well	C	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Once

Notes:

Wells completed at the top of the unconfined aquifer.

Bold/italic print indicates upgradient well.

a. Filtered and unfiltered total chromium.

b. Anions include, but are not limited to, chloride, nitrate, and sulfate.

c. Metals (filtered and unfiltered) include, but are not limited to, calcium, magnesium, potassium, and sodium.

d. Well is usable for monitoring based on EPA and Ecology's "Policy on Remediation of Existing Wells and Acceptance Criteria for RCRA and CERCLA" (Nord and Day 1990).

C = well is constructed as a resource protection well under WAC 173-160, "Minimum Standards for Construction and Maintenance of Wells"

Ecology = Washington State Department of Ecology

EPA = U.S. Environmental Protection Agency

N = well is not constructed as a resource protection well under WAC 173-160

Table 3-2. Monitoring Network, Constituent List, and Sampling Frequency for WMA A-AX

Well	WAC Compliant	RCRA	Supporting Parameters				Field-Measured Parameters					Table 3-1 Analytes
		Nickel[a]	Nitrate	Alkalinity	Anions[b]	Metals[c]	pH	Specific Conductance	Temperature	Turbidity	Water Levels	

N/A = not applicable
Q = sampled quarterly
RCRA = *Resource Conservation and Recovery Act of 1976*
WAC = *Washington Administrative Code*

Sampling for the remaining constituents identified in Table 3-1 will be performed once in all wells during the first available sample event after this plan is in effect to determine if these constituents have impacted groundwater quality. Those constituents not detected in groundwater will be removed from future sampling. If an organic constituent from Table 3-1 is detected in a groundwater sample and it is not attributed to contamination from another facility (detected in comparable concentrations in upgradient wells), a confirmation sample will be collected at the next scheduled sample event, with split samples sent to different analytical laboratories. If the detection is confirmed by positive results from both laboratories, the constituent will be added to the list of analytes for routine sampling to evaluate the extent of contamination. If the detection is not confirmed, the analyte will be removed from future sampling.

Some of the inorganic constituents included in Table 3-1 occur naturally in groundwater at concentrations above the laboratory method detection limit (e.g., barium, selenium, vanadium, and zinc). Detections of an inorganic constituent will be evaluated to determine if the constituent is present naturally by comparison to sample results from the upgradient well and comparisons to the Hanford Site background values (DOE/RL-96-61). If it is determined that an inorganic constituent may be present as a contaminant from the WMA, confirmation samples will be collected (as described for the organic constituents). If contamination is confirmed, then the constituent will be added to the routine sample list to evaluate the extent of contamination. If the contamination is not confirmed, the constituent will be removed from future sampling.

3.2 Well Network

Table 3-2 includes the list of monitoring wells for WMA A-AX, and Figure 2-1 shows the well locations. The wells are also co-sampled for the 200-PO-1 Operable Unit (under the *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* [CERCLA]), although CERCLA sampling is at a lower frequency (annually). Sampling is coordinated to avoid duplication of analyses and additional well trips. Maintenance issues and sampling logistics sometimes delay scheduled sampling events. If sampling of a well is delayed by 2 months or more, that event will be cancelled, as it is nearly time for the next quarterly sampling event. The proposed new well near the existing well 299-E25-93 is for the purpose of monitoring the base of the unconfined aquifer. The Ringold lower mud unit is missing beneath WMA A-AX, so the bottom of the unconfined aquifer is the basalt bedrock at approximately 111 m (365 ft).

Table 3-3 summarizes well depth information, including the depth of the water column in each monitoring well. All wells are constructed of stainless-steel casing and screens with full annular seals, with the exception of well 299-E25-2, which has a perforated carbon-steel casing. All wells are equipped with dedicated sampling pumps. With the exception of well 299-E25-236, as-built diagrams showing details of construction for each well are provided in PNNL-15315. The as-built diagram for well 299-E25-236 is provided in Appendix B.

Table 3-3. WMA A-AX Well Depths and Water Table Elevation

Well	Year Drilled	Water Table Elevation (m)* (March 2010)	Casing Elevation (m)*	Open Interval Bottom Elevation (m)*	Water Column (m) (March 2010)
299-E24-20	1991	121.896	211.151	117.7	4.2
299-E24-22	2003	121.855	210.285	111.6	10.3
299-E24-33	2004	121.855	206.801	112.3	9.6
299-E25-40	1989	121.826	203.997	118.8	3.0
299-E25-41	1989	121.844	205.688	119.5	2.3
299-E25-2	1955	121.933	206.954	109.7	12.2
299-E25-93	2003	121.853	208.040	111.8	10.1
299-E25-94	2004	122.110	211.313	110.7	11.4
299-E25-236	2008	121.820	212.587	112.8	9.0

Notes: Bold/italic print indicates upgradient well.

* North American Vertical Datum of 1988 (NAVD88).

Water-level measurements are collected in each well at the time of sampling. In addition, water-level measurements are collected from each of the wells shown in Table 3-3 within a single day during March of each year to support water table mapping. The water table elevation beneath WMA A-AX has been declining at an average rate of approximately 0.06 to 0.08 m/year (0.20 to 0.26 ft/year) since 2007. The long-term decline is the result of reduced effluent discharges to ground at the Hanford Site since peak discharge occurred in the 1980s. At this same rate of decline (0.06 to 0.08 m/year [0.20 to 0.26 ft/year]), the well with the shortest water column (299-E25-41) will go dry in 25 to 33 years. Because there are no immediate plans for pump-and-treat operations, nor are any increases in wastewater discharges expected in the near future, both the water table and the water table decline per year will likely decrease as equilibrium conditions are reached.

The existing wells in WMA A-AX are all screened across the water table. None of the wells monitor the lower portion of the aquifer. As a result, information is not available regarding potential groundwater contamination in the deeper portions of the aquifer beneath WMA A-AX. Well 299-E27-155 is screened within the lower portion of the aquifer at WMA C and shows elevated levels of technetium-99 (DOE/RL-2010-11, Chapter 4, Section 4.2.3.3). It is possible that similar deep aquifer contamination may occur beneath WMA A-AX; therefore, a new, deep well is proposed for WMA A-AX near well 299-E25-93 (Figure 2-1) in order to characterize potential groundwater contamination in the lower portion of the unconfined aquifer. The proposed location is near existing well 299-E25-93 because the well has the highest levels of known groundwater contamination from WMA A-AX (nitrate and

technetium-99). New wells at the Hanford Site are negotiated annually by Ecology, DOE, and EPA under the *Hanford Federal Facility Agreement and Consent Order* (Tri-Party Agreement) (Ecology et al., 1989) Milestone M-24-00.

3.3 Sampling and Analysis Protocol

Groundwater monitoring at WMA A-AX follows the conventions of the project and is discussed in the QAPjP (Appendix A).

4 Data Evaluation and Reporting

This chapter discusses data evaluation and reporting for WMA A-AX.

4.1 Data Review

Data review, validation, and verification are discussed in the QAPjP (Appendix A).

4.2 Interpretation

After sampling and water-level data are validated and verified, the acceptable data are used to interpret groundwater conditions at the site. Interpretive techniques include the following:

- **Hydrographs:** Graph water levels versus time to determine decreases, increases, seasonal, or manmade fluctuations in groundwater levels.
- **Water table maps:** Use water table elevations from multiple wells to construct contour maps to estimate flow directions. Groundwater flow is assumed to be perpendicular to lines of equal potential.
- **Trend plots:** Graph concentrations of constituents versus time to determine increases, decreases, and fluctuations. May be used in tandem with hydrographs and/or water table maps to determine if concentrations relate to changes in water level or in groundwater flow directions.
- **Plume maps:** Map distributions of chemical constituents in the aquifer to determine extent of contamination. Changes in plume distribution over time assist in determining plume movement and direction of groundwater flow.
- **Contaminant ratios:** Can sometimes be used to distinguish between different sources of contamination.

4.3 Annual Determination of Monitoring Network

The RCRA groundwater monitoring requirements include an annual evaluation of the monitoring well network to determine if it remains adequate to monitor the WMA. The network must include upgradient and downgradient wells to monitor groundwater quality in the uppermost aquifer (see Appendix A). The one new well proposed for installation in WMA A-AX is described in Section 3.2.

Water-level measurements will continue to be collected before each sampling event, and more comprehensive measurements will continue to be made in March of each year. The data are presented in the annual Hanford Site groundwater monitoring report (e.g., DOE/RL-2010-11).

4.4 Reporting and Notification

The results of assessment monitoring are reported annually in accordance with the requirements of 40 CFR 265.94, "Recordkeeping and Reporting." Reporting will be made in annual Hanford Site groundwater monitoring reports (e.g. DOE/RL-2010-11).

1

5 References

10 CFR 962, "Byproduct Material," *Code of Federal Regulations*. Available at: http://www.access.gpo.gov/nara/cfr/waisidx_10/10cfr962_10.html.

40 CFR 264, "Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities," Appendix IX, "Ground-Water Monitoring List," *Code of Federal Regulations*. Available at: http://edocket.access.gpo.gov/cfr_2009/julqtr/40cfr264AppIX.htm.

40 CFR 265, "Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities," *Code of Federal Regulations*. Available at: http://www.access.gpo.gov/nara/cfr/waisidx_10/40cfr265_10.html.

265.90, "Applicability."

265.91, "Ground-Water Monitoring System."

265.93, "Preparation, Evaluation, and Response."

265.94, "Recordkeeping and Reporting."

265, Subpart F, "Ground-Water Monitoring."

51 FR 24504, 1986, "EPA Clarification of Regulatory Authority Over Radioactive Mixed Waste," *Federal Register*, July 3, 1986.

Atomic Energy Act of 1954, 42 USC 2011, et seq. Available at: http://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr0980/ml022200075-vol1.pdf.

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Appendix A

Quality Assurance Project Plan

1

Contents

A1 Project Management A-1
A1.1 Project/Task Organization A-1
A1.1.1 Regulatory Project Manager A-1
A1.1.2 U.S. Department of Energy, Richland Operations Office Project Manager A-2
A1.1.3 U.S. Department of Energy, Richland Operations Office Subject Matter Expert A-2
A1.1.4 Contractor Groundwater Remediation Department Manager A-2
A1.1.5 Groundwater Sampling Operations A-3
A1.1.6 RCRA Monitoring and Reporting A-3
A1.1.7 Sample Management and Reporting Organization A-3
A1.1.8 Contract Laboratories A-3
A1.1.9 Quality Assurance A-3
A1.1.10 Environmental Compliance Officer A-3
A1.1.11 Health and Safety A-3
A1.1.12 Waste Management A-3
A1.2 Problem Definition/Background A-4
A1.3 Project/Task Description A-4
A1.4 Quality Objectives and Criteria A-4
A1.5 Special Training/Certification A-4
A1.6 Documents and Records A-4
A2 Data Generation and Acquisition A-5
A2.1 Sampling Process Design (Experimental Design) A-5
A2.1.1 Regulatory Requirements A-5
A2.1.2 Judgmental Sampling A-5
A2.2 Sampling Methods A-6
A2.3 Sample Handling and Custody A-6
A2.4 Analytical Methods A-6
A2.5 Quality Control A-11
A2.5.1 Field Quality Control Samples A-12
A2.5.2 Laboratory Quality Control Samples A-12
A2.5.3 Quality Control Requirements A-12
A2.6 Instrument/Equipment Testing, Inspection, and Maintenance A-16
A2.7 Instrument/Equipment Calibration and Frequency A-16
A2.8 Inspection/Acceptance of Supplies and Consumables A-16
A2.9 Non-Direct Measurements A-16

A2.10 Data Management A-16
A3 Assessment and Oversight A-17
A3.1 Assessments and Response Actions A-17
A3.2 Reports to Management A-17
A4 Data Validation and Usability A-17
A4.1 Data Review, Verification, and Validation A-17
A4.2 Verification and Validation Methods A-17
A4.3 Reconciliation with User Requirements A-18
A5 References A-18

Figure

Figure A-1. Project Organization A-2

Tables

Table A-1. Actions and Documentation for Regulatory Notification A-5
Table A-2. Preservation Techniques, Analytical Methods Used, and Current Method Quantitation Limits for Continuing Constituents A-7
Table A-3. Preservation Techniques, Analytical Methods Used, and Current Method Quantitation Limits for Listed Assessment Constituents A-8
Table A-4. Quality Control Samples A-11
Table A-5. Field and Laboratory Quality Control Elements and Acceptance Criteria A-13
Table A-6. Blind Standard Constituents and Schedule A-15

Terms

CFR	*Code of Federal Regulations*
DOE	U.S. Department of Energy
DQO	data quality objective
EB	equipment blank
Ecology	Washington State Department of Ecology
EPA	U.S. Environmental Protection Agency
FTB	full trip blank
FXR	field transfer blank
HASQARD	*Hanford Analytical Services Quality Assurance Requirements Documents*
HEIS	Hanford Environmental Information System
QA	quality assurance
QAPjP	quality assurance project plan
QC	quality control
RCRA	*Resource Conservation and Recovery Act of 1976*
RL	U.S. Department of Energy, Richland Operations Office
Tri-Party Agreement	*Hanford Federal Facility Agreement and Consent Order*
TSD	treatment, storage, and disposal
WAC	*Washington Administrative Code*

1

Quality Assurance Project Plan

The contractor's quality assurance (QA) program describes the contractor's QA structure, requirements, implementation methods, and responsibilities. The contractor's environmental QA program plan provides the requirements for collecting and assessing environmental data in accordance with the following:

- 10 *Code of Federal Regulations* (CFR) 830, Subpart A, "Nuclear Safety Management," "Quality Assurance Requirements"
- DOE/RL-96-68, *Hanford Analytical Services Quality Assurance Requirements Documents* (HASQARD)
- EPA/240/B-01/003, *EPA Requirements for Quality Assurance Project Plans*
- U.S. Department of Energy (DOE) O 414.1C, *Quality Assurance*

This quality assurance project plan (QAPjP) establishes the quality requirements for environmental data collection including the planning, implementation, and assessment of sampling, field measurements, and laboratory analyses. Sections 6.5 and 7.8 of the *Hanford Federal Facility Agreement and Consent Order* (Tri-Party Agreement) (Ecology et al., 1989a), Attachment 2, "Action Plan," require that the QA/quality control (QC) and sampling and analysis activities specify the QA requirements for treatment, storage, and disposal (TSD) units. The HASQARD requirements (DOE/RL-96-68) also apply to this work.

The content of this QAPjP is patterned after the QA elements of EPA/240/B-01/003. The QAPjP demonstrates conformance to the Part B requirements of ANSI/ASQ E4, *Quality Systems for Environmental Data and Technology Programs: Requirements with Guidance for Use*. This QAPjP is divided into four sections (as designated in EPA/240/B-01/003) that describe the quality requirements and controls applicable to this investigation. This QAPjP is intended to supplement the contractor's environmental QA program plan.

A1 Project Management

This section addresses the basic aspects of project management and will ensure that the project has defined goals, that the participants understand the goals and the approaches used, and that the planned outputs are appropriately documented.

A1.1 Project/Task Organization

The project organization in regard to planning, sampling, analysis, and data assessment is described in the following subsections and is shown in Figure A-1. For each functional primary contractor role, there is a corresponding oversight role within the DOE.

A1.1.1 Regulatory Project Manager

The Washington State Department of Ecology (Ecology) project manager is responsible for oversight of the work being performed under this groundwater monitoring plan. Ecology will work with the DOE Richland Operations Office (RL) to resolve concerns regarding the work as described in this QAPjP. Ecology can request this plan during a regulatory compliance inspection for review.

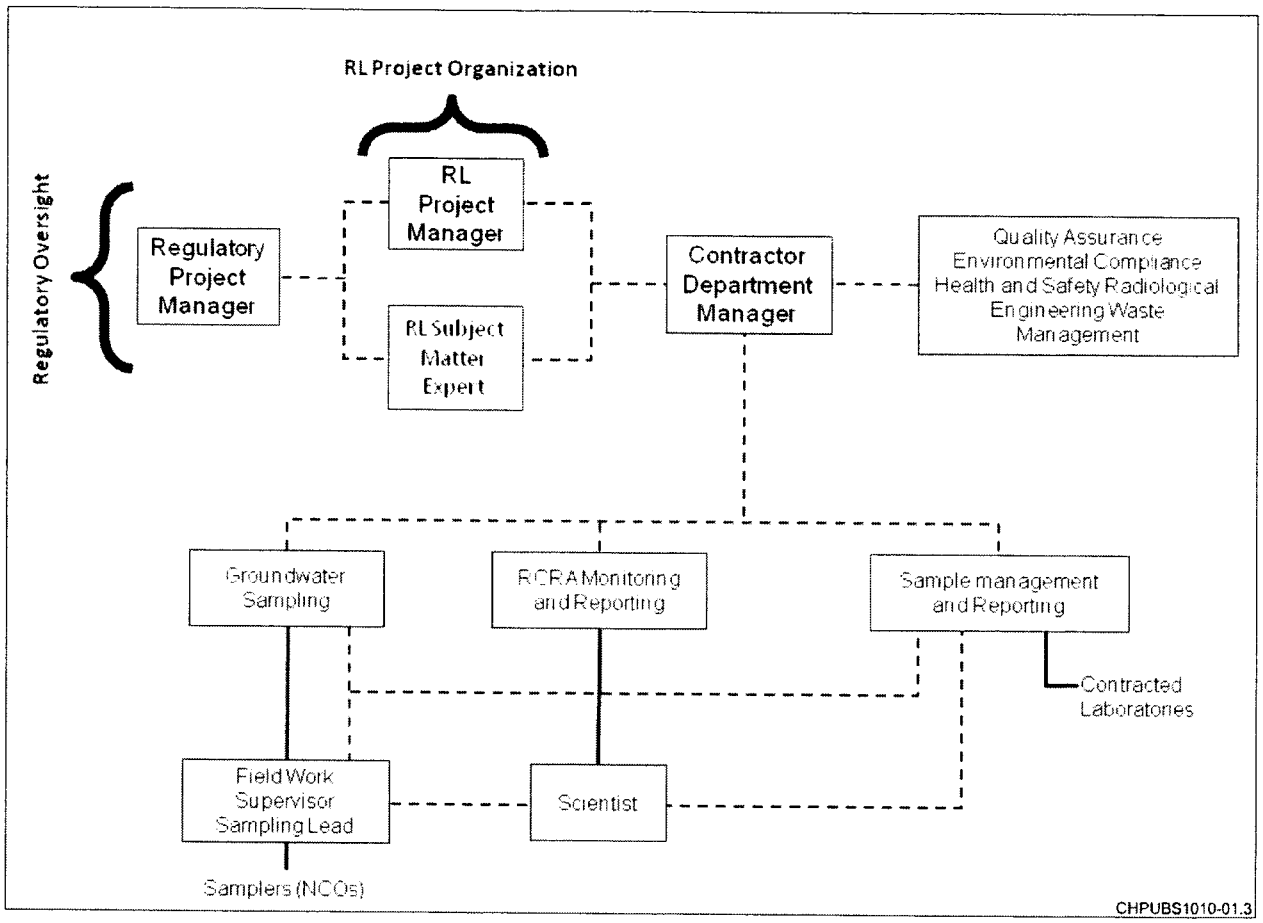

Figure A-1. Project Organization

A1.1.2 U.S. Department of Energy, Richland Operations Office Project Manager

Hanford Site cleanup is the responsibility of RL. The RL project manager is responsible for authorizing the contractor to perform activities under the *Comprehensive Environmental Response, Compensation, and Liability Act of 1980*; the *Resource Conservation and Recovery Act of 1976* (RCRA); the *Atomic Energy Act of 1954*; and the Tri-Party Agreement for the Hanford Site.

A1.1.3 U.S. Department of Energy, Richland Operations Office Subject Matter Expert

The RL subject matter expert is responsible for day-to-day oversight of the contractor's performance of workscope, for working with the contractor and the regulatory agencies to identify and work through issues, and for providing technical input to the RL project manager.

A1.1.4 Contractor Groundwater Remediation Department Manager

The contractor groundwater remediation department manager provides oversight for all activities and coordinates with DOE, the regulators, and primary contractor management in support of sampling and reporting activities. The remediation department manager also provides support to the RCRA Monitoring and Reporting manager to ensure that work is performed safely and cost effectively.

A1.1.5 Groundwater Sampling Operations

Groundwater sampling operations is responsible for planning and coordinating field sampling resources and provides the field work supervisor for routine groundwater sampling operations. The field work supervisor directs the samplers, who collect groundwater samples in accordance with the sampling and analysis plan, and corresponding standard procedures and work packages. The samplers also complete the field logbook and chain-of-custody forms, including any shipping paperwork, and ensure delivery of the samples to the analytical laboratory.

A1.1.6 RCRA Monitoring and Reporting

The RCRA Monitoring and Reporting manager is responsible for direct management of activities performed to meet RCRA TSD monitoring requirements. The RCRA Monitoring and Reporting manager coordinates with and reports to DOE and primary contractor management regarding RCRA TSD monitoring requirements. The RCRA Monitoring and Reporting manager assigns scientists to provide technical expertise.

A1.1.7 Sample Management and Reporting Organization

The Sample Management and Reporting organization coordinates laboratory analytical work to ensure that the laboratories conform to HASQARD requirements (or their equivalent), as approved by DOE, the U.S. Environmental Protection Agency (EPA), and Ecology. Sample Management and Reporting receives analytical data from the laboratories, performs data entry into the Hanford Environmental Information System (HEIS) database, and arranges for data validation. Sample Management and Reporting is responsible for informing the RCRA Monitoring and Reporting manager of any issues reported by the analytical laboratories.

A1.1.8 Contract Laboratories

The contract laboratories analyze samples in accordance with established procedures and provide necessary sample reports and explanations of results to support data validation. The laboratories must meet site-specific QA requirements and must have an approved QA plan in place.

A1.1.9 Quality Assurance

The QA point of contact is matrixed to the subject matter expert and is responsible for QA issues on the project. Responsibilities include overseeing implementation of the project QA requirements; reviewing project documentation, including data quality objective (DQO) summary reports, sampling and analysis plans, and the QAPjP; and participating in QA assessments on sample collection and analysis activities, as appropriate. The QA point of contact must be independent of the unit generating the data.

A1.1.10 Environmental Compliance Officer

The environmental compliance officer provides technical oversight, direction, and acceptance of project and subcontracted environmental work, and also develops appropriate mitigation measures with the goal of minimizing adverse environmental impacts.

A1.1.11 Health and Safety

The Health and Safety organization is responsible for coordinating industrial safety and health support within the project as carried out through health and safety plans, job hazard analyses, and other pertinent safety documents required by federal regulations or by internal primary contractor work requirements.

A1.1.12 Waste Management

Waste Management communicates policies and procedures and ensures project compliance for storage, transportation, disposal, and waste tracking in a safe and cost-effective manner.

A1.2 Problem Definition/Background

The problem definition, as required by *Washington Administrative Code* (WAC) 173-303-400 ("Dangerous Waste Regulations," "Interim Status Facility Standards") and 40 CFR 265, Subpart F ("Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities," "Ground-Water Monitoring"), is outlined in the main text discussion of this monitoring plan. The background is provided in the monitoring plan.

A1.3 Project/Task Description

The project description is provided in Chapters 3 and 4 of this monitoring plan and includes the selection of appropriate dangerous waste or dangerous waste constituents, collection and analyses of groundwater from the monitoring network, interpretation of analytical results, evaluation of the monitoring network, and reporting.

The target analytes, along with the monitoring wells and frequency of sampling, are provided in Chapter 3.

A1.4 Quality Objectives and Criteria

The quality objectives and criteria for groundwater monitoring are defined in this QAPjP in order to meet the evaluation requirements stated in the monitoring plan.

A1.5 Special Training/Certification

Workers receive a level of training that is commensurate with their responsibility of collecting and transporting groundwater samples according to the requirements of WAC 173-303-330, "Personnel Training." The field work supervisor, in coordination with line management, will ensure that all field personnel meet training requirements.

A1.6 Documents and Records

The project scientist is responsible for ensuring that the current version of the groundwater monitoring plan is used and for providing any updates to field personnel. Version control is maintained through the administrative document control process. Significant changes to the plan that affect DQOs will be reviewed and approved by DOE and the regulatory agency prior to implementation. Table A-1 defines the types of changes that may be made to the sampling design and the documentation requirements.

Logbooks and data forms are required for field activities. The logbook must be identified with a unique project name and number. Individuals responsible for the logbooks shall be identified in the front of the logbook, and only authorized individuals may make entries into the logbooks. Logbooks will be controlled in accordance with internal work requirements and processes.

The HEIS database will be identified as a data repository for the Hanford Facility Operating Record unit file. Records may be stored in either electronic or hardcopy format. Documentation and records, regardless of medium or format, are controlled in accordance with internal work requirements and processes that ensure accuracy and retrievability of stored records. Records required by the Tri-Party Agreement will be managed in accordance with the requirements therein.

Table A-1. Actions and Documentation for Regulatory Notification

Type of Change	Action	Documentation
Temporary addition of wells or constituents, or increased sampling frequency	RCRA Monitoring and Reporting manager approval; notify regulatory agency, if appropriate	Project's schedule tracking system
Unintentional impact to groundwater monitoring plan including one-time missed well sampling due to operational constraints, delayed sample collection, broken pump, lost bottle set, missed sampling of indicator parameters, loss of samples in transit, etc.	Electronic notification	RCRA annual report
Planned change to groundwater monitoring activities, including addition or deletion of constituents or wells, change of sampling frequency, etc.	Revise monitoring plan	Revised RCRA groundwater monitoring plan
Anticipated unavoidable changes (e.g., dry wells)	Electronic notification; revise monitoring plan	RCRA annual report and revised groundwater monitoring plan

RCRA = *Resource Conservation and Recovery Act of 1976*

The results of groundwater monitoring are reported annually in accordance with the requirements of 40 CFR 265.94, "Recordkeeping and Reporting." Reporting will be made in annual Hanford Site groundwater monitoring reports (e.g., DOE/RL-2008-66, *Hanford Site Groundwater Monitoring for Fiscal Year 2008*).

A2 Data Generation and Acquisition

This section addresses data generation and acquisition to ensure that the project's methods for sampling, measurement and analysis, data collection or generation, data handling, and QC activities are appropriate and documented.

A2.1 Sampling Process Design (Experimental Design)

The sampling design is based on regulatory requirements and judgmental sampling.

A2.1.1 Regulatory Requirements

The groundwater protection regulations of WAC 173-303-400 dictate the groundwater sampling and analysis requirements applicable to interim status TSD units.

A2.1.2 Judgmental Sampling

The selection of sampling and analysis requirements is based on knowledge of the feature or condition under investigation and is also based on professional judgment. The TSD monitoring is based on professional judgment. Conclusions depend on the validity and accuracy of professional judgment.

A2.2 Sampling Methods

Sampling is described in the contractor's environmental QA program plan, including the following:

- Field sampling methods
- Sample preservation, containers, and holding times
- Corrective actions for sampling activities
- Decontamination of sampling equipment

The groundwater sampling operations supervisor must ensure that situations that may impair the usability of samples and/or data are documented in the field logbook or on nonconformance report forms in accordance with internal corrective action procedures, as appropriate. The groundwater sampling operations supervisor will note any deviations that occur from the standard procedures for sample collection, contaminants of potential concern, sample transport, or monitoring. The groundwater sampling operations supervisor is also responsible for coordinating all activities related to the use of field monitoring equipment (e.g., dosimeters and industrial hygiene equipment). Field personnel will document in the logbook all noncompliant measurements taken during field sampling. Ultimately, the groundwater sampling operations supervisor will be responsible for developing, implementing, and communicating corrective action procedures; for documenting all deviations from procedure; and for ensuring that immediate corrective actions are applied to field activities. Problems with sample collection, custody, or data acquisition that adversely impact data quality or impair the ability to acquire data or failure to follow procedure will be documented in accordance with internal corrective action procedures, as appropriate.

A2.3 Sample Handling and Custody

A sampling and data tracking database is used to track samples from the point of collection through the laboratory analysis process. Laboratory analytical results are entered and maintained in the HEIS database. Each sample is identified and labeled with a unique HEIS sample number. The contractor's environmental QA program plan specifies sample handling information, including the following:

- Container requirements
- Container labeling and tracking process
- Sample custody requirements
- Shipping and transportation

A2.4 Analytical Methods

Information on analytical methods is provided in Tables A-2 and A-3. These analytical methods are controlled in accordance with the laboratory's QA plan and the requirements of this QAPjP. The primary contractor participates in oversight of offsite analytical laboratories to qualify the laboratories for performing Hanford Site analytical work.

Table A-2. Preservation Techniques, Analytical Methods Used, and Current Method Quantitation Limits for Continuing Constituents

Constituent	Collection and Preservation[a]	Analysis Methods[b]	Method Quantitation Limit (µg/L)[c]
Metals Analyzed by Inductively Coupled Plasma Method – Unfiltered/Filtered			
Calcium	P, HNO_3 to pH <2	SW-846[d] Method 6010B/C, SW-846 Method 6020[d], or EPA/600 Method 200.8[d]	1,000
Nickel			40
Magnesium			750
Potassium			4,000
Sodium			500
Anions by Ion Chromatography			
Chloride	P	EPA/600 Method 300.0[e]	200
Nitrate			250
Sulfate			500
Other			
Alkalinity	G/P	Standard Method[f] 2320, EPA/600 Method 310.1, EPA/600 Method 310.2	5,000
Conductivity, field	Field measurement	Instrument/meter	1 µohm
pH, field measurement	Field measurement	Instrument/meter	0.1
Temperature	Field measurement	Instrument/meter	--
Turbidity, field measurement	Field measurement	Instrument/meter	0.1 NTU

a. All samples will be collected in plastic (P) or glass (G) containers and will be cooled to 4°C upon collection.

b. Constituents grouped together are analyzed by the same method, unless otherwise indicated.

c. Detection limit units, unless otherwise indicated.

d. SW-846, *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, Third Edition; Final Update IV-B.*

e. Analytical method adapted from Method 300.0, *Test Methods for Determination of Inorganic Anions in Water by Ion Chromatography* (EPA-600/4-84-017).

f. *Standard Methods for the Examination of Water and Wastewater* (AWWA et al., 2005).

EPA = U.S. Environmental Protection Agency

N/A = not applicable

Table A-3. Preservation Techniques, Analytical Methods Used, and Current Method Quantitation Limits for Listed Assessment Constituents

Constituent	Collection and Preservation[a]	Analysis Methods[b]	Method Quantitation Limit (µg/L)[c]
Metals Analyzed by Inductively Coupled Plasma Method – Unfiltered/Filtered			
Barium	P, HNO_3 to pH <2	SW-846[d] Method 6010B/C, SW-846 Method 6020[e], or EPA/600 Method 200.8[e]	20
Beryllium			5
Cadmium			5
Cobalt			20
Copper			10
Nickel			40
Silver			10
Vanadium			25
Zinc			10
Trace Metals – Unfiltered/Filtered			
Antimony	P, HNO_3 to pH <2	SW-846 Method 6020 or EPA/600 Method 200.8	6
Arsenic			10
Lead			5
Mercury	G, HNO_3 to pH <2	SW-846 Method 7470A, EPA/600 Method 200.8	0.5
Selenium	P, HNO_3 to pH <2	SW-846 Method 6020 or EPA/600 Method 200.8	10
Thallium			5
Volatile Organic Analyses			
1,1-Dichloroethene	G, no headspace	SW-846 Method 8260B	10
1, 2-Dichloroethane			5
1,1,1-Trichloroethane			5
1,1,2-Trichloroethane			5
1,1,2,2-Tetrachloroethane			5
Acetone (2-propanone)			20
Benzene			5
Carbon disulfide			5
Carbon tetrachloride			5
Chlorobenzene			5
Chloroform			5

Table A-3. Preservation Techniques, Analytical Methods Used, and Current Method Quantitation Limits for Listed Assessment Constituents

Constituent	Collection and Preservation[a]	Analysis Methods[b]	Method Quantitation Limit (µg/L)[c]
Ethylbenzene			5
Isobutanol			500
Methylene chloride			5
Methyl ethyl ketone (2-butanone)			10
Methyl isobutyl ketone (4-methyl-2-pentanone) (MIBK)			10
Tetrachloroethene			5
Toluene			5
trans-1,3-Dichloropropene			5
Trichloroethene			5
Trichlorofluoromethane			10
Vinyl chloride (chloroethene)			10
Xylenes			10
Semivolatile Organic Analyses			
1,2-Dichlorobenzene (o-Dichlorobenzene)			10
1,2,4-Trichlorobenzene			10
2-Chlorophenol			10
2-Methylphenol (o-cresol)			10
2-Nitrophenol (o-Nitrophenol)			20
2,4-Dinitrotoluene			10
2,4,5-Trichlorophenol			10
2,4,6-Trichlorophenol	Amber glass	SW-846 Method 8270D	10
3-Methylphenol (m-cresol)			20
4-Chloro-3-methylphenol (p-Chloro-m-cresol)			10
4-Methylphenol (p-cresol)			10
Acenaphthene			10
Butylbenzylphthalate			10
Di-n-butylphthalate			10
Di-n-octylphthalate			10

Table A-3. Preservation Techniques, Analytical Methods Used, and Current Method Quantitation Limits for Listed Assessment Constituents

Constituent	Collection and Preservation[a]	Analysis Methods[b]	Method Quantitation Limit (µg/L)[c]
Fluoranthene			10
Hexachlorobutadiene			10
Hexachloroethane			10
n-Nitroso-di-n-propylamine			10
n-Nitrosomorpholine			10
Naphthalene			10
Nitrobenzene			10
Pyrene			10
Pyridine			20
Polychlorinated Biphenyls			
Aroclor-1016			0.5
Aroclor-1221			0.5
Aroclor-1232			0.5
Aroclor-1242	G	SW-846 Method 8082	0.5
Aroclor-1248			0.5
Aroclor-1254			0.5
Aroclor-1260			0.5
Other			
Cyanide	P, NaOH to pH >12	SW-846 Method 9012, Standard Method[f] 4500, EPA/600 Method 335.2	5
Sulfide	G,P, 2 mL 2 N zinc acetate and NaOH pH >9, cool 4°C	Sulfides – 9030	500

a. All samples will be collected in plastic (P) or glass (G) containers and will be cooled to 4°C upon collection.

b. Constituents grouped together are analyzed by the same method, unless otherwise indicated.

c. Detection limit units, unless otherwise indicated.

d. SW-846, *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, Third Edition; Final Update IV-B.*

e. SW-846 Method 6010 is the preferred method; however, Method 6020 or EPA/600 Method 200.8 may be used, as long as the method quantitation limit listed is met.

f. *Standard Methods for the Examination of Water and Wastewater* (AWWA et al., 2005).

EPA = U.S. Environmental Protection Agency

Laboratories providing analytical services in support of this QAPjP will report errors to the Sample Management and Reporting project coordinator, who will then initiate a sample disposition record. The error-reporting process is intended to document analytical errors and the resolution of those errors with the project scientist. The corrective action program addresses the following:

- Evaluation of impacts of laboratory QC failures on data quality
- Root-cause analysis of QC failures
- Evaluation of recurring conditions that are adverse to quality
- Trend analysis of quality-affecting problems
- Implementation of a quality improvement process
- Control of nonconforming materials that may affect quality

A2.5 Quality Control

The QC procedures must be followed in the field and laboratory to ensure that reliable data are obtained. Field QC samples will be collected to evaluate the potential for cross-contamination and to provide information pertinent to field variability. Field QC for sampling will require the collection of field replicates (duplicates), trip or field blanks, and equipment blanks. Laboratory QC samples estimate the precision and bias of the analytical data. Field and laboratory QC samples are summarized in Table A-4.

Table A-4. Quality Control Samples

Sample Type	Primary Characteristics Evaluated	Frequency
Field QC		
Full trip blank	Contamination from containers or transportation	1 per 20 well trips
Field transfer blank	Contamination from sampling site	1 each day; volatile organic compounds sampled
Equipment blank	Contamination from non-dedicated equipment	As needed[a]
Replicate/duplicate samples	Reproducibility	1 per 20 well trips
Laboratory QC		
Method blanks	Laboratory contamination	1 per batch
Laboratory duplicates	Laboratory reproducibility	See footnote[b]
Matrix spikes	Matrix effect and laboratory accuracy	See footnote[b]
Matrix spike duplicates	Laboratory reproducibility/accuracy	See footnote[b]
Surrogates	Recovery/yield	See footnote[b]
Laboratory control samples	Method accuracy	1 per batch

a. For portable Grundfos® (registered trademark of Grundfos Pumps Corporation, Colorado Springs, Colorado) pumps, equipment blanks are collected 1 per 10 well trips. Whenever a new type of non-dedicated equipment is used, an equipment blank shall be collected every time sampling occurs until it can be shown that less frequent collection of equipment blanks is adequate to monitor the decontamination procedure for the non-dedicated equipment.

b. As defined in the laboratory contract or quality assurance plan, and/or analysis procedures.

QC = quality control

A2.5.1 Field Quality Control Samples

Field QC samples will be collected to evaluate the potential for cross-contamination and laboratory performance. The QC samples and the required frequency for collection are described in this section.

Full trip blanks (FTBs) are prepared by the sampling team prior to traveling to the sampling site. The FTB is filled with high-purity reagent water. The bottles are sealed and transported, unopened, to the field in the same storage containers used for samples collected that day. Collected FTBs are analyzed for the same constituents as the samples. The FTBs are used to evaluate potential contamination of the samples due to the sample bottles, preservative, handling, storage, or transportation.

Field transfer blanks (FXRs) are preserved volatile organic analysis sample bottles that are filled at the sample collection site with high-purity reagent water that has been transported to the field. After collection, FXR bottles are sealed and placed in the same storage containers with the samples from the associated sampling event. The FXR samples are analyzed for volatile organic compounds only. The FXRs are used to evaluate potential contamination caused by conditions in the field.

Equipment blanks (EBs) are samples in which high-purity reagent water is passed through the pump or placed in contact with the sampling surfaces of the equipment to collect blank samples identical to the sample set that will be collected. The EB bottles are placed in the same storage containers with the samples from the associated sampling event. The EB samples are analyzed for the same constituents as the samples from the associated sampling event. The EBs are used to evaluate the effectiveness of the cleaning process to ensure that samples are not cross-contaminated from previous sampling events.

For the field blanks (i.e., FTBs, FXRs, and EBs), results above two times the method detection limit are identified as suspected contamination. However, for common laboratory contaminants such as acetone, methylene chloride, 2-butanone, toluene, and phthalate esters, the limit is five times the method detection limit.

Field duplicates, also known as replicates, are two samples that are collected as close as possible to the same time and same location, and they are intended to be identical. Field duplicates are stored and transported together and are analyzed for the same constituents. The field duplicates are used to determine precision for both sampling and laboratory measurements. The results of the field duplicates must have precision within 20 percent, as measured by the relative percent difference. Only field duplicates with at least one result greater than five times the method detection limit or minimum detectable activity are evaluated.

Double-blind samples contain a concentration of analyte known to the supplier but unknown to the analyzing laboratory. The laboratory is not informed that the samples are QC samples. The project submits double-blind samples to assess analytical precision and accuracy.

A2.5.2 Laboratory Quality Control Samples

The laboratory QC samples (e.g., method blanks, laboratory control sample/blank spikes, and matrix spikes) are defined in Chapter 1 of SW-846, *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, Third Edition; Final Update IV-B*, and will be run at the frequency specified in that reference, unless superseded by agreement.

A2.5.3 Quality Control Requirements

Table A-5 lists the acceptance criteria for QC samples, and Table A-6 lists the acceptable recovery limits for the double-blind standards. These samples are prepared by spiking Hanford Site background well water with known concentrations of constituents of interest. Spiking concentrations range from the detection limit to the upper limit of concentration determined in groundwater on the Hanford Site.

Investigations shall be conducted for double-blind standards that are outside of acceptance limits. The results from these standards are used to determine the acceptability of the associated parameter data.

Holding time is the elapsed time period between sample collection and analysis. The contractor's environmental QA program plan provides a table with holding times. Exceeding the required holding times could result in changes in constituent concentrations due to volatilization, decomposition, or other chemical alterations. Recommended holding times depend on the analytical method, as specified in SW-846 or *Methods of Chemical Analysis of Water and Wastes* (EPA/600/4-79/020). Data associated with exceeded holding times are flagged with an "H" in the HEIS database. Data that exceed the holding time shall be maintained but potentially may not be used in statistical analyses.

Table A-5. Field and Laboratory Quality Control Elements and Acceptance Criteria

Method[a]	QC Element	Acceptance Criteria	Corrective Action
General Chemical Parameters			
Alkalinity Conductivity pH	MB[b]	<MDL	Flagged with "C"
	LCS	80-120% recovery[c]	Data reviewed[d]
	DUP	≤20% RPD[c]	Data reviewed[d]
	MS[e]	75-125% recovery[c]	Flagged with "N"
	EB, FTB	<2 times MDL	Flagged with "Q"
	Field duplicate	≤20% RPD[f]	Flagged with "Q"
Anions			
Anions by IC Cyanide Sulfide	MB	<MDL	Flagged with "C"
	LCS	80-120% recovery[c]	Data reviewed[d]
	DUP	≤20% RPD[c]	Data reviewed[d]
	MS	75-125% recovery[c]	Flagged with "N"
	EB, FTB	<2 times MDL	Flagged with "Q"
	Field duplicate	≤20% RPD[f]	Flagged with "Q"
Metals			
Arsenic Cadmium Chromium Lead Mercury Selenium Thallium ICP metals ICP/MS metals	MB	<CRDL	Flagged with "C"
	LCS	80-120% recovery[c]	Data reviewed[d]
	MS	75-125% recovery[c]	Flagged with "N"
	MSD	≤20% RPD[c]	Data reviewed[d]
	EB, FTB	<2 times MDL	Flagged with "Q"
	Field duplicate	≤20% RPD[f]	Flagged with "Q"

Table A-5. Field and Laboratory Quality Control Elements and Acceptance Criteria

Method[a]	QC Element	Acceptance Criteria	Corrective Action
Volatile Organic Compounds			
Volatiles by GC/MS	MB	<MDL	Flagged with "B"
	LCS	Statistically derived[g]	Data reviewed
	MS	Statistically derived[g]	Flagged with "N"
	MSD	Statistically derived[g]	Data reviewed[d]
	SUR	Statistically derived[g]	Data reviewed[d]
	EB, FTB, FXR	<2 times MDL[h]	Flagged with "Q"
	Field duplicate	≤20% RPD[f]	Flagged with "Q"
Semivolatile Organic Compounds			
PCBs by GC Phenols by GC Semivolatiles by GC/MS	MB	<2 times MDL	Flagged with "B"
	LCS	Statistically derived[g]	Data reviewed[d]
	MS	Statistically derived[g]	Flagged with "N"
	MSD	Statistically derived[g]	Data reviewed[d]
	SUR	Statistically derived[g]	Data reviewed[d]
	EB, FTB	<2 times MDL[h]	Flagged with "Q"
	Field duplicate	≤20% RPD[f]	Flagged with "Q"

a. Refer to Tables A-2 and A-3 for specific analytical methods.

b. Does not apply to pH.

c. Laboratory-determined, statistically derived control limits may also be used. Such limits are reported with the data.

d. After review, corrective actions are determined on a case-by-case basis. Corrective actions may include a laboratory recheck or flagging the data as suspect ("Y" flag) or rejected ("R" flag).

e. Applies to total organic carbon and total organic halides only.

f. Applies only in cases where one or both results are greater than five times the detection limit.

g. Determined by the laboratory based on historical data. Control limits are reported with the data.

h. For common laboratory contaminants such as acetone, methylene chloride, 2-butanone, toluene, and phthalate esters, the acceptance criteria is less than five times the MDL.

Data flags:

B, C = possible laboratory contamination (analyte was detected in the associated method blank)

N = result may be biased (associated matrix spike result was outside the acceptance limits)

Q = problem with associated field QC sample (blank and/or duplicate results were out of limits)

Table A-5. Field and Laboratory Quality Control Elements and Acceptance Criteria

Method[a]	QC Element	Acceptance Criteria	Corrective Action

Abbreviations:

CRDL = contract-required detection limit
DUP = laboratory matrix duplicate
EB = equipment blank
FTB = full trip blank
FXR = field transfer blank
GC = gas chromatography
IC = ion chromatography
ICP = inductively coupled plasma
ICP/MS = inductively coupled plasma/mass spectrometry
LCS = laboratory control sample
MB = method blank
MDA = minimum detectable activity
MDL = method detection limit
MS = matrix spike
MSD = matrix spike duplicate
QC = quality control
RPD = relative percent difference
SUR = surrogate

Table A-6. Blind Standard Constituents and Schedule

Constituents	Frequency	Accuracy (%)	Precision (% RSD)*
Nitrate	Quarterly	±25%	≤25%
Chromium	Annually	±20%	≤25%

* If the results are less than five times the required detection limit, then the criterion is that the difference of the results of the replicates is less than the required detection limit.

RSD = relative standard deviation

Additional QC measures include laboratory audits and participation in nationally based performance evaluation studies. The contract laboratories participate in national studies such as the EPA-sanctioned Water Pollution and Water Supply Performance Evaluation studies. The groundwater project periodically audits the analytical laboratories to identify and solve quality problems, or to prevent such problems from occurring. Audit results are used to improve performance, and the summaries of audit results and performance evaluation studies are presented in the annual groundwater monitoring report.

Failure of QC will be determined and evaluated during data validation and the data quality assessment process. Data will be qualified, as appropriate.

A2.6 Instrument/Equipment Testing, Inspection, and Maintenance

Measurement and testing equipment used in the field or in the laboratory that directly affects the quality of analytical data will be subject to preventive maintenance measures to minimize measurement system downtime. Laboratories and onsite measurement organizations must maintain and calibrate their equipment. Maintenance requirements (e.g., documentation of routine maintenance) will be included in the individual laboratory's and the onsite organization's QA plan or operating procedures, as appropriate. Maintenance of laboratory instruments will be performed in a manner consistent with SW-846, or with auditable HASQARD and contractual requirements. Consumables, supplies, and reagents will be reviewed in accordance with SW-846 requirements and will be appropriate for their use.

A2.7 Instrument/Equipment Calibration and Frequency

Specific field equipment calibration information is provided in the environmental QA program plan. Standards used for calibration will be certified and traceable to nationally recognized performance standards. Analytical laboratory instruments and measuring equipment are calibrated in accordance with the laboratory's QA plan.

A2.8 Inspection/Acceptance of Supplies and Consumables

Supplies and consumables used in support of sampling and analysis activities are procured in accordance with internal work requirements and processes that describe the contractor's acquisition system and the responsibilities and interfaces necessary to ensure that items procured/acquired for contractor meet specific technical and quality requirements. The procurement system ensures that purchased items comply with applicable procurement specifications. Supplies and consumables are checked and accepted by users prior to use.

Supplies and consumables that are procured by the analytical laboratories are procured, checked, and used in accordance with the laboratory's QA plan.

A2.9 Non-Direct Measurements

Non-direct measurements include data obtained from sources such as computer databases, programs, literature files, and historical databases. If evaluation includes data from historical sources, whenever possible such data will be validated to the same extent as the data generated as part of this effort. All data used in evaluations will be identified by source.

A2.10 Data Management

The Sample Management and Reporting organization, in coordination with the RCRA Monitoring and Reporting manager, is responsible for ensuring that analytical data are appropriately reviewed, managed, and stored in accordance with applicable programmatic requirements that govern data management procedures. Electronic data access, when appropriate, will be via a database (e.g., HEIS or project-specific database). Where electronic data are not available, hardcopies will be provided in accordance with Section 9.6 of the Tri-Party Agreement Action Plan (Ecology et al., 1989b). The HEIS database will be identified as a data repository for the Hanford Facility Operating Record unit file.

All field activities will be recorded in the field logbook.

Laboratory errors are reported to the Sample Management and Reporting organization on a routine basis. For reported laboratory errors, a sample disposition record will be initiated in accordance with contractor procedures. This process is used to document analytical errors and to establish resolution of the errors

with the RCRA Monitoring and Reporting manager. Sample disposition records become a permanent part of the analytical data package for future reference and for records management.

A3 Assessment and Oversight

The elements in this section address the activities for assessing the effectiveness of project implementation and the associated QA and QC activities. The purpose of the assessment is to ensure that the QAPjP is implemented as prescribed.

A3.1 Assessments and Response Actions

The contractor management, Regulatory Compliance, Quality, and/or Health and Safety organizations may conduct random surveillances and assessments to verify compliance with the requirements outlined in this QAPjP.

Oversight activities in the analytical laboratories, including corrective action management, are conducted in accordance with the laboratory's QA plan. The primary contractor conducts oversight of offsite analytical laboratories to qualify them for performing Hanford Site analytical work.

A3.2 Reports to Management

Reports to management on data quality issues will be made if and when these issues are identified. Issues reported by the laboratories are communicated to the Sample Management and Reporting organization, which initiates a sample disposition record in accordance with contractor procedures. This process is used to document analytical or sample issues and to establish resolution with the RCRA Monitoring and Reporting manager.

A4 Data Validation and Usability

The elements in this section address the QA activities that occur after the data collection phase of the project is completed. Implementation of these elements determines whether the data conform to the specified criteria, thus satisfying project objectives. These elements are further discussed in the contractor's environmental QA program plan.

A4.1 Data Review, Verification, and Validation

The criteria for verification may include review for completeness (e.g., all samples were analyzed as requested), use of the correct analytical method/procedure, transcription errors, correct application of dilution factors, appropriate reporting of dry weight versus wet weight, and correct application of conversion factors. Laboratory personnel may perform data verification.

A4.2 Verification and Validation Methods

The work activities shall follow documented procedures and processes for data validation and verification, as summarized below. Validation of groundwater data consists of assessing whether the data collected and measured truly reflect aquifer conditions. Verification means assessing data accuracy, completeness, consistency, availability, and internal control practices to determine overall reliability of the data collected. Other DQOs that shall be met include proper chain-of-custody, sample handling, use of proper analytical techniques as applied for each constituent, and the quality and acceptability of the laboratory analyses conducted.

Groundwater monitoring staff perform checks on laboratory electronic data files for formatting, allowed values, data flagging (i.e., qualifiers), and completeness. Hardcopy results are verified to check for (1) completeness, (2) notes on condition of samples upon receipt by the laboratory, (3) notes on problems encountered during analysis of the samples, and (4) correct reporting of results. If data are incomplete or deficient, staff work with the laboratory to correct the problem found during the analysis.

The data validation process provides the requirements and guidance for validating groundwater data that are routinely collected. Validation is a systematic process of reviewing verified data against a set of criteria (provided in Section A2.5) to determine whether the data are acceptable for their intended use.

Results of laboratory and field QC evaluations, double-blind sample results, laboratory performance evaluation samples, and holding-time criteria are considered when determining data usability. Staff review the data to identify whether observed changes reflect changes in groundwater quality or potential data errors, and they may request data reviews of laboratory, field, or water-level data for usability purposes. The laboratory may be asked to check calculations or re-analyze the sample, or the well may be resampled. Results of the data reviews are used to flag the data appropriately in the HEIS database (e.g., "R" for reject, "Y" for suspect, or "G" for good) and/or to add comments.

A4.3 Reconciliation with User Requirements

The data quality assessment process compares completed field sampling activities to those proposed in corresponding sampling documents and provides an evaluation of the resulting data. The purpose of the data evaluation is to determine if quantitative data are of the correct type and are of adequate quality and quantity to meet project DQOs. The RCRA Monitoring and Reporting manager is responsible for determining if data quality assessment is necessary and for ensuring that, if required, one is performed. The results of the data quality assessment will be used in interpreting the data and determining if the objectives of this activity have been met.

A5 References

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1

Appendix B

Well Construction Information for 299-25-236

WELL SUMMARY SHEET

Start Date: 8-26-08
Finish Date: 9-25-08
Page 1 of 2

Well ID: C6542	Well Name: 299-E25-236
Location: W. of 242-A Evaporator, 200-E	Project: RCRA M-24 MONITORING WELLS
Prepared By: Jess Hocking — Date: 10/13/08	Reviewed By: L.D. Walker — Date: 10/14/08
Signature:	Signature:

CONSTRUCTION DATA

Description
11 3/4" Temporary Drive Casing: 0 - 138 ft bgs
9 5/8" Temporary Drive Casing: 0 - 378.7 ft bgs
NOTE: All temporary casing has been fully removed from the ground
304/304L 4" OD sch. 10s Riser: +2.26 - 290.0 ft bgs 0.020-in
304/304L 4" OD ~~sch. 10s~~ Slot Continuous wire-wrap screen: 290.0 - 325.1 ft bgs
304/304L 4" OD sch. 10s Stainless steel sump: 325.1 - 328.1 ft bgs
Portland Cement (Tp. I-II) 0.0 - 8.10 ft bgs
Bentonite Crumbles (#8) / Bentonite Pellets (1/4") 8.10 - 263.9 ft bgs.

Diagram

GEOLOGIC/HYDROLOGIC DATA

Depth in Feet: 0, 30, 60, 90, 120, 150

Graphic Log

Lithologic Description
0 - 0.5' Gravel Pad
0.5 - 7.5' Silty Sand (mS)
7.5 - 8' Sand (S)
8 - 15' Gravelly Sand (gS)
15 - 17' Silty Sand (mS)
17 - 19' Silty Sandy Gravel (msG)
19 - 40' Sand (S)
40 - 59' Gravelly Sand (gS)
59 - 66' Slightly Silty Sand (sm S)
66 - 80' Silty Sand (mS)
80 - 84' Sand (S)
84 - 85' Gravelly Sand (gS)
85 - 99' Sand (S)
99 - 105' Gravelly Sand (gS)
105 - 109' Sand (S)
109 - 124' Gravelly Sand (gS)
124 - 245' Sand (S)

A-6003-643 (03/03)

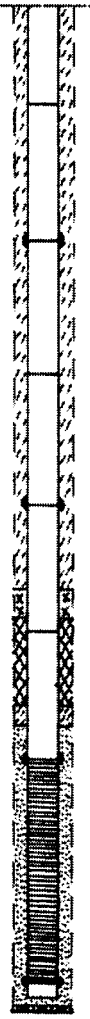
WELL SUMMARY SHEET

Start Date: 8-26-08
Finish Date: 9-25-08
Page 2 of 2

Well ID: C6542
Well Name: 299-E25-236
Location: W. of 242-A Evaporator, 200-E
Project: RCRA M-24 MONITORING WELLS
Prepared By: Jess Hocking
Date: 10/13/08
Reviewed By: L.D. Walker
Date: 10/14/08
Signature: Jess Hocking
Signature: LD Walker

CONSTRUCTION DATA

Description	Diagram
Coated Bentonite Pellets (1/4") 263.9 – 269.0 ft bgs	
Portland Cement (Tp. I-II) 269.0 – 282.5 ft bgs	
Bentonite Crumbles (#8) 282.5 – 287.2 ft bgs	
Colorado Silica Sand (10/20) 287.2 – 328.9 ft bgs	
NATURAL CAVE-IN MATERIAL 328.9 – 329.3 ft bgs	
NOTE: All depths reported in feet below ground surface (ft bgs), unless otherwise noted.	



GEOLOGIC/HYDROLOGIC DATA

Depth in Feet	Graphic Log	Lithologic Description
180		
210		
240		245 – 247' Gravelly Sand (gS)
		247 – 248' Sandy Gravel (sG)
		248 – 249' Gravelly Sand (gS)
		249 – 267' Sand (S)
		267 – 277' Slightly Silty Sand (sm S)
270		
		277 – 281.5' Silt (M)
		281.5 – 282.5' Sand (S)
		282.5 – 284' Gravelly Sand (gS)
		284 – 318' Sandy Gravel (sG)
300		
		318 – 328' Silty Sandy Gravel (msG)
		328 – 329.3' Gravelly Sand (gS)
		TD = 329.3' bgs (9/11/08)
330		DTW = 294.5' bgs (9/10/08)

A-6003-643 (03/03)

WELL CONSTRUCTION SUMMARY REPORT

Start Date: 8/26/08
Finish Date: 9/25/08
Page 1 of 2

Well ID: 6542	Well Name: 299-E25-236	Approximate Location: W. of 242-A Evaporator, 200E
Project: RCRA Wells (A-Farm Monitoring Well)		Other Companies: GRAM, Inc.
Drilling Company: Blue Star Enterprise		Geologist(s): I. Thrasher, T. Buswell, M. J. Hocking, S. Sexton
Driller:	License #:	

TEMPORARY CASING AND DRILL DEPTH			DRILLING METHOD	HOLE DIAMETER (In.) / INTERVAL (ft)
*Size/Grade/Lbs. Per Ft.	Interval	Shoe O.D./I.D.	Auger:	Diameter ____ From ____ to ____
11 3/4", C.S.	0.0 - 138	11 3/8"/10 3/4"	Cable Tool: X	Diameter 11 3/4 From 0.0 to 140
9 5/8", C.S.	138 - 328.7	9 7/8"/9 3/4"	Air Rotary:	Diameter 9 5/8 From 140 to 329.3
	-		A.R. w/Sonic:	Diameter ____ From ____ to ____
	-			Diameter ____ From ____ to ____
	-			Diameter ____ From ____ to ____
*Indicate Welded (W) - Flush Joint (FJ) Coupled (C) & Thread Design				Diameter ____ From ____ to ____
Unk. Thread				
			Drilling Fluid: Water	
Total Drilled Depth: 329.3 ft	Hole Dia @ TD:		Total Amt. Of Water Added During Drilling: ~ 75 gallons	
Well Straightness Test Results: Pass			Static Water Level: 294.5 ft	Date: 9/10/08

GEOPHYSICAL LOGGING

Sondes (type)	Interval	Date	Sondes (type)	Interval	Date
	-			-	
	-			-	
	-			-	

COMPLETED WELL

Size/Wt./Material	Depth	Thread	Slot Size	Type	Interval Annular Seal/Filter Pack	Volume	Mesh Size
4"/Sch. 10/Stainless steel	328.1 - 325.1	✓	—	Natural Cave-in Material	329.3 - 328.9	—	—
4"/Sch 10/Cont. wire wrap	325.1 - 290.0	✓	20-slot	Silica Sand	328.9 - 287.2	17.39 ft³	10-20
4"/Sch 10/Stainless steel	290.0 - 42.26	✓	—	Bentonite Crumbles	287.2 - 282.5	2.84	—
	-			Portland Cement	282.5 - 269.0	7.71	—
	-			Coated Bentonite Pellets	269.0 - 263.9	3.72	—

OTHER ACTIVITIES

Aquifer Test:	Date:	Well Decommission:	Yes:	No:	Date:
Description: N/A		Description:			

WELL SURVEY DATA (if applicable)

	Protective Casing Elevation:
Washington State Plane Coordinates:	Brass Survey Marker Elevation:

COMMENTS / REMARKS

Well ID # ALF 979 riveted onto side of protective casing
All temporary casing removed from borehole.

Reported By:	Title:	Signature:	Date:
T. Buswell	Geologist	T. Buswell	10/6/2008

A-6003-658 (04/03)

WELL CONSTRUCTION SUMMARY REPORT

Start Date: 8/26/2008
Finish Date: 9/25/2008
Page 2 of 2

Well ID: C6542	Well Name: 299-E25-236	Approximate Location: W. of 242-A Evaporator, 200 E.
Project: RCRA Wells (A-Farm Monitoring Well)		Other Companies: GRAM, Inc.
Drilling Company: Blue Star Enterprises		Geologist(s): J. Thorsen T. Buswell M.J. Hocking S. Yeates
Driller:	License #:	

TEMPORARY CASING AND DRILL DEPTH			DRILLING METHOD	HOLE DIAMETER (in.) / INTERVAL (ft)
*Size/Grade/Lbs. Per Ft.	Interval	Shoe O.D./I.D.	Auger:	Diameter ___ From ___ to ___
(See pg. 1)	___ - ___		Cable Tool:	Diameter ___ From ___ to ___
	___ - ___		Air Rotary:	Diameter ___ From ___ to ___
	___ - ___		A.R. w/Sonic:	Diameter ___ From ___ to ___
	___ - ___			Diameter ___ From ___ to ___
	___ - ___			Diameter ___ From ___ to ___
*Indicate Welded (W) - Flush Joint (FJ) Coupled (C) & Thread Design				Diameter ___ From ___ to ___
(See pg. 1)				
			Drilling Fluid: (See pg. 1)	
Total Drilled Depth:	Hole Dia @ TD:		Total Amt. Of Water Added During Drilling:	
Well Straightness Test Results			Static Water Level:	Date:

GEOPHYSICAL LOGGING

Sondes (type)	Interval	Date	Sondes (type)	Interval	Date
	___ - ___			___ - ___	
	___ - ___			___ - ___	
	___ - ___			___ - ___	

COMPLETED WELL

Size/Wt./Material	Depth	Thread	Slot Size	Type	Interval Annular Seal/Filter Pack	Volume	Mesh Size
(See pg. 1)	___ - ___			Bentonite Crumbles/Pellets	263.9 - 8.10	135.96 ft³	—
	___ - ___			Portland Cement Grout	8.10 - 0.0	9.0	—
	___ - ___				___ - ___		
	___ - ___				___ - ___		
	___ - ___				___ - ___		

OTHER ACTIVITIES

Aquifer Test:	Date:	Well Decommission:	Yes:	No:	Date:
Description: N/A		Description:			

WELL SURVEY DATA (if applicable)

	Protective Casing Elevation:
Washington State Plane Coordinates:	Brass Survey Marker Elevation:

COMMENTS / REMARKS

Reported By:	Title:	Signature:	Date:
T. Buswell	Geologist	Tom Buswell	10/6/08

A-6003-658 (04/03)

Distribution

	MS	Quantity
U.S. Department of Energy, Richland Operations Office		
R.D. Hildebrand	A6-38	1
A.C. Tortoso	A6-38	1
DOE Public Reading Room	H2-53	1
U.S. Department of Energy, Office of River Protection		
L.A. Huffman	H6-60	1
C.J. Kemp	H6-60	1
R.W. Lober	H6-60	1
CH2M HILL Plateau Remediation Company (Electronic Distribution)		
W.R. Faught	H8-15	1
R.L. Fleshman	R3-50	1
D.A. Gamon	R3-50	1
J.W. Lindbert	R3-50	1
S.P. Luttrell	R3-50	1
C.J. Martin	R3-50	1
J.P. McDonald	R3-50	1
C.W. Miller	H8-15	1
A.G. Mishko	H8-45	1
R.W. Oldham	R3-60	1
L.C. Swanson	R3-50	1
W.R. Thackaberry	R3-60	1
G.S. Thomas	R3-50	1
J.A. Winterhalder	R3-60	1
M.I. Wood	H8-51	1

Washington River Protection Solutions		
S.J. Eberlein	E6-31	1
J.G. Field	E6-31	1
J.J. Luke	R1-51	1
D.A Myers	E6-31	1
C.L. Tabor	E6-31	1
Administrative Record	H6-08	1
Document Clearance	H6-08	1