# SUPPLEMENTAL GROUNDWATER INFORMATION COMPENDIUM

## For the Nonradioactive Dangerous Waste and the Solid Waste Landfill Facilities

HANFORD SITE

AUGUST 2009

Prepared for

U.S. DEPARTMENT OF ENERGY

Prepared by

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PLATEAU REMEDIATION COMPANY

This Supplemental Groundwater Information Compendium contains information on groundwater and underlying geologic conditions at the Nonradioactive Dangerous Waste Landfill (NRDWL) and Solid Waste Landfill (SWL) Area. The information sources include various routine monitoring reports, electronic databases, and special studies conducted as part of historical or on-going site assessment activities. Some reports are provided in full while relevant excerpts have been provided from other reports (typically where NRDWL or SWL are minor components of the report).

Subsurface conditions at the NRDWL and SWL sites are routinely monitored and have been for over 20 years. In lieu of hardcopy, the groundwater database information is included herein in electronic format. For convenience, separate EXCEL files are included for the NRDWL and the SWL sites, since each file contains excess of 10,000 analyte data records. Also, to assist in review, data records for each well are provided on separate EXCEL worksheets within each main site file, sorted by method and by date.

This compendium is intended to support the current dialogue between DOE and ECOLOGY on groundwater conditions at NRDWL and SWL and for supporting related informational workshops. This compendium may be supplemented with additional groundwater information or analysis of interest, as identified by DOE or Ecology.

The reports and data assembled in this compendium (along with summary descriptions as applicable) are:

- EXHIBIT A: Solid Waste Annual Monitoring Report (July 2007-June 2008).
  This report includes a summary of new groundwater results and results from the lysimeter leachate collection and current soil gas monitoring data. Trend lines illustrating changes in groundwater conditions over a twenty year period (1987-Present) are included in the appendix for selected constituents.
- EXHIBIT B: Quarterly RCRA Groundwater Monitoring Report for October-2008-December 2009 (SGW-41323).
  This is a site wide report for all Treatment, Storage, and Disposal Units at Hanford with groundwater monitoring requirements. Excerpts from the report related to NRDWL are provided herein.
- Exhibit C: Groundwater Quality Assessment Report for the Nonradioactive Dangerous Landfill (SGW-41904 and SGW-40274).
  This report contains the results of the RCRA "first determination assessment plan" regarding the elevated TOC in selected wells reported in recent sampling events. The Work Plan for conducting the assessment is also included.
- EXHIBIT D: Geologic Cross Sections of the NRDWL/SWL AREA
  These figures contain area wide and localized geologic cross sections now under revision.

- EXHIBIT E: GROUNDWATER DATABASE
  Analytical results from all active SWL and NRDWL Monitoring Wells from 1997 to Present (on CD). Provided in excel format.
- EXHIBIT F: Geophysical Report: Data Package for Geophysical Investigation of NRDWL (WHC-SD-EN-TI-116)
  This report provides ground penetrating radar results specific to NRDWL and some discussion of SWL.
- EXHIBIT G: Remote Sensing-LIDAR
  This survey provides highly detailed digital site and area wide images from Light Detection and Ranging remote imaging technology that digital documents current site conditions in high resolution.
- EXHIBIT H: *Groundwater Monitoring Plan for the Nonradioactive Dangerous Waste Landfill* PNNL-12227
  This plan provides the details and requirements for the NRDWL groundwater baseline and current RCRA monitoring program, well construction details and other on-going monitoring program information.
- EXHIBIT I: *Excavation and Inventory of Trench 19N at NRDWL* (91-EAB-078)
  This documents the investigation and removal of sodium nitrite and other materials from Trench 19. The known waste inventory records for 19N and other NRDWL trenches are included.
- EXHIBIT J: Soil Gas Survey Reports
  Included are NRDWL Soil-Gas Survey: Final Data Report from 1993 (WHC-SD-EN-TI-1990) and Evaluation of the Soil-Gas Survey at NRDWL from 1997 (BHI-01115).
- EXHIBIT K: Excerpts from *Hanford's Site Groundwater Monitoring Fiscal Year 2008* (DOE/RL-2008-66)
  This report describes the current groundwater monitoring results for the 200-PO-1 Groundwater Operable unit.

These exhibits document that groundwater quality in the vicinity of NRDWL/SWL area has primarily been affected by upgradient sources which have been identified and monitored through the CERCLA program for the 200-PO-1 Groundwater Operable Unit. As a result, it has been recommended that management of groundwater underlying NRDWL and SWL be conducted as an integral part of the 200-PO-1 Groundwater Operable unit rather than as part of the individual NRDWL and SWL closure planning and implementation processes.

EXHIBIT A:

Solid Waste Annual Monitoring Report (July 2007-June 2008)

**Department of Energy**
Richland Operations Office
P.O. Box 550
Richland, Washington 99352

OCT 2 0 2008

09-AMCP-0010

Ms. J. A. Hedges, Program Manager
Nuclear Waste Program
State of Washington
Department of Ecology
3100 Port of Benton Boulevard
Richland, Washington 99354

Dear Ms. Hedges:

HANFORD SITE SOLID WASTE LANDFILL ANNUAL MONITORING REPORT, JULY 2007 THROUGH JUNE 2008

The purpose of this letter is to transmit the Hanford Site Solid Waste Landfill Annual Monitoring Report, July 2007 through June 2008 for your information. The report contains information concerning monitoring at the Hanford Solid Waste Landfill. The landfill is in closure status and has not received waste since March 1996.

The report is a compilation of data from quarterly monitoring of leachate, groundwater, and soil gas over the past reporting year.

If you have any questions, please contact me, or your staff may contact Briant Charboneau, of my staff, on (509) 373-6137.

Sincerely,

Matthew S. McCormick, Assistant Manager
for the Central Plateau

AMCP:FMR

Attachment

cc: See Page 2

cc w/attach:
G. Bohnee, NPT
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C. E. Cameron, EPA
N. Ceto, EPA
S. Harris, CTUIR
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S. L. Leckband, HAB
K. Niles, ODOE
J. B. Price, Ecology
Administrative Record
Environmental Portal

cc w/o attach:
R. H. Engelmann, EFSH
R. E. Piippo, FHI
J. G. Vance, FFS

# HANFORD SITE SOLID WASTE LANDFILL
# ANNUAL MONITORING REPORT

July 2007 through June 2008

Consisting of 25 pages,
including this cover page.

This report summarizes results of leachate, groundwater, and soil gas monitoring performed at the Hanford Site Solid Waste Landfill (SWL) during the period of July 2007 through June 2008. In March 1996, waste disposal activities at the SWL were discontinued. The SWL is currently in interim closure status.

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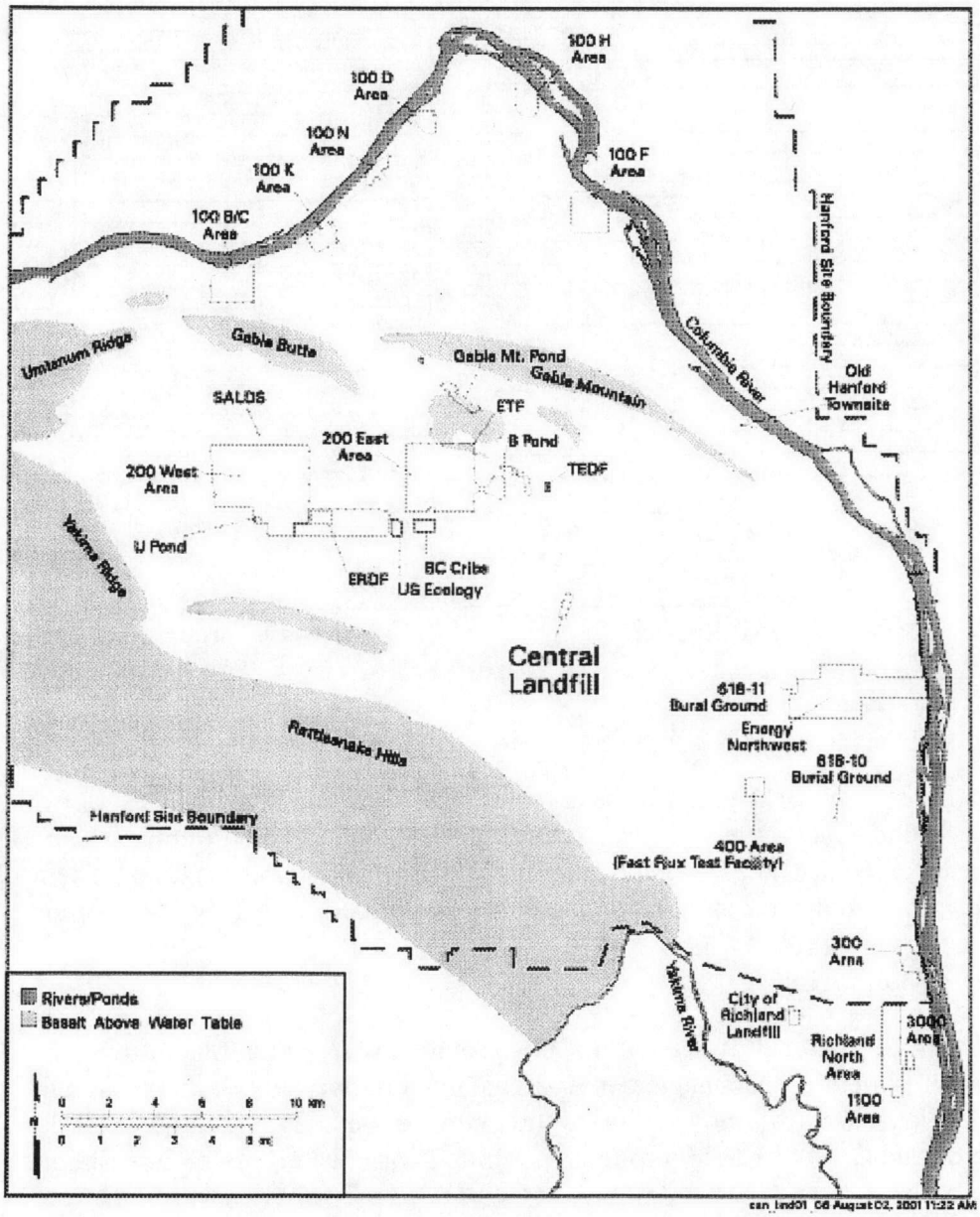
## 1.0 Introduction

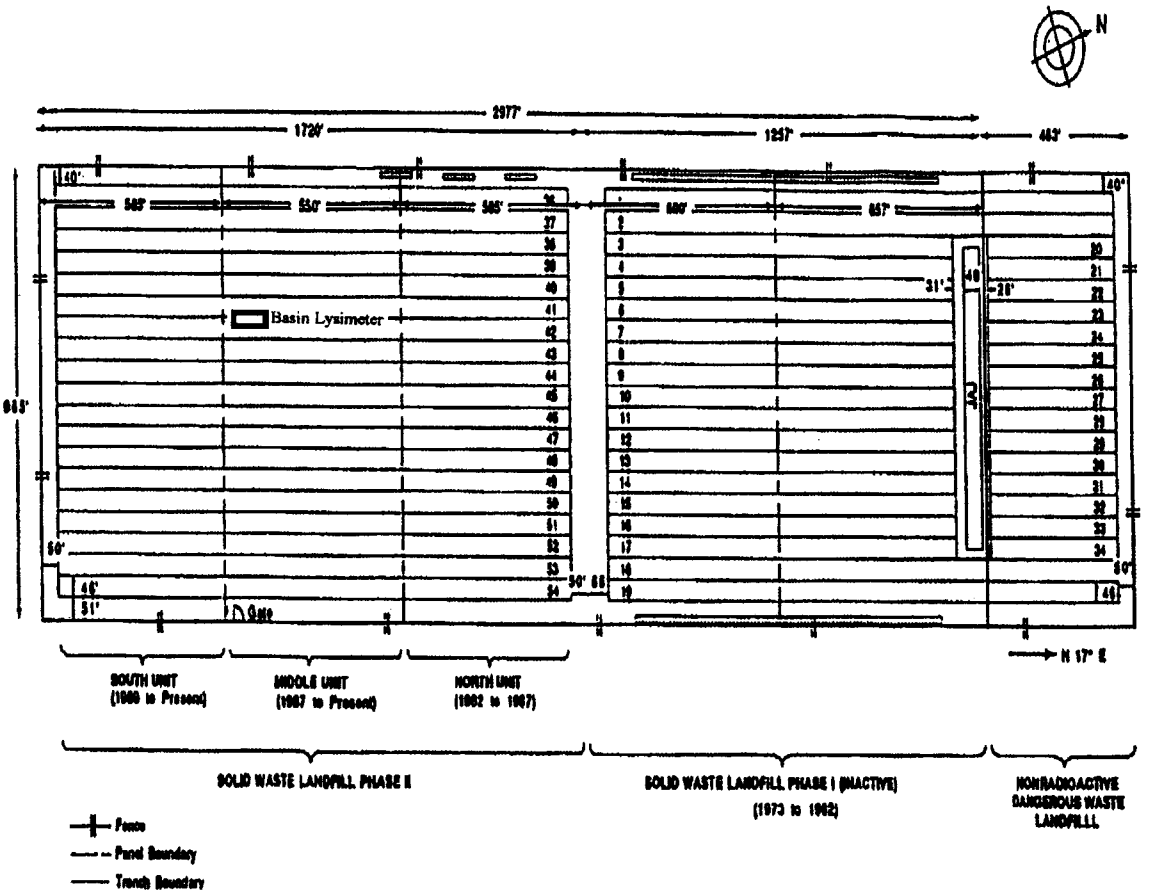
The Hanford Solid Waste Landfill (SWL) covers approximately 27 hectares (66 acres) and began operations in 1973. Figure 1 shows location of the SWL (Central Landfill) on the Hanford Site.

**Figure 1 - Hanford Site Map**




The SWL is divided into five units, each consisting of a series of parallel trenches (Figure 2). The two oldest units comprise Phase I. Phase II is comprised of three units: north, middle, and south. The SWL stopped receiving waste in 1996, and an intermediate cover was placed over all disposal trenches. Current plans call for the placement of an engineered final cover to minimize infiltration and leachate generation.

**Figure 2 – Location of Solid Waste Landfill Trenches And Basin Lysimeter**




Monitoring systems at the landfill have been established and provide data for evaluating changes which could indicate increased risks to human health and the environment. Current monitoring activities include leachate, groundwater, and soil gas testing and tracking. The following sections provide information from monitoring activities performed from July 2007 through June 2008.

## 2.0 Leachate Monitoring

One of the double trenches in the landfill is provided with a liner that allows for collection of leachate in a basin lysimeter. Leachate is generated as precipitation percolates through the contents of the landfill. Figure 2 shows the location of the basin lysimeter in relation to other landfill trenches. The collected leachate is disposed through a permitted wastewater treatment system.

Leachate monitoring provides an indication of potential impurities which may be reaching the groundwater from unlined disposal cells. However, it is important to note that leachate is only collected under one of the double trenches in the Phase II area of the SWL trenches; therefore, results are not necessarily representative of total leachate generation throughout the landfill. Contaminants potentially leaching from trenches throughout the SWL represent a 23-year disposal period, dating back to 1973, before many of the regulations putting restrictions on land disposal were enacted. In contrast, the leachate being collected is from one of the newer disposal trenches. There are also varying amounts of vegetation growing over the intermediate cover, which has an effect on the volume of leachate generation. The older trenches have a thick vegetation cover, while some of the newer trenches remain essentially bare.

## 2.1 Leachate Generation

Leachate is removed from the underground lysimeter collection tank every 10 to 14 days. During the period of July 2007 through June 2008, a total of 660.81 gallons of leachate was collected, for a daily average during the year of 1.81 gallons. This is about a 21% decrease in leachate generation over the previous year, when the daily average was 2.3 gallons. This decrease is mainly attributed to below-normal precipitation recorded at Hanford in October 2007 (0.21 inches, which is 43% of normal [i.e. 0.49 inch]) and December 2007 (0.53 inches which is 48% of normal [i.e., 1.11 inches]).

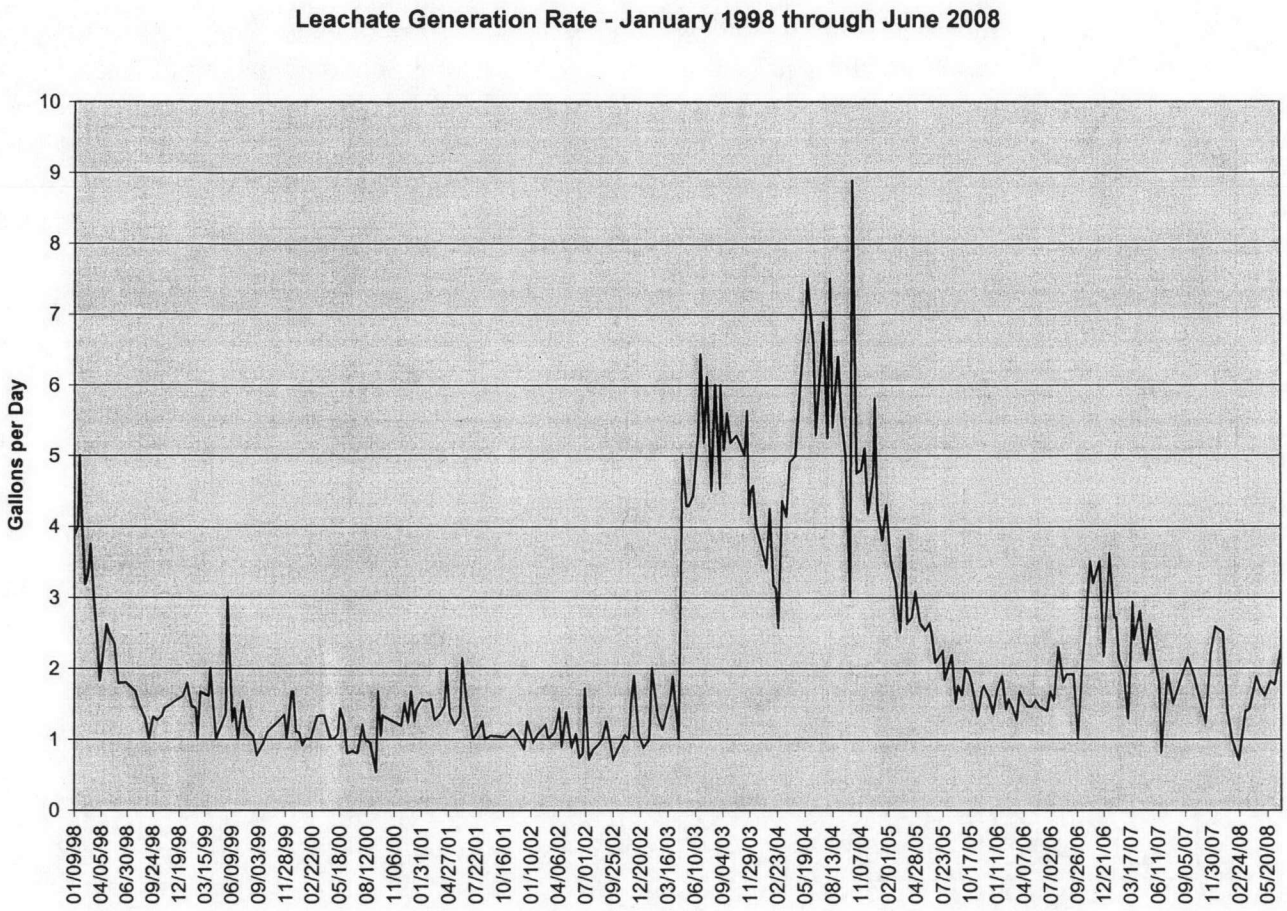
The Hanford Meteorological Station recorded 2.36 inches of precipitation during the December 2007 through February 2008 period, which is 88% of normal (i.e., 2.66 inches). Total precipitation for the first half of 2008 (i.e., January through June 2008) was 3.06 inches, which is 87% of normal (i.e., 3.53 inches). Because precipitation received at Hanford during the first half of 2008 is less than normal, a decrease in drainage through the lysimeter may be expected during the second half of 2008 (i.e., July through December 2008).

Table 1 provides leachate volumes by month for the reporting period. A chart of generation rates over the past decade is provided in Figure 3. As data in Figure 4 indicate, about 27% of the precipitation drains through the vadose zone.

**Table 1 – Leachate Generation Volumes**

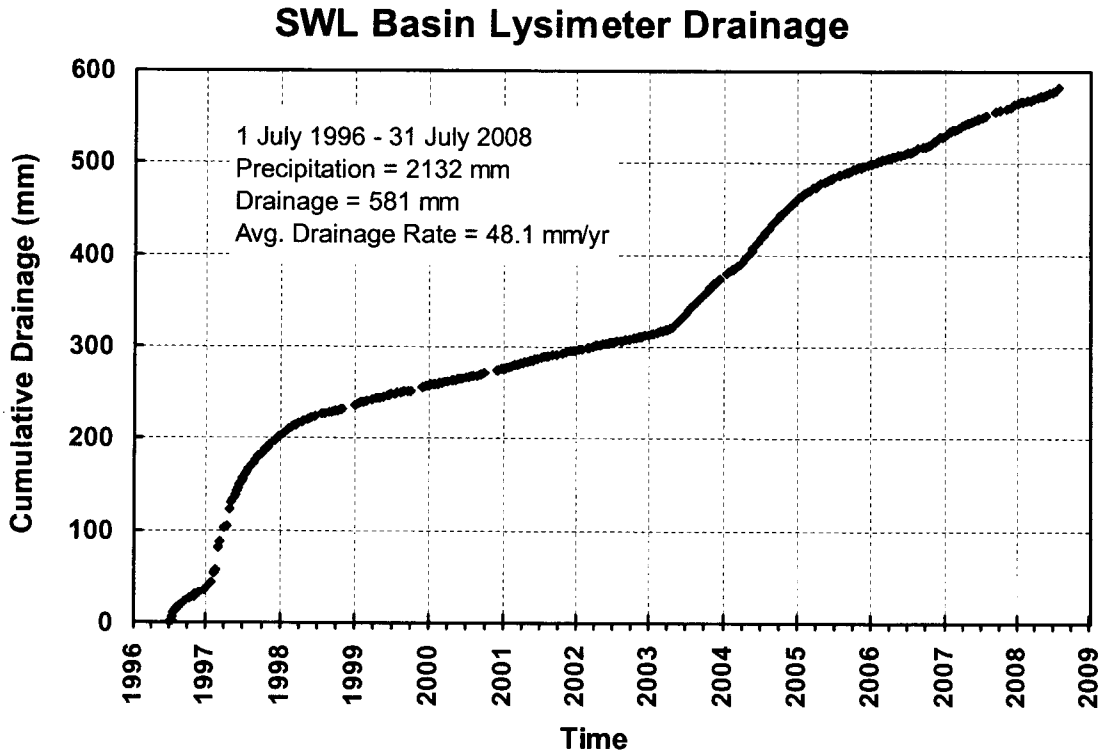
| Month | Volume (gallons) | Average Rate (gallons/day) |
|---|---|---|
| July 2007 | 53.57 | 1.73 |
| August 2007 | 66.65 | 2.15 |
| September 2007 | 60.25 | 2.0 |
| October 2007 | 59.65 | 1.92 |
| November 2007 | 65.36 | 2.18 |
| December 2007 | 75.54 | 2.43 |
| January 2008 | 63.26 | 2.04 |
| February 2008 | 26.60 | 0.91 |
| March 2008 | 35.02 | 1.13 |
| April 2008 | 49.62 | 1.65 |
| May 2008 | 51.71 | 1.67 |
| June 2008 | 53.58 | 1.79 |

## Figure 3 – Leachate Generation Rate




Note: In June 2008, a typographical error in the number of gallons of leachate collected during pumping on January 23, 2007 was detected. Eighty-eight gallons were added to the cumulative total instead of 38 gallons. Data presented in this report reflects the corrected volume.

**Figure 4 – Solid Waste Landfill Basin Lysimeter Drainage**




## 2.2 Leachate Results

Table 2 shows results of indicator and site-specific parameters for the leachate. Only the indicator parameters for groundwater monitoring listed in WAC 173-304-490 are monitored on a quarterly basis. In addition, at least once per year, the leachate is tested for a complete range of metals and organics (i.e., site-specific parameters). During this reporting period, the site-specific parameters were analyzed during the first quarter of 2008. Laboratory report No. 20080195 (issued March 10, 2008) show testing results for the site-specific parameters. Note, site specific metals were analyzed twice (i.e., fourth quarter CY 2007 and first quarter CY 2008). The analytical results were similar to previous years and did not identify any areas of concern. Note, leachate was not tested for indicator parameters during the second quarter of CY 2008 due to a scheduling oversight.

As can be seen from Table 2, some of the parameters continue to be above WAC 173-200 Groundwater Quality Criteria (GWQC) and/or Maximum Contaminant Levels (MCL) for public water supplies established in WAC 246-290. The fact that these contaminants are above compliance levels in the leachate does not necessarily mean that they will be present in the same concentrations in the groundwater. Groundwater monitoring results are reported in Section 3.0.

## Table 2 – Leachate Monitoring Results – Key Constituents

| Parameter[1] | Results by Quarter | | | | GWQC[2] | MCL[3] |
|---|---|---|---|---|---|---|
| | 3rd 2007 | 4th 2007 | 1st 2008 | 2nd 2008 | | |
| **Indicator Parameters** | | | | | | |
| Conductivity (uS/cm) | 2,050 | 1,840 | 2,000 | NT | NA | 700 umhos/cm |
| pH | 6.83 | 6.76 | 7.23 | NT | 6.5-8.5 | NA |
| Ammonia as N (mg/L) | 1.23 | 0.338 | 0.373 | NT | NA | NA |
| Dissolved Iron (ug/L) | 119 | 364 | 7910 | NT | 0.3 mg/L | 0.3 mg/L |
| Dissolved Manganese (ug/L) | 1,480 | 1,510 | 1,710 | NT | 0.05 mg/L | 0.05 mg/L |
| Dissolved Zinc (ug/L) | 381 | <8.0 | <4.0 | NT | 5.0 mg/L | 5.0 mg/L |
| Chemical Oxygen Demand (mg/L) | 214 | 200 | 230 | NT | NA | NA |
| Total Organic Carbon (mg/L) | 72.6 | 61.9 | 3.21 | NT | NA | NA |
| **Site-Specific Parameters** | | | | | | |
| Total Dissolved Solids (mg/L) | NT | NT | 1,440 | NT | 500 mg/L | 500 mg/L[4] |
| Total Organic Halides (ug/L) | NT | NT | 671 | NT | NA | NA |
| Arsenic (ug/L) | NT | 17.5 | 65.3 | NT | 0.05 ug/L | 0.010 mg/L |
| Barium (ug/L) | NT | 463 | 492 | NT | 1.0 mg/L | 2.0 mg/L |
| Cadmium (ug/L) | NT | <1.0 | <4.0 | NT | 0.01 mg/L | 0.005 mg/L |
| Chloride (mg/L) | 203 | 200 | 196 | NT | 250 mg/L | 25.0 mg/L |
| Copper (ug/L) | NT | 1.72 | <4.0 | NT | 1.0 mg/L | NA |
| Fluoride (mg/L) | <1.21 | <0.606 | 0.18 | NT | 4 mg/L | 4 mg/L |
| Nickel (ug/L) | NT | 109 | 106 | NT | NA | 0.1 mg/L |
| Selenium ug/L) | NT | 11.6 | 3.43 | NT | 0.01 mg/L | 0.05 mg/L |
| Sulfate (mg/L) | <14.1 | 7.07 | 7.12 | NT | 250 mg/L | 25 mg/L |
| 1,1-Dichloroethane (ug/L) | NT | NT | <1.0 | NT | 1.0 ug/L | NA |
| 1,1,1-Trichloroethane (ug/L) | NT | NT | <1.0 | NT | 0.20 mg/L | 0.2 mg/L |
| 1,4-Dioxane (ug/L) | NT | NT | 26.0 | NT | 7 ug/L | NA |
| 1,4-Dichlorobenzene (ug/L) | NT | NT | 12.0 | NT | 4 ug/L | NA |
| Carbon Tetrachloride (ug/L) | NT | NT | <1.0 | NT | 0.3 ug/L | 0.005 mg/L |
| Chloroform (ug/L) | NT | NT | <1.0 | NT | 7.0 ug/L | NA |
| Methylene Chloride (ug/L) | NT | NT | <1.0 | NT | 5 ug/L | NA |
| Tetrachloroethene (ug/L) | NT | NT | <1.0 | NT | NA | NA |
| Trichloroethene (ug/L) | NT | NT | <1.0 | NT | NA | NA |

NT = Not Tested
NA = Not Applicable
[1] Units as provided in analytical results report.
[2] Groundwater Quality Criteria from WAC 173-200.
[3] Maximum Contaminant Levels from WAC 246-290.
[4] Required only when specific conductivity exceeds 700 uS/cm.

## 3.0 Groundwater Monitoring

The existing SWL groundwater monitoring network consists of two upgradient wells on the west side of the SWL and eight downgradient wells along the east and south sides of the SWL. See Figure 5 for location of SWL groundwater monitoring wells. These wells are monitored quarterly as required by WAC 173-304 as part of the overall Hanford Site groundwater monitoring project. Well 699-25-34C has gone dry. Consequently, only nine wells are being monitored. At this time, there are no plans to deepen or replace 699-25-34C because there are seven other downgradient wells remaining in the network. The results of groundwater sampling are evaluated each quarter and statistical procedures are applied to determine if there are any significant increases in any of the constituents sampled over established background threshold values and/or the GWQC or MCL.

A complete list of constituents sampled in the groundwater over the past four quarters is provided in Table 3 below.

**Table 3 – Groundwater Monitoring Constituents**

| | | | |
|---|---|---|---|
| 1,1,1-Trichloroethane | Cadmium | M+P-Xylene | Temperature |
| 1,1,2-Trichloroethane | Calcium | Magnesium | Tetrachloroethene |
| 1,1-Dichloroethane | Carbon Disulfide | Manganese (dissolved) | Tetrahydrofuran |
| 1,2-Dichloroethane | Carbon Tetrachloride | Methylene Chloride | Tolulene |
| 1,4-Dichlorobenzene | Chemical Oxygen Demand | Nickel | Total Organic Carbon |
| 1,4-Dioxane | Chloride | Nitrogen in Nitrate | |
| 1-Butanol | Chloroform | Nitrogen as Nitrite | Total Xylenes |
| 2-Butanone | Chromium | Nitrogen in Ammonia | Trans-1,2-Dichloroethylene |
| 4-Methyl-2-Pentanone | Cis-1,2-Dichloroethylene | o-Xylene | Trichloroethene |
| Acetone | Cobalt | pH Measurement | Turbidity |
| Aluminum | Coliform Bacteria | Potassium | Vanadium |
| Antimony | Copper | Silver | Vinyl Chloride |
| Arsenic | Ethylbenzene | Sodium | Zinc (dissolved) |
| Barium | Ethyl Cyanide | Specific Conductivity | |
| Benzene | Fluoride | Strontium (elemental) | |
| Beryllium | Iron (dissolved) | Sulfate | |

All groundwater wells at the SWL were sampled successfully for this reporting period.

## 3.1 Background Threshold Value Exceedances

Sample results for SWL groundwater monitoring wells are compared to background threshold values (BTV) for groundwater constituents specified in WAC 173-304-490(2)(d). The BTVs are calculated from monitoring results at the two background (upgradient) wells 699-24-35 and 699-26-35A.

During the previous reporting year, BTVs for chemical oxygen demand, chloride, coliform bacteria, field pH, specific conductance, total organic carbon, iron, and sulfate were exceeded. During this reporting period, BTVs for these parameters again showed some exceedances.

Table 4 summarizes the exceedances during the four quarters of sampling associated with this reporting period.

**Table 4 – Background Threshold Value Exceedances**

| Parameter (BTV) | Maximum Previous Year | July-Sept 2007 | Oct-Dec 2007 | Jan-Mar 2008 | Apr-June 2008 |
|---|---|---|---|---|---|
| Chemical Oxygen Demand (10,000 µg/L) | 285,000 µg/L @ 699-22-35 | No exceedances | - One down-gradient<br>- Maximum: 23,000 µg/L @ 699-24-33 | No exceedances | No exceedances |
| Chloride (7,820 µg/L) | 9,700 µg/L @ 699-23-34B | No exceedances | No exceedances | No exceedances | No exceedances |
| Coliform bacteria (1 colony/100 ml) | 345 colonies/ 100 ml @ 699-23-34B | No exceedances | No exceedances | No exceedances | No exceedances |
| Field pH (6.68-7.84) | 6.49 @ 699-23-34A (lowest value) | - One down-gradient 6.68 @ 699-23-34A | - One down-gradient 6.59 @ 699-23-34A | - One down-gradient 6.63 @ 699-23-34A | No exceedances |
| Specific Conductance (583 µS/cm) | 829 µS/cm @ 699-22-35 | - Six down-gradient and one upgradient<br>- Maximum: 831 µS/cm @ 699-22-35 | - Seven down-gradient<br>- Maximum: 827 µS/cm @ 699-22-35 | - Seven down-gradient<br>- Maximum: 828 µS/cm @ 699-22-35 | - Seven down-gradient<br>- Maximum: 824 µS/cm @ 699-22-35 |
| Sulfate (47,200 µg/L) | 66,900 µg/L @ 699-24-34B | No exceedances | No exceedances | _ Four down-gradient<br>- Maximum 54.3 mg/L @ 699-24-34B | _ Two down-gradient<br>- Maximum 55.5 mg/L @ 699-24-34B |
| Temperature (20.7 degrees C) | No exceedances | - One down-gradient<br>- Maximum: 22.2 degrees C @ 699-23-34B | No exceedances | No exceedances | - One down-gradient<br>- Maximum: 25.9 degrees C @ 699-22-35 |
| Iron (160 µg/L) | No exceedances | No exceedances | No exceedances | - Two down-gradient<br>- Maximum: 290µg/L @ 699-24-34B | - Two down-gradient<br>- Maximum: 263µg/L @ 699-24-34C |

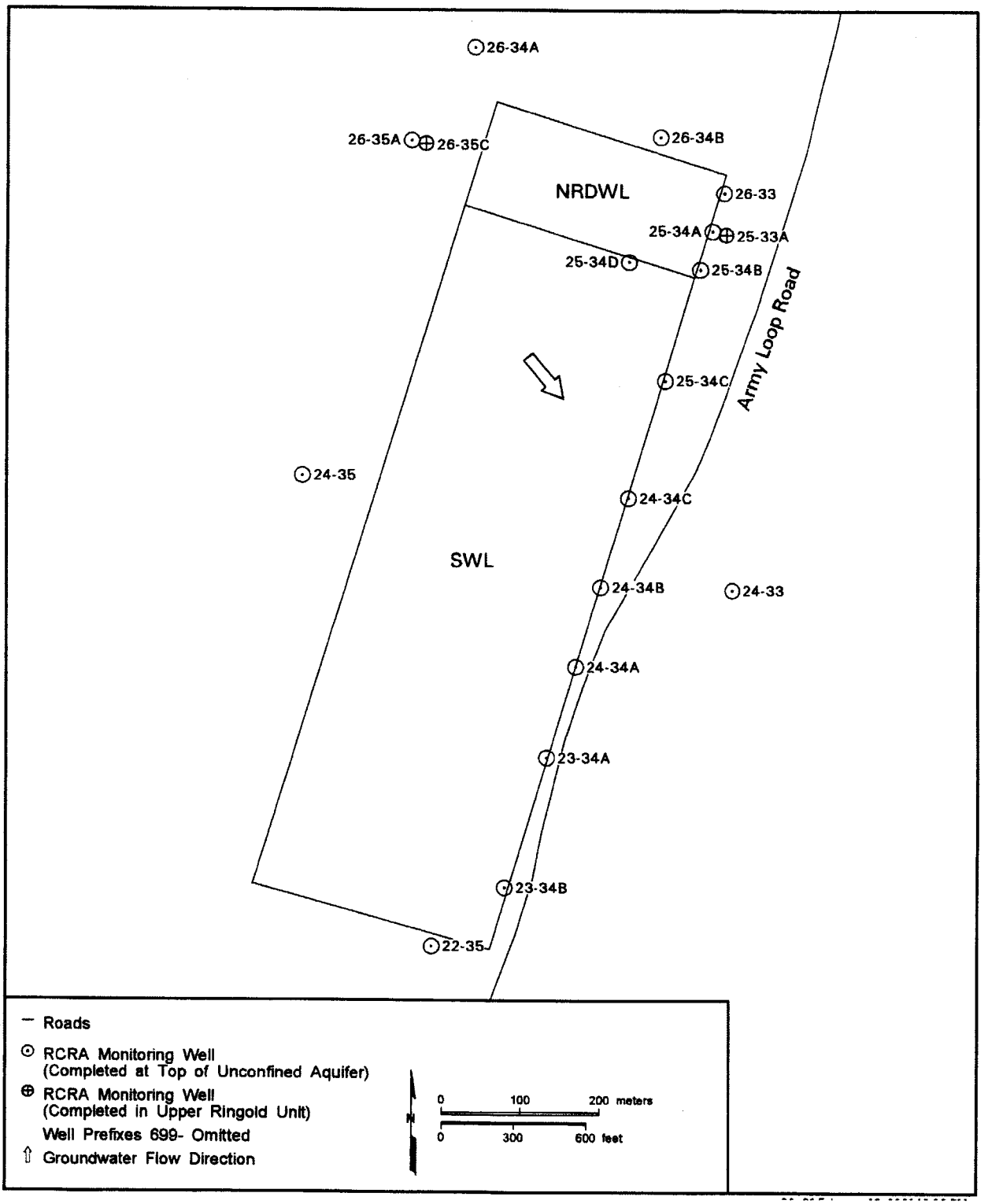
| Parameter (BTV) | Maximum Previous Year | July-Sept 2007 | Oct-Dec 2007 | Jan-Mar 2008 | Apr-June 2008 |
|---|---|---|---|---|---|
| Total organic carbon (1430 ug/L) | No exceedances | No exceedances | No exceedances | - Five down-gradient and one upgradient<br>- Maximum: 38,000 µg/L @ 699-24-33 | No exceedances |

The total organic carbon results for the January through March 2008 quarter represent a deviation of the historical trend. Based on follow-up discussions and review with the lab, the unusual results were attributed to laboratory error. Subsequent analytical testing shows parameter concentrations that are consistent with the historical trend.

The analytical results for this reporting period are typical of results shown in previous years and are consistent with the type of waste disposed in the landfill, including sewage and chlorinated hydrocarbons from the 1100 Area heavy equipment garage and bus shop. Chemical oxygen demand and coliform bacteria continued to show erratic results in response to the sewage disposed at the site. Specific conductance remains steady to slightly decreasing at the SWL wells. Field measurements of pH in downgradient wells continued to be lower than wells upgradient of the landfill.

In summary, the analytical results are typical of historical trends at the SWL and are consistent with the results at the two background wells.

## Figure 5 – Location of Groundwater Monitoring Wells



### 3.2 Groundwater Quality Criteria and Drinking Water Maximum Contaminant Level Exceedances

During the previous reporting period, WAC 173-200 GWQC exceedances were observed for filtered arsenic, pH, and tetrachloroethene. Specific conductance exceeded the Washington Drinking Water MCL.

During this reporting period, the limits for these parameters again showed some exceedances (with the exception of pH). Additionally, the Federal MCL for antimony was exceeded at one well. Table 5 provides a summary of the exceedances during the four quarters of sampling included in this report.

**Table 5 – GWQC and Drinking Water MCL Exceedances**

| Parameter (Limit) | Maximum Previous Year | July-Sept 2006 | Oct-Dec 2006 | Jan-Mar 2007 | Apr-June 2007 |
|---|---|---|---|---|---|
| Filtered arsenic (0.05 µg/L)[1] | 2.5 µg/L @ 699-23-34B & 699-24-35 | - All network wells<br>- Maximum 3.5 µg/L @ 699-24-34C | All network wells<br>- Maximum 2.7 µg/L @ 699-23-34B | All network wells<br>- Maximum 2.7 µg/L @ 699-23-34B | All network wells<br>- Maximum 3.7 µg/L @ 699-26-35A |
| pH (6.5-8.5)[1] | 6.49 @ 699-23-34A | No exceedances | No exceedances | No exceedances | No exceedances |
| Specific conductance (700 µS/cm)[2] | 829 µS/cm @ 699-22-35 | - Four down-gradient<br>- Maximum: 831 µS/cm @ 699-22-35 | - Six downgradient<br>- Maximum: 827 µS/cm @ 699-22-35 | - Five down-gradient<br>- Maximum: 828 µS/cm @ 699-22-35 | - Six downgradient<br>- Maximum: 824 µS/cm @ 699-22-35 |
| Tetrachloro-ethene (0.8 µg/L)[1] | 1.5 µg/L @ 699-24-33 | - Five down-gradient and one upgradient<br>- Maximum: 1.5 µg/L @ 699-24-33 | No exceedances | No exceedances | No exceedances |
| Antimony (6 ug/L)[3] | No exceedances | No exceedances | No exceedances | - One upgradient 34.9 ug/L @ 699-24-35 | No exceedances |

[1]Groundwater Quality Criteria from WAC 173-200-040
[2]Maximum Contaminant Levels from WAC 246-290-310
[3] Maximum Contaminant Levels from 40 CFR 141.62

The antimony results for the January through March 2008 quarter represent a deviation of the historical trend. Based on follow-up discussions and review with the lab, the unusual results were attributed to laboratory error associated with results at or near the method detection limit. Subsequent analytical testing shows constituent concentrations that are consistent with the historical trend.

Results remain consistent with the type of waste that was disposed to the landfill which included sewage and chlorinated hydrocarbons from the 1100 Area heavy equipment garage and bus shop. Arsenic continues to be detected at SWL wells, but the concentrations detected are typical of Hanford Site background values. Field measurements of pH in downgradient wells continued to be lower than upgradient

wells at the site. Specific conductance remains steady to slightly decreasing at SWL wells. Volatile organic compounds (such as tetrachloroethene) continued to decrease slightly in concentration.

## 3.3 Groundwater Hydrology

The direction and flow of groundwater beneath the SWL is difficult to determine from water table maps because of the extremely low hydraulic gradients. However, groundwater is known to flow southeast between the 200 East Area and the SWL, because the average water-level elevation at the landfill is about 0.43 foot (0.13 meter) less than the average elevation in the 200 East Area. The groundwater flow rate was estimated in the *Hanford Site Groundwater Monitoring for Fiscal Year 2006* (PNNL-16346) to be in the range of 0.066 to 0.427 foot (0.02 to 0.13 meter) per day, based on measurements of the hydraulic gradient from water table maps and current understanding of the local hydraulic conductivity and effective porosity.

According to information provided by the Pacific Northwest National Laboratory (PNNL-16346), the elevation of the water table continued to decline but at a slower rate within the 200 East Area and vicinity. In the 200 East Area, the elevation of the water table declined an average of 0.23 foot (0.07 meter) from March 2005 to April 2006. This is less than the previous annual decline (i.e., 0.055 foot [0.13 meter] from March 2004 to March 2005), and is below the average rate of decline observed from June 1997 to March 2002 (i.e., 0.56 foot [0.17 meter] per year). Beginning in the fall of 2002, the rate of water table elevation decline in the 200 East Area and vicinity slowed significantly with water levels actually increasing in some wells. The region affected by this smaller than normal decline extended from north of Gable Gap through the 200 East Area to the SWL. An investigation into the cause of the water table fluctuation was completed during FY 2006 and documented in a PNNL report (PNNL-SA-49780).

## 3.4 Chlorinated Organics in Target Wells

Based on past monitoring of the 10 wells in the SWL groundwater monitoring program, six primary contaminants have been identified in the groundwater below the SWL for inclusion in this report: 1) 1,1-Dichloroethane, 2) 1,1,1-Trichloroethane, 3) Chloroform, 4) Carbon Tetrachloride, 5) Tetrachloroethylene, and 6) Trichloroethylene. These chlorinated hydrocarbons are detected in both upgradient and downgradient wells, although concentrations for most constituents are slightly higher in the downgradient wells. The three wells which historically have shown the highest levels of contamination are included in this report. These three wells are referred to as the target wells and are all downgradient wells. Well 699-22-35 is located outside the south perimeter fence of the SWL; well 699-23-34A is located outside the east perimeter fence near the southeast corner; and well 699-24-34C is located outside the east perimeter fence near the mid-point of the landfill. Table 6 shows the results of analyses for the six primary contaminants in the three target downgradient wells, in addition to comparison data from one of the upgradient wells (699-24-35).

The historical trend for each of the six contaminants in the three target wells is downward. With the exception of tetrachloroethene; the levels for all of the chlorinated organic constituents shown in these figures are currently below WAC 173-300 GWQC. Tetrachloroethene levels, as indicated previously, are slightly above GWQC thresholds in some of the wells, with an apparent downward trend. Of note is that tetrachloroethene levels are about the same in the upgradient well as in the downgradient wells.

Charts showing decreases in concentrations of these six organic chemical contaminants in the

groundwater are provided in the Appendix, Figures A-1 through A-6. The contaminants have steadily decreased over the past 10 years as shown on the charts. Minor apparent increases in two of the reporting periods (December 2007 and May 2008) are indicative of an increase in the method detection level (MDL) to 1.0 ug/L due to use of a different analytical laboratory.

**Table 6 – Results of Groundwater Monitoring in Three Target Wells Compared with One Upgradient Well ***

| 699-22-35 | | | | 699-23-34A | | | | 699-24-34C | | | | 699-24-35 (upgradient) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2007 | | 2008 | | 2007 | | 2008 | | 2007 | | 2008 | | 2007 | | 2008 | |
| 3rd | 4th | 1st | 2nd | 3rd | 4th | 1st | 2nd | 3rd | 4th | 1st | 2nd | 3rd | 4th | 1st | 2nd |
| 1,1,1 Trichloroethane (GWQC of 200 ug/L)** | | | | | | | | | | | | | | | |
| 1.2 | 1.0u | 0.68j | 1.0u | 1.1 | 1.0u | 0.95j | 1.0u | 0.74j | 1.0u | 0.64j | 1.0u | 1.0 | 1.0u | 0.8j | 1.0u |
| 1,1 Dichloroethane (GWQC of 1 ug/L)** | | | | | | | | | | | | | | | |
| 0.42j | 1.0u | 0.046u | 1.0u | 0.42j | 1.0u | 0.046u | 1.0u | 0.21j | 1.0u | 0.046u | 1.0j | 0.19j | 1.0u | 0.046u | 1.0u |
| Carbon Tetrachloride (GWQC of 0.3 ug/L)** | | | | | | | | | | | | | | | |
| 0.1u | 1.0u | 0.1u | 1.0u | 0.1u | 1.0u | 1.0u | 1.0u | 1.0u | 1.0u | 0.1u | 1.0u | 0.1u | 1.0u | 0.1u | 1.0u |
| Chloroform (GWQC of 7 ug/L)** | | | | | | | | | | | | | | | |
| 0.31j | 1.0u | 0.26j | 1.0u | 0.1u | 1.0u | 0.11j | 1.0u | 0.1u | 1.0u | 0.1u | 1.0u | 1.0u | 01.u | 1.0u | 0.14j |
| Tetrachloroethene | | | | | | | | | | | | | | | |
| 0.17u | 1.0u | 0.17u | 1.0u | 0.43j | 1.0u | 0.29j | 1.0u | 0.52j | 1.0u | 0.4j | 1.0u | 0.23j | 1.0u | 0.17u | 1.0u |
| Trichloroethene | | | | | | | | | | | | | | | |
| 0.37j | 1.0u | 0.32j | 1.0u | 0.1u | 1.0u | 0.35j | 1.0u | 0.57j | 1.0u | 0.52j | 1.0u | 0.39j | 1.0u | 0.36j | 1.0u |

*Units in ug/L

**Groundwater Quality Criteria from WAC 173-200

j means the reported value is estimated because analyte was detected at a level less than the required detection level or the practical quantitation limit and greater than or equal to the method detection level.

u means non-detect or below the method detection level (MDL = 1.0 ug/L).

## 4.0 Soil Gas Monitoring

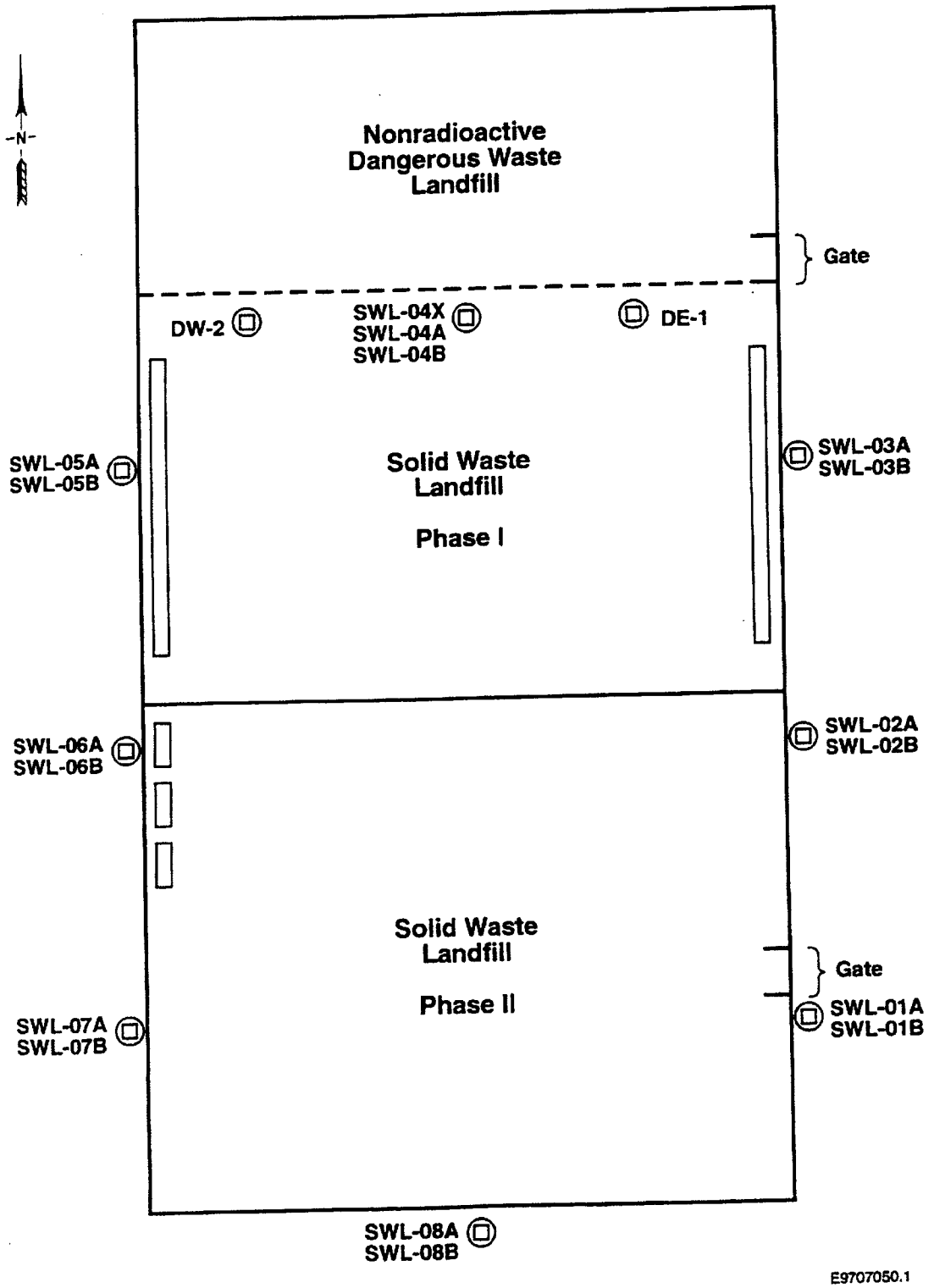
The soil gas monitoring network consists of eight shallow monitoring stations located around the perimeter of the SWL. Each monitoring station consists of two dedicated soil-gas probes driven to depths of approximately 9 and 15 feet (2.7 and 4.6 meters), respectively. The gas is monitored quarterly to determine concentrations of carbon dioxide and methane. The soil gas is also analyzed for several key volatile organic constituents; i.e., methylene chloride, 1,1-dichloroethane, chloroform, 1,1,1-trichloroethane, carbon tetrachloride, trichloroethylene, 1,1,2-trichloroethane, and tetrachloroethylene. See Figure 6 for location of soil gas monitoring stations. Note, soil gas monitoring station DE-1 (shown in Figure 6) is no longer used due to fire damage.

In addition to the eight monitoring stations in the SWL soil gas monitoring network, soil gas monitoring station DW-2 (located along the border with the Non-Radioactive Dangerous Waste Landfill) is sampled routinely.

A summary of soil gas monitoring results is provided in Table 7. Results are consistent with results of

previous monitoring. The concentrations for the volatile organic constituents were at or below the detection limits. Methane concentrations remain low or, for the most part, are not detected. Carbon dioxide concentrations continue to be consistent with data provided in previous reports.

## Figure 6 – Soil Gas Monitoring Stations



## Table 7 – SWL Soil Gas Monitoring Results
(July 2007 through June 2008)

| Constituents / Sample Month | Wells | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 01-A | 01-B | 02-A | 02-B | 03-A | 03-B | 04-A | 04-B | 04-X | DW-2 | 05-A | 05-B | 06-A | 06-B | 07-A | 07-B | 08-A | 08-B |
| **Methane ($CH_4$) (ppm)** | | | | | | | | | | | | | | | | | | |
| Aug 2007 | 12.53 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Dec 2007 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | [2] | [2] | [2] | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Apr 2008 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 29.0 | 0.0 | 0.0 | 0.0 | 0.0 | 31 | [1] | 0.0 | 0.0 |
| May 2008 | 51 | 31 | 0.0 | 31 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 60 | [1] | 38 | 0.0 |
| **Carbon dioxide ($CO_2$) (ppm)** | | | | | | | | | | | | | | | | | | |
| Aug 2007 | 430 | 626 | 0 | 0 | 283 | 239 | 331 | 1450 | 447 | 0 | 0 | 0 | 136 | 136 | 522 | 368 | 0 | 0 |
| Dec 2007 | 0 | 0 | 0 | 0 | 0 | 515 | [2] | [2] | [2] | 873 | 0 | 1335 | 1108 | 1405 | 1293 | 1179 | 1365 | 1861 |
| Apr 2008 | 1530 | 2722 | 1537 | 3051 | 511 | 2355 | 4061 | 4047 | 3322 | 2970 | 1377 | 2679 | 2501 | 2738 | 1879 | [1] | 2743 | 3347 |
| May 2008 | 2274 | 3180 | 2376 | 3783 | 1078 | 3349 | 0 | 0 | 0 | 4696 | 3233 | 4017 | 4130 | 4406 | 2184 | [1] | 3202 | 3881 |
| **Methylene chloride (DCM) (ppm)** | | | | | | | | | | | | | | | | | | |
| Aug 2007 | <0.44 | <0.44 | <0.44 | <0.44 | <0.44 | <0.44 | <0.44 | <0.44 | <0.44 | <0.44 | <0.44 | <0.44 | <0.44 | <0.44 | <0.44 | <0.44 | <0.44 | <0.44 |
| Dec 2007 | <0.44 | <0.44 | <0.44 | <0.44 | <0.44 | <0.44 | [2] | [2] | [2] | <0.44 | <0.44 | <0.44 | <0.44 | <0.44 | <0.44 | <0.44 | <0.44 | <0.44 |
| Apr 2008 | <0.44 | <0.44 | <0.44 | <0.44 | <0.44 | <0.44 | <0.44 | <0.44 | <0.44 | <0.44 | <0.44 | <0.44 | <0.44 | <0.44 | <0.44 | [1] | <0.44 | <0.44 |
| May 2008 | <0.44 | <0.44 | <0.44 | <0.44 | <0.44 | <0.44 | <0.44 | <0.44 | <0.44 | <0.44 | <0.44 | <0.44 | <0.44 | <0.44 | <0.44 | <0.44 | <0.44 | <0.44 |
| **1,1-Dichloroethane (1,1-DCA) (ppm)** | | | | | | | | | | | | | | | | | | |
| Aug 2007 | <0.22 | <0.22 | <0.22 | <0.22 | <0.22 | <0.22 | <0.22 | <0.22 | <0.22 | <0.22 | <0.22 | <0.22 | <0.22 | <0.22 | <0.22 | <0.22 | <0.22 | <0.22 |
| Dec 2007 | <0.22 | <0.22 | <0.22 | <0.22 | <0.22 | <0.22 | [2] | [2] | [2] | <0.22 | <0.22 | <0.22 | <0.22 | <0.22 | <0.22 | <0.22 | <0.22 | <0.22 |
| Apr 2008 | <0.22 | <0.22 | <0.22 | <0.22 | <0.22 | <0.22 | <0.22 | <0.22 | <0.22 | <0.22 | <0.22 | <0.22 | <0.22 | <0.22 | <0.22 | [1] | <0.22 | <0.22 |
| May 2008 | <0.22 | <0.22 | <0.22 | <0.22 | <0.22 | <0.22 | <0.22 | <0.22 | <0.22 | <0.22 | <0.22 | <0.22 | <0.22 | <0.22 | <0.22 | [1] | <0.22 | <0.22 |
| **Chloroform (TCM) (ppm)** | | | | | | | | | | | | | | | | | | |
| Aug 2007 | <0.07 | <0.07 | <0.07 | <0.07 | <0.07 | <0.07 | <0.07 | <0.07 | <0.07 | <0.07 | <0.07 | <0.07 | <0.07 | <0.07 | <0.07 | <0.07 | <0.07 | <0.07 |
| Dec 2007 | <0.07 | <0.07 | <0.07 | <0.07 | <0.07 | <0.07 | [2] | [2] | [2] | <0.07 | <0.07 | <0.07 | <0.07 | <0.07 | <0.07 | <0.07 | <0.07 | <0.07 |
| Apr 2008 | <0.07 | <0.07 | <0.07 | <0.07 | <0.07 | <0.07 | <0.07 | <0.07 | <0.07 | <0.07 | <0.07 | <0.07 | <0.07 | <0.07 | <0.07 | [1] | <0.07 | <0.07 |
| May 2008 | <0.07 | <0.07 | <0.07 | <0.07 | <0.07 | <0.07 | <0.07 | <0.07 | <0.07 | <0.07 | <0.07 | <0.07 | <0.07 | <0.07 | <0.07 | [1] | <0.07 | <0.07 |
| **1,1,1-Trichloroethane (1,1,1-TCA) (ppm)** | | | | | | | | | | | | | | | | | | |
| Aug 2007 | <0.15 | <0.15 | <0.15 | <0.15 | <0.15 | <0.15 | <0.15 | <0.15 | <0.15 | <0.15 | <0.15 | <0.15 | <0.15 | <0.15 | <0.15 | <0.15 | <0.15 | <0.15 |
| Dec 2007 | <0.15 | <0.15 | <0.15 | <0.15 | <0.15 | <0.15 | [2] | [2] | [2] | <0.15 | <0.15 | <0.15 | <0.15 | <0.15 | <0.15 | <0.15 | <0.15 | <0.15 |
| Apr 2008 | <0.15 | <0.15 | <0.15 | <0.15 | <0.15 | <0.15 | <0.15 | <0.15 | <0.15 | <0.15 | <0.15 | <0.15 | <0.15 | <0.15 | <0.15 | [1] | <0.15 | <0.15 |
| May 2008 | <0.15 | <0.15 | <0.15 | <0.15 | <0.15 | <0.15 | <0.15 | <0.15 | <0.15 | <0.15 | <0.15 | <0.15 | <0.15 | <0.15 | <0.15 | [1] | <0.15 | <0.15 |

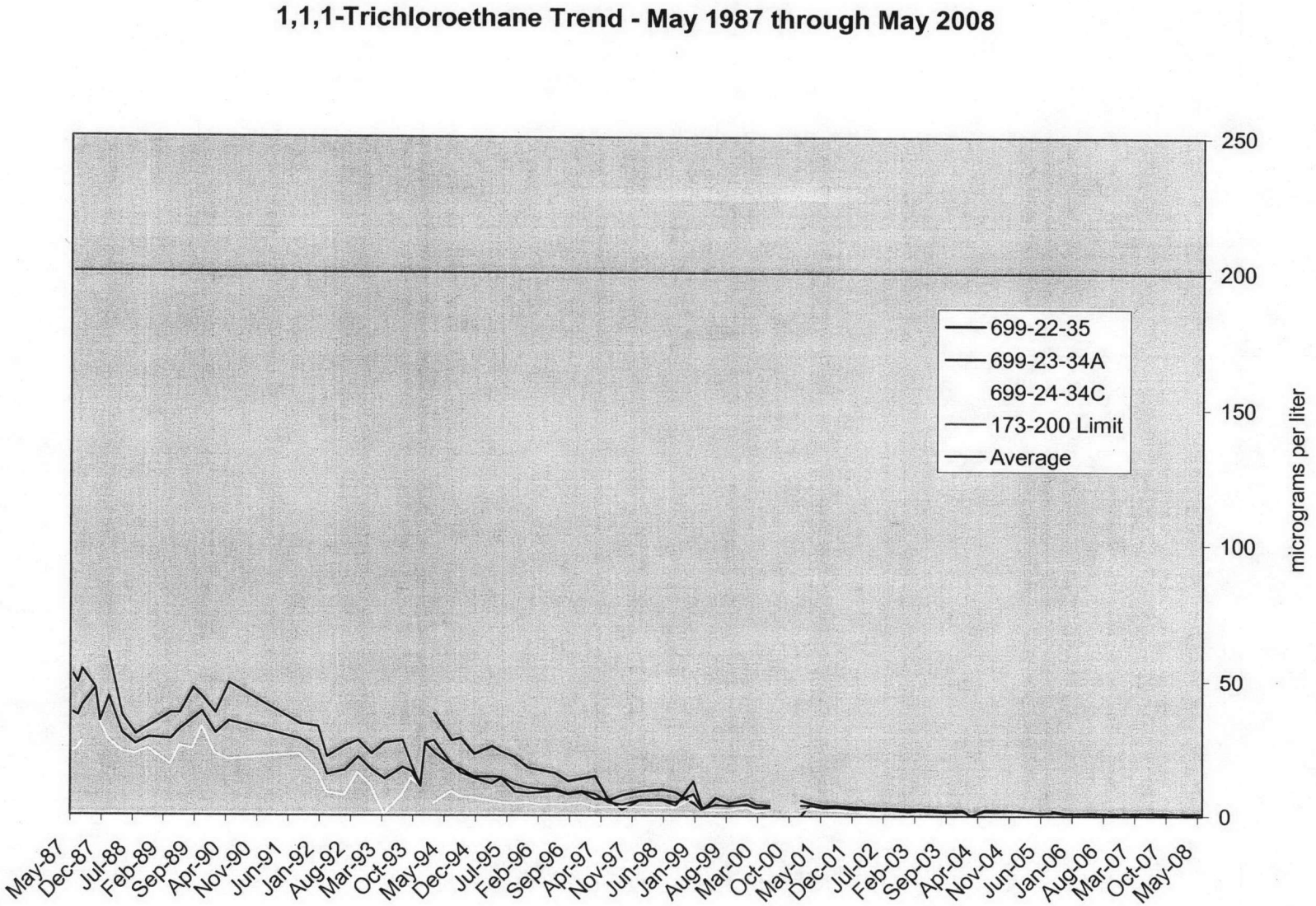
| Constituents / Sample Month | Wells | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 01-A | 01-B | 02-A | 02-B | 03-A | 03-B | 04-A | 04-B | 04-X | DW-2 | 05-A | 05-B | 06-A | 06-B | 07-A | 07-B | 08-A | 08-B |
| **Carbon tetrachloride ($CCl_4$) (ppm)** | | | | | | | | | | | | | | | | | | |
| Aug 2007 | <0.09 | <0.09 | <0.09 | <0.09 | <0.09 | <0.09 | <0.09 | <0.09 | <0.09 | <0.09 | <0.09 | <0.09 | <0.09 | <0.09 | <0.09 | <0.09 | <0.09 | <0.09 |
| Dec 2007 | <0.09 | <0.09 | <0.09 | <0.09 | <0.09 | <0.09 | [2] | [2] | [2] | <0.09 | <0.09 | <0.09 | <0.09 | <0.09 | <0.09 | <0.09 | <0.09 | <0.09 |
| Apr 2008 | <0.09 | <0.09 | <0.09 | <0.09 | <0.09 | <0.09 | <0.09 | <0.09 | <0.09 | <0.09 | <0.09 | <0.09 | <0.09 | <0.09 | <0.09 | [1] | <0.09 | <0.09 |
| May 2008 | <0.09 | <0.09 | <0.09 | <0.09 | <0.09 | <0.09 | <0.09 | <0.09 | <0.09 | <0.09 | <0.09 | <0.09 | <0.09 | <0.09 | <0.09 | [1] | <0.09 | <0.09 |
| **Trichloroethylene (TCE) (ppm)** | | | | | | | | | | | | | | | | | | |
| Aug 2007 | <1.2 | <1.2 | <1.2 | <1.2 | <1.2 | <1.2 | <1.2 | <1.2 | <1.2 | <1.2 | <1.2 | <1.2 | <1.2 | <1.2 | <1.2 | <1.2 | <1.2 | <1.2 |
| Dec 2007 | <1.2 | <1.2 | <1.2 | <1.2 | <1.2 | <1.2 | [2] | [2] | [2] | <1.2 | <1.2 | <1.2 | <1.2 | <1.2 | <1.2 | <1.2 | <1.2 | <1.2 |
| Apr 2008 | <1.2 | <1.2 | <1.2 | <1.2 | <1.2 | <1.2 | <1.2 | <1.2 | <1.2 | <1.2 | <1.2 | <1.2 | <1.2 | <1.2 | <1.2 | [1] | <1.2 | <1.2 |
| May 2008 | <1.2 | <1.2 | <1.2 | <1.2 | <1.2 | <1.2 | <1.2 | <1.2 | <1.2 | <1.2 | <1.2 | <1.2 | <1.2 | <1.2 | <1.2 | [1] | <1.2 | <1.2 |
| **1,1,2-Trichloroethane (1,1,2-TCA) (ppm)** | | | | | | | | | | | | | | | | | | |
| Aug 2007 | <0.07 | <0.07 | <0.07 | <0.07 | <0.07 | <0.07 | <0.07 | <0.07 | <0.07 | <0.07 | <0.07 | <0.07 | <0.07 | <0.07 | <0.07 | <0.07 | <0.07 | <0.07 |
| Dec 2007 | <0.07 | <0.07 | <0.07 | <0.07 | <0.07 | <0.07 | [2] | [2] | [2] | <0.07 | <0.07 | <0.07 | <0.07 | <0.07 | <0.07 | <0.07 | <0.07 | <0.07 |
| Apr 2008 | <0.07 | <0.07 | <0.07 | <0.07 | <0.07 | <0.07 | <0.07 | <0.07 | <0.07 | <0.07 | <0.07 | <0.07 | <0.07 | <0.07 | <0.07 | [1] | <0.07 | <0.07 |
| May 2008 | <0.07 | <0.07 | <0.07 | <0.07 | <0.07 | <0.07 | <0.07 | <0.07 | <0.07 | <0.07 | <0.07 | <0.07 | <0.07 | <0.07 | <0.07 | [1] | <0.07 | <0.07 |
| **Tetrachloroethylene (PCE) (ppm)** | | | | | | | | | | | | | | | | | | |
| Aug 2007 | <0.16 | <0.16 | <0.16 | <0.16 | <0.16 | <0.16 | <0.16 | <0.16 | <0.16 | <0.16 | <0.16 | <0.16 | <0.16 | <0.16 | <0.16 | <0.16 | <0.16 | <0.16 |
| Dec 2007 | <0.16 | <0.16 | <0.16 | <0.16 | <0.16 | <0.16 | [2] | [2] | [2] | <0.16 | <0.16 | <0.16 | <0.16 | <0.16 | <0.16 | <0.16 | <0.16 | <0.16 |
| Apr 2008 | <0.16 | <0.16 | <0.16 | <0.16 | <0.16 | <0.16 | <0.16 | <0.16 | <0.16 | <0.16 | <0.16 | <0.16 | <0.16 | <0.16 | <0.16 | [1] | <0.16 | <0.16 |
| May 2008 | <0.16 | <0.16 | <0.16 | <0.16 | <0.16 | <0.16 | <0.16 | <0.16 | <0.16 | <0.16 | <0.16 | <0.16 | <0.16 | <0.16 | <0.16 | [1] | <0.16 | <0.16 |

[1]Sample tube was filled with water and no sample was collected.

[2] No sample was collected due to inadvertent oversight associated with personnel on medical leave.

## Appendix – Groundwater Trends

### Figure A-1 – 1,1,1-Trichloroethane Trend



## Figure A-2 – 1,1-Dichloroethane Trend

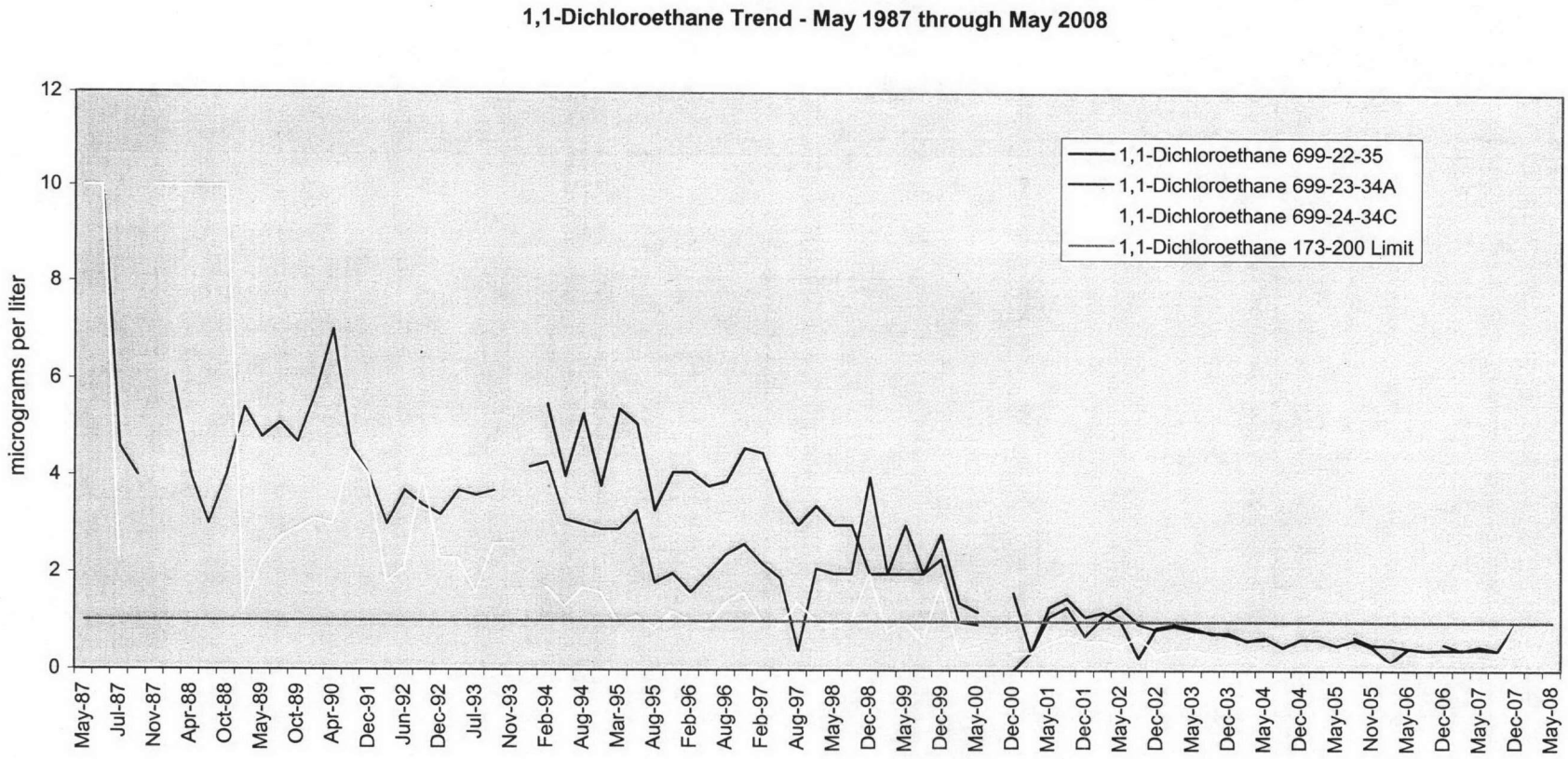


**Figure A-3 – Carbon Tetrachloride Trend**

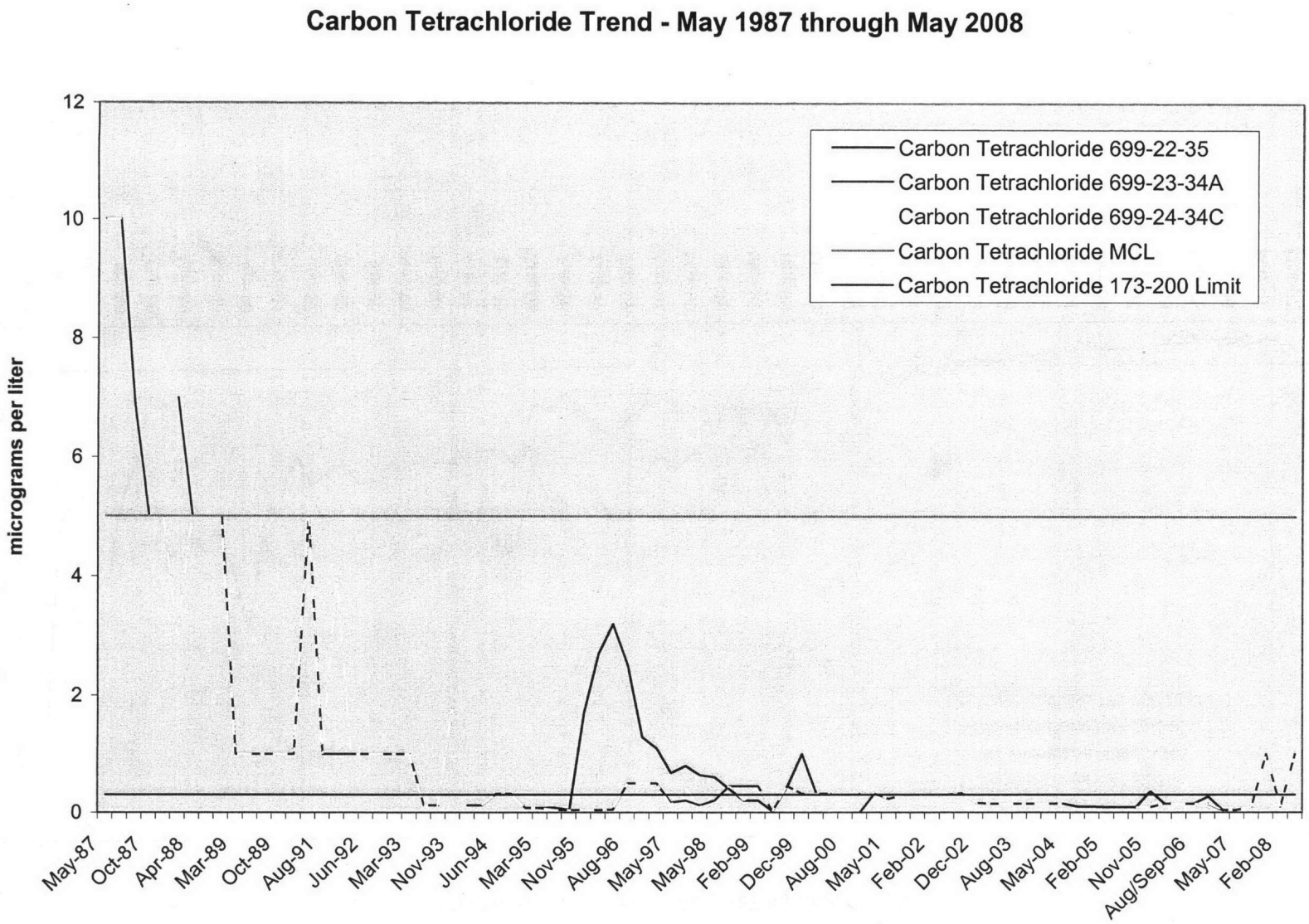


**Figure A-4 – Chloroform Trend**

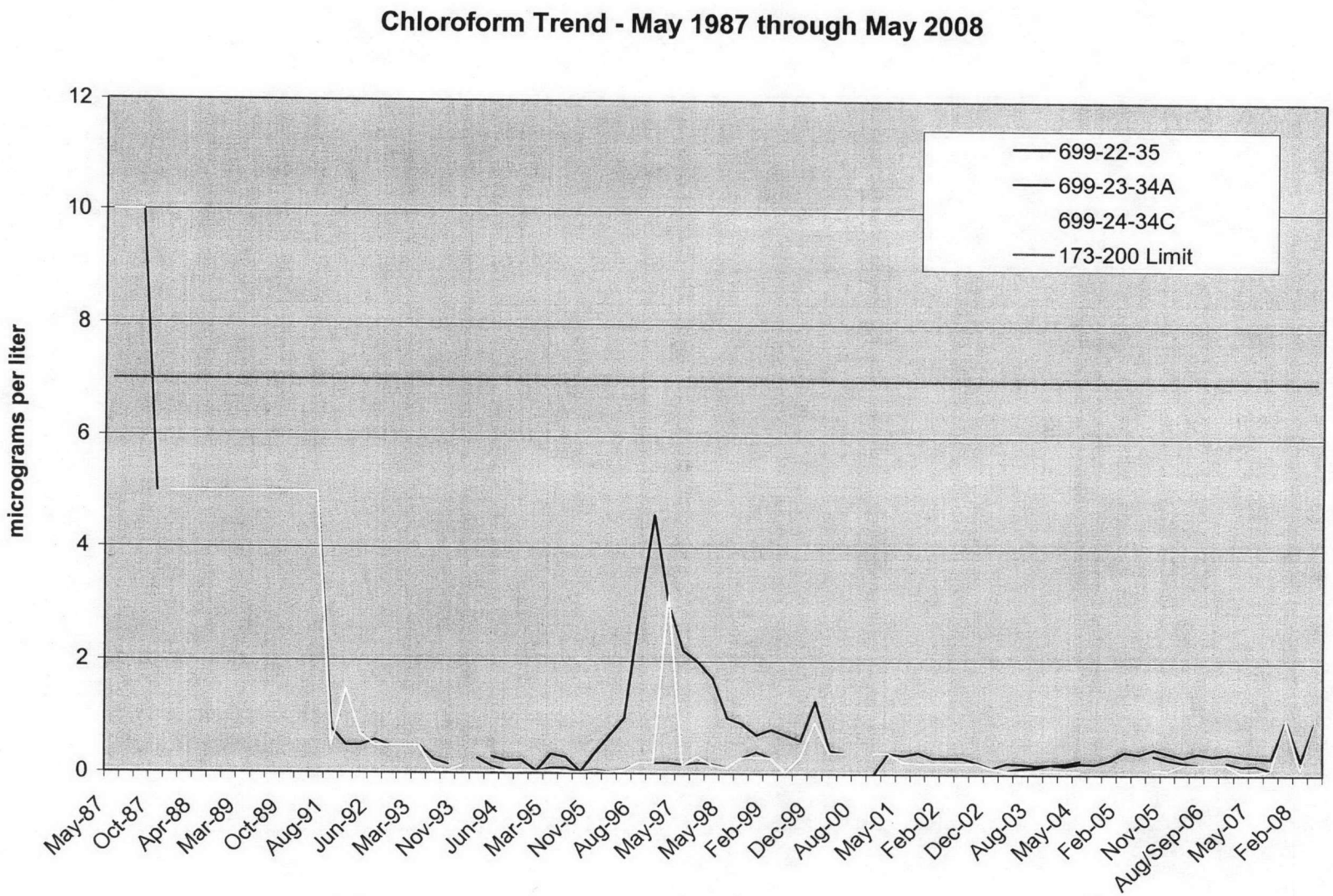


**Figure A-5 – Tetrachloroethene Trend**

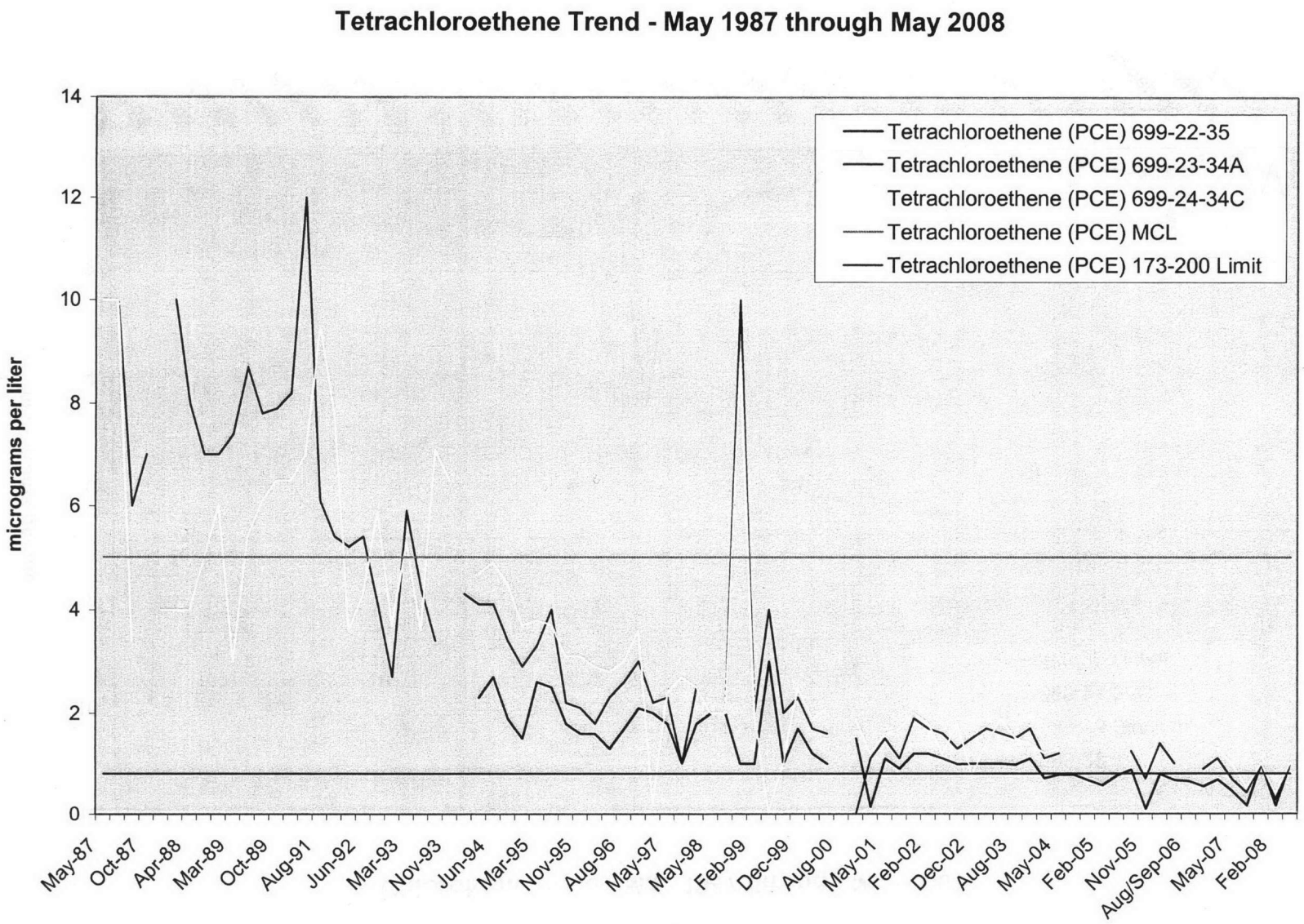


**Figure A-6 – Trichloroethene Trend**

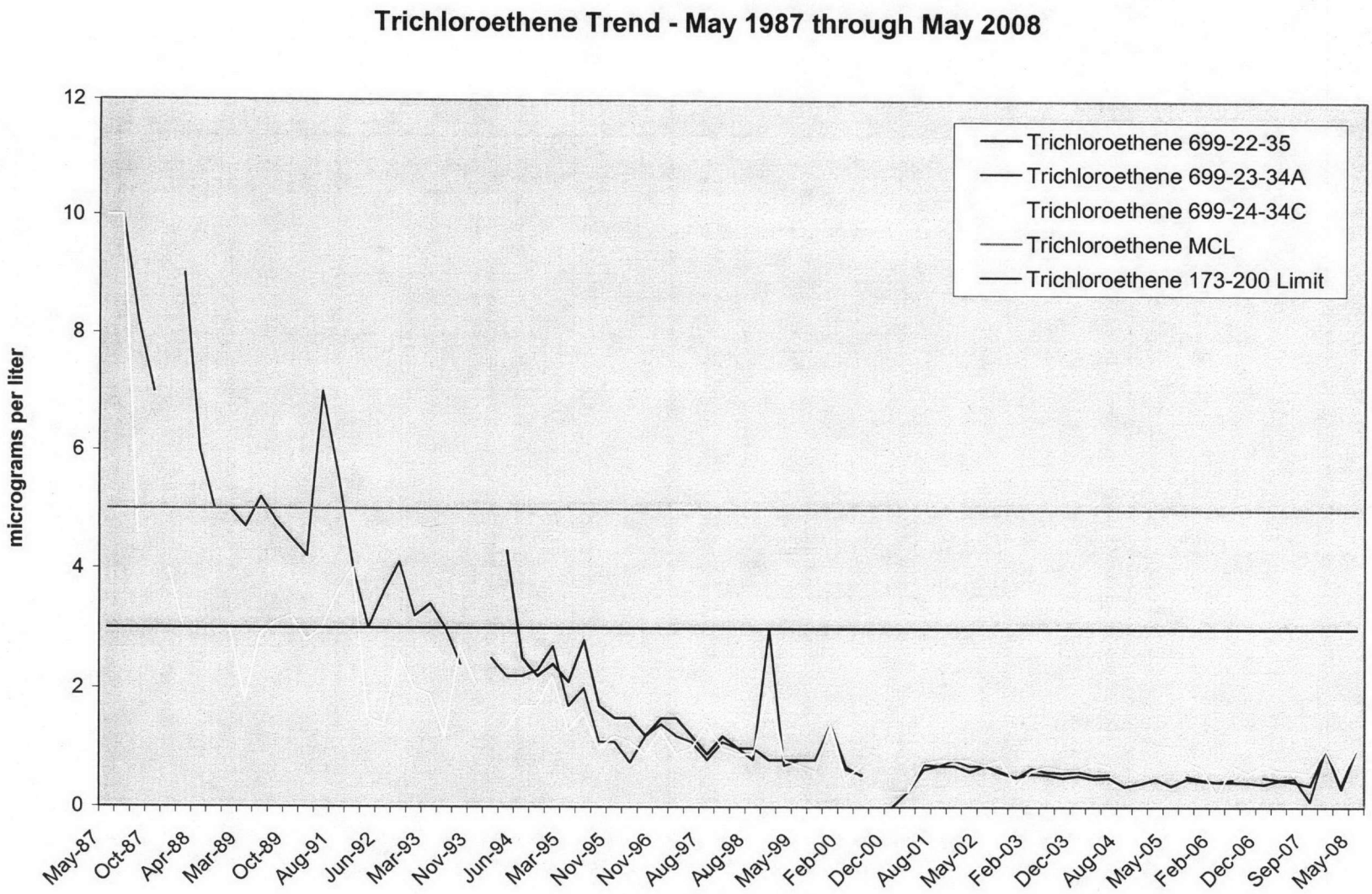


EXHIBIT B:

Quarterly RCRA Groundwater Monitoring Report (October-2008-December 2009)

SGW-41323
Revision 0

# Quarterly RCRA Groundwater Monitoring Report

## October 2008 - December 2008

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

Contractor for the U.S. Department of Energy
under Contract DE-AC06-08RL14788

CH2MHILL
Plateau Remediation Company

**P.O. Box 1600**
**Richland, Washington 99352**

**Approved for Public Release;**
Further Dissemination Unlimited

SGW-41323
Revision 0

# Quarterly RCRA Groundwater Monitoring Report

## October 2008 - December 2008

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# Executive Summary

This report presents the results of groundwater monitoring activities conducted during the period October to December 2008 for the Hanford Site *Resource Conservation and Recovery Act of 1976*[1] (RCRA) sites. The objectives of this continuing series of quarterly reports are to (1) present a summary of the analytical results from groundwater wells sampled during the report period, (2) report statistical evaluations required under RCRA, (3) describe the current status of groundwater quality assessment programs, (4) present groundwater data for single-shell tank Waste Management Area C collected during the tank waste retrieval activities, and (5) report quality control results for the laboratory analyses.

Monitoring wells at 18 RCRA sites were sampled during the October through December 2008 reporting quarter. Sampled sites include seven that are monitored under groundwater indicator evaluation programs, nine sites monitored under groundwater quality assessment programs, and three monitored under final-status programs. Very few of the scheduled wells were not sampled as scheduled during the report period, and most of the missed wells were sampled in January 2009.

Contamination indicator parameter data (i.e., pH, specific conductance, total organic halides, and total organic carbon) from downgradient wells were compared to background values at sites monitored under interim status detection requirements, as required in 40 *Code of Federal Regulations* (CFR) 265.93.[2] Statistical analysis identified changes in groundwater quality at both the Low-Level Waste Management Area 4 and the Nonradioactive Dangerous Waste Landfill, and confirmatory sampling prompted notification of the Washington State Department of Ecology.

No significant changes in groundwater quality that require regulatory notification were recognized in the sites currently monitored under groundwater quality assessment programs.

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

2 40 CFR 265.93, "Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities," "Preparation, Evaluation, and Response," *Code of Federal Regulations*.

Groundwater at Waste Management Area C is monitored quarterly for tank waste constituents and supporting parameters as required during the tank waste retrieval operations at the 241-C Tank Farm. The primary contaminants observed in the groundwater at Waste Management Area C are sulfate, nitrate, and the non-RCRA-regulated constituent technetium-99. During this report period, the specific conductance critical mean was not exceeded, and this site remains in a detection monitoring program.

The quality control evaluation indicated that the analytical results had a high level of reliability for the reporting period.

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# Terms

| | |
|---|---|
| CERCLA | *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* |
| CFR | *Code of Federal Regulations* |
| CHPRC | CH2M Hill Plateau Remediation Company |
| COC | contaminant of concern |
| DOE | U.S. Department of Energy |
| DWS | drinking water standard |
| Ecology | Washington State Department of Ecology |
| FFS | Fluor Federal Services |
| LERF | Liquid Effluent Retention Facility |
| LLWMA | low-level waste management area |
| N/A | not applicable |
| NRDWL | Nonradioactive Dangerous Waste Landfill |
| OU | operable unit |
| PFP | Plutonium Finishing Plant |
| PUREX | Plutonium-Uranium Extraction (Plant) |
| QC | quality control |
| RCRA | *Resource Conservation and Recovery Act of 1976* |
| SST | single-shell tank |
| TCE | trichloroethene |
| TOC | total organic carbon |
| TOX | total organic halide |
| TPH | total petroleum hydrocarbon |
| WAC | *Washington Administrative Code* |
| WMA | waste management area |
| WSCF | Waste Sampling and Characterization Facility |

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# Metric Conversion Chart

| Into Metric Units | | | Out of Metric Units | | |
|---|---|---|---|---|---|
| ***If you know*** | ***Multiply by*** | ***To get*** | ***If you know*** | ***Multiply by*** | ***To get*** |
| **Length** | | | **Length** | | |
| inches | 25.40 | millimeters | millimeters | 0.0394 | inches |
| inches | 2.54 | centimeters | centimeters | 0.394 | inches |
| feet | 0.305 | meters | meters | 3.281 | feet |
| yards | 0.914 | meters | meters | 1.094 | yards |
| miles (statute) | 1.609 | kilometers | kilometers | 0.621 | miles (statute) |
| **Area** | | | **Area** | | |
| sq. inches | 6.452 | sq. centimeters | sq. centimeters | 0.155 | sq. inches |
| sq. feet | 0.0929 | sq. meters | sq. meters | 10.764 | sq. feet |
| sq. yards | 0.836 | sq. meters | sq. meters | 1.196 | sq. yards |
| sq. miles | 2.591 | sq. kilometers | sq. kilometers | 0.386 | sq. miles |
| acres | 0.405 | hectares | hectares | 2.471 | acres |
| **Mass (weight)** | | | **Mass (weight)** | | |
| ounces (avoir) | 28.349 | grams | grams | 0.0353 | ounces (avoir) |
| pounds | 0.453 | kilograms | kilograms | 2.205 | pounds (avoir) |
| tons (short) | 0.907 | ton (metric) | ton (metric) | 1.102 | tons (short) |
| **Volume** | | | **Volume** | | |
| teaspoons | 5 | milliliters | milliliters | 0.034 | ounces (U.S., liquid) |
| tablespoons | 15 | milliliters | liters | 2.113 | pints |
| ounces (U.S., liquid) | 29.573 | milliliters | liters | 1.057 | quarts (U.S., liquid) |
| cups | 0.24 | liters | liters | 0.264 | gallons (U.S., liquid) |
| pints | 0.473 | liters | cubic meters | 35.315 | cubic feet |
| quarts (U.S., liquid) | 0.946 | liters | cubic meters | 1.308 | cubic yards |
| gallons (U.S., liquid) | 3.785 | liters | | | |
| cubic feet | 0.0283 | cubic meters | | | |
| cubic yards | 0.764 | cubic meters | | | |
| **Temperature** | | | **Temperature** | | |
| Fahrenheit | (°F-32)*5/9 | Centigrade | Centigrade | (°C*9/5)+32 | Fahrenheit |
| **Radioactivity** | | | **Radioactivity** | | |
| picocurie | 37 | millibecquerels | millibecquerels | 0.027 | picocurie |

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# 1 Introduction[3]

Eighteen *Resource Conservation and Recovery Act of 1976* (RCRA) sites were scheduled for sampling during the reporting quarter of October through December 2008, as listed in Table 1-1. Sampled sites included seven monitored under groundwater indicator evaluation (detection) programs (40 *Code of Federal Regulations* [CFR] 265.93[b], "Preparation, Evaluation, and Response"), nine monitored under groundwater quality assessment programs (40 CFR 265.93[d]), and three monitored under final status programs (*Washington Administrative Code* [WAC] 173-303-645, "Dangerous Waste Regulations," "Releases from Regulated Units").

**Table 1-1. Status of RCRA Sites with Sampling Scheduled, October through December 2008 (2 pages)**

| Site | Scheduled for Routine Sampling This Quarter? | Downgradient Statistical Exceedance? | Comments |
|---|---|---|---|
| ***Detection Sites (40 CFR 265.93[b]) (sampled semi-annually)*** | | | |
| 1301-N Liquid Waste Disposal Facility[a] | No | Not sampled | |
| 1324-N/NA Facilities[a] | No | Not sampled | |
| 1325-N Liquid Waste Disposal Facility[a] | No | Not sampled | |
| 216-A-29 Ditch | Yes | Yes[b] | |
| 216-B-3 Pond | Yes | No | |
| 216-B-63 Trench | Yes | No | |
| 216-S-10 Pond and Ditch | Yes | Yes[b] | |
| LERF[a] | No | N/A | Sampled in January and July. |
| LLWMA-1 | Yes | No | |
| LLWMA-2 | Yes | No | |
| LLWMA-3 | No | Not sampled | |
| SST WMA C | Yes | No | |
| ***Groundwater Quality Assessment Sites (40 CFR 265.93[d]) (sampled quarterly)*** | | | |
| Nine sites[c] | Yes | Not required | See updates in Chapter 4. |
| ***Sites Under a WAC 173-303-645 Monitoring Program*** | | | |
| Integrated Disposal Facility | Yes | N/A | No waste in place, hence no statistical evaluation required. |
| 300 Area Process Trenches | Yes | N/A[d] | |

[3] This section was prepared by G. L. Kasza (Freestone Environmental Services) and M. J. Hartman (CH2M Hill Plateau Remediation Company [CHPRC]).

**Table 1-1. Status of RCRA Sites with Sampling Scheduled, October through December 2008 (2 pages)**

| Site | Scheduled for Routine Sampling This Quarter? | Downgradient Statistical Exceedance? | Comments |
|---|---|---|---|
| 183-H Solar Basins | Yes | N/A[e] | |

a. These sites are incorporated into Permit Number WA 7890008967, Dangerous Waste Portion of the Resource Conservation and Recovery Act Permit for the Treatment, Storage, and Disposal of Dangerous Waste but continue to be monitored to satisfy interim status requirements, as specified in the permit.

b. No indication of dangerous waste contamination from site; see individual sections in text for explanation.

c. PUREX cribs; NRDWL; LLWMA-4; and SST WMAs A-AX, B-BX-BY, S-SX, T, TX-TY, and U.

d. Implementation of the corrective action will be deferred and integrated with the remediation of the 300-FF-1 and 300-FF-5 Operable Units.

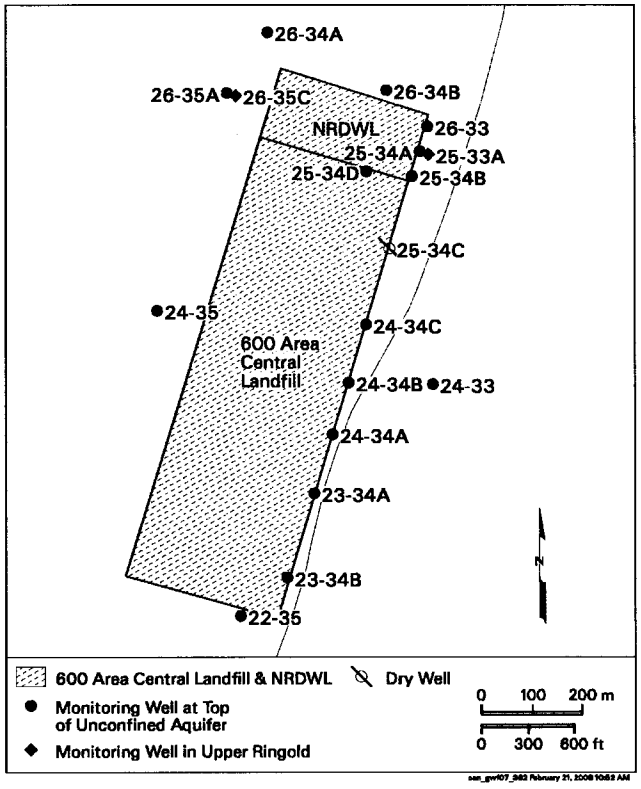
e. No formal comparison of contaminant concentrations to these limits will be made during the 100-HR-3 Operable Unit interim action. The purpose of groundwater monitoring under the RCRA Permit is to monitor contaminant trends during the period of CERCLA interim action.

CERCLA = *Comprehensive Environmental Response, Compensation, and Liability Act of 1980*
CFR = *Code of Federal Regulations*
LERF = Liquid Effluent Retention Facility
LLWMA = low-level waste management area
N/A = not applicable
NRDWL = Nonradioactive Dangerous Waste Landfill
PUREX = Plutonium-Uranium Extraction (Plant)
RCRA = *Resource Conservation and Recovery Act of 1976*
SST = single-shell tank
WAC = *Washington Administrative Code*
WMA = waste management area

Chapter 2 presents the results of statistical comparisons for the sites in detection monitoring while Chapter 4 provides updated information for the sites in assessment monitoring. Chapter 3 lists the wells that were not sampled as scheduled during the reporting quarter. Chapter 5 and Appendix A provide the results of sampling during the quarter at Waste Management Area (WMA) C monitoring wells (these results are required during waste retrieval from the tank farm). Chapter 6 and Appendix B include the results of the quality control (QC) program.

## 4.2 Nonradioactive Dangerous Waste Landfill[12]

The monitoring network for the Nonradioactive Dangerous Waste Landfill (NRDWL) includes seven wells screened at the water table and two wells screened immediately above a low-permeability unit in the Ringold Formation that constitutes the base of the unconfined aquifer locally. Two wells located northwest of the site (one screened at the top of the aquifer and the other screened at the bottom of the aquifer) are currently classified as upgradient wells.




Groundwater flow in the unconfined aquifer beneath the NRDWL is difficult to interpret from water table contours because of the extremely low water table gradient (approximately 0.00002). Based on the water table contours, the flow direction could be interpreted to range from northeast to southeast. The large tritium, nitrate, and iodine-129 plumes emanating from the 200 East Area flow past the NRDWL in a southeast direction, therefore, the most likely flow direction beneath the NRDWL is southeast.

Concentrations of TOC at three downgradient wells exceeded the 1,020 µg/L critical mean during the sampling in the previous quarter (sampled in August 2008). One of these wells (699-25-33A) is a deep well screened at the top of the Ringold Formation low-permeability unit at the base of the unconfined aquifer locally, and upgradient-downgradient statistical comparisons are not made with this well. The other two wells (699-25-34A and 699-25-34B) are screened at the water table. The quadruplicate results averaged 1,525 µg/L for well 699-25-34A and 1,803 µg/L for well 699-25-34B. The wells were resampled in October 2008 with a set of four replicates sent to two different laboratories. The average results for well 699-25-34A were <200 µg/L from one laboratory and 1,140 µg/L from another laboratory. Laboratory analytical averages for well 699-25-34B were 2,025 and 2,333 µg/L. Verification sampling results confirmed the initial results and indicate that the NRDWL may be impacting groundwater quality. The DOE then notified Ecology (Letter 09-AMCP-0058), and a groundwater quality assessment plan (for First Determination) was prepared and transmitted by DOE to Ecology on January 30, 2009 (SGW-40274, *Groundwater Quality Assessment Plan for the Non-Radioactive Dangerous Waste Landfill*).

[12] This section was prepared by J. W. Lindberg (CHPRC).

# 6 Quality Control[21]

Highlights of the groundwater QC program for the reporting period are summarized below. Appendix B contains more specific information to assess overall project quality, as well as to assist groundwater scientists in evaluating project-specific data quality.

- Over 99% of field and laboratory QC results for this quarter were within the acceptance criteria, suggesting that both field sampling and analytical processes were in control and that reliable data were generated.
- Data related to QC failures are flagged in the database.

***Field QC Summary:***

- Twenty-two field duplicates were collected, which generated 1,035 pairs of data. Over 99% of the data were acceptable, demonstrating good overall sampling and analysis precision (Appendix B, Section B2.1).
- Seven split samples were collected to evaluate data comparability between TestAmerica Laboratories, Inc. (St. Louis, Missouri, and Richland, Washington) and WSCF. After taking into account differences in analytical methods and detection limits, all but one of the evaluated results were comparable (Appendix B, Section B2.3).
- Over 96% of the field blank results were within the QC limits. Methylene chloride and metals had the greatest number of out-of-limit results. Field blank results should have little impact on the interpretation of this quarter's groundwater data (Appendix B, Section B2.4).

***Laboratory QC Summary:***

- WSCF metals data continue to demonstrate poor precision. While there has been improvement with the precision for metals analysis by inductively coupled plasma, the hexavalent chromium data are indicating anomalies, which is being investigated.
- Laboratory performance on the analysis of blind standards was average overall, with 87% of the results acceptable. The WSCF had out-of-limit results for TCE, fluoride, gross alpha, and gross beta. TestAmerica Richland had one out-of-limit result for gross alpha. TestAmerica St. Louis had out-of-limit results for cyanide, fluoride, and carbon tetrachloride. Eberline had one out-of-limit result for gross beta. All of the evaluated results for Lionville Laboratory were acceptable. The results for TOC and chloride for all participating laboratories were not evaluated due to a potential preparation error (Appendix B, Section B3.1).
- Performance evaluation study results were available from Mixed Analyte Performance Evaluation Program Series 19 and InterLaB RadCheM Proficiency Testing Program studies. Laboratory performance was acceptable (Appendix B, Section B3.4).
- Over 98% of the laboratory QC results for this quarter were within the acceptance limits, suggesting that the laboratory analyses were in control and that reliable data were generated (Appendix B, Section B3.6).

[21] This section was provided by H. L. Anastos (FFS).

# Appendix B

# Quality Control Report, October through December 2008

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## B.1 Introduction

This quality control (QC) report presents information on laboratory performance and field QC sample results for the fourth quarter of calendar year 2008 (CY08). Routine chemical and radiochemical analyses were performed by TestAmerica Laboratories, Inc. (St. Louis, Missouri [TASL], and Richland, Washington [TARL]), Lionville Laboratory (Lionville, Pennsylvania), Eberline Services (Richmond, California), and an onsite laboratory (the Waste Sampling and Characterization Facility [WSCF]). The WSCF laboratory is managed and staffed by Fluor Hanford, Inc. (FH). TestAmerica, Lionville Laboratory, and Eberline Services operate under contract with FH. Management of the Soil and Groundwater Remediation Project (S&GRP) was transitioned from FH to CH2M Hill Plateau Remediation Project Company (CHPRC) effective October 1, 2008; therefore, groundwater sampling was conducted by CHPRC nuclear chemical operators. The tasks conducted by the samplers included bottle preparation, sample set coordination, field measurements, sample collection, sample transport and shipping, well pumping, and coordination of purgewater containment and disposal.

Table B-1 summarizes the data completeness. The determination of completeness is made by dividing the number of results judged to be valid by the total number of results evaluated, and then multiplying by 100. Data judged to be valid are results that have not been flagged as suspect, rejected, having a missed holding time, or associated with out-of-limit method blanks or field QC samples. A total of 96% of the first quarter's results were considered valid, and this percentage is similar to the value from the previous quarter (94%).

**Table B-1. Completeness Summarized by Method (3 pages)**

| HEIS Method Name | Total Results | Suspect Results | Rejected Results | Field QC Flags | Missed Holding Time | Method Blank Qualifiers | Results Flagged |
|---|---|---|---|---|---|---|---|
| **General Chemical Parameters** | | | | | | | |
| 120.1_CONDUCT | 6 | - | - | - | - | - | 0 |
| 2320_ALKALINITY | 234 | - | - | - | - | - | 0 |
| 360.1_OXYGEN | 6 | - | - | - | - | - | 0 |
| 360.1_OXYGEN_FLD | 211 | - | - | - | - | - | 0 |
| 410.4_COD | 10 | - | - | - | - | - | 0 |
| 413.1_OILGREASE | 2 | - | - | 2 | - | 2 | 2 |
| 9020_TOX | 236 | - | - | - | 4 | - | 4 |
| 9060_TOC | 278 | - | - | - | - | - | 0 |
| 9223_COLIFORM | 12 | - | - | - | - | - | 0 |
| CONDUCT_FLD | 377 | 9 | - | - | - | - | 9 |
| PH_ELECT_FLD | 377 | - | - | - | - | - | 0 |
| REDOX_PROBE_FLD | 167 | - | - | - | - | - | 0 |
| TEMP_FLD | 377 | 1 | - | - | - | - | 1 |
| TURBIDITY_FLD | 377 | - | - | - | - | - | 0 |
| WTPH_DIESEL | 8 | - | - | - | - | - | 0 |

**Table B-1. Completeness Summarized by Method (3 pages)**

| HEIS Method Name | Total Results | Suspect Results | Rejected Results | Field QC Flags | Missed Holding Time | Method Blank Qualifiers | Results Flagged |
|---|---|---|---|---|---|---|---|
| WTPH_GASOLINE | 3 | - | - | - | - | - | 0 |
| **Ammonia and Anions** | | | | | | | |
| 300.0_ANIONS_IC | 1402 | - | - | 12 | 36 | - | 48 |
| 335.2_CYANIDE | 75 | - | - | - | - | - | 0 |
| 9012_CYANIDE | 4 | - | - | - | - | - | 0 |
| **Metals** | | | | | | | |
| 200.8_METALS_ICPMS | 316 | - | - | - | - | 1 | 1 |
| 6010_METALS_ICP | 8568 | 7 | - | 502 | - | 51 | 549 |
| 7196_CR6 | 54 | - | - | 2 | 1 | - | 3 |
| **Volatile Organic Compounds** | | | | | | | |
| 8260_VOA_GCMS | 2399 | - | - | 66 | - | 7 | 68 |
| **Semi-Volatile Organic Compounds** | | | | | | | |
| 8040_PHENOLIC_GC | 884 | - | - | - | - | - | 0 |
| 8081_PEST_GC | 19 | - | - | - | - | - | 0 |
| 8082_PCB_GC | 77 | - | - | - | - | - | 0 |
| 8270_SVOA_GCMS | 177 | - | - | - | 1 | - | 1 |
| **Radiological Parameters** | | | | | | | |
| 900.0_ALPHABETA_GPC | 3 | - | - | - | - | - | 0 |
| 906.0_H3_LSC | 4 | - | - | - | - | - | 0 |
| 9310_ALPHABETA_GPC | 54 | - | - | - | - | - | 0 |
| ALPHA_GPC | 117 | - | - | - | - | - | 0 |
| AMCMISO_IE_PREC_AEA | 2 | - | - | - | - | - | 0 |
| BETA_GPC | 137 | - | - | 28 | - | - | 28 |
| C14_LSC | 7 | - | - | - | - | - | 0 |
| GAMMA_GS | 50 | - | - | - | - | - | 0 |
| GAMMALL_GS | 760 | 1 | - | 11 | - | - | 12 |
| I129_SEP_LEPS_GS | 16 | - | - | - | - | - | 0 |
| I129LL_SEP_LEPS_GS | 59 | - | - | 2 | - | - | 2 |
| NI63_LSC | 3 | - | - | - | - | - | 0 |
| NP237_LLE_PLATE_AEA | 2 | - | - | - | - | - | 0 |
| PUISO_IE_PRECIP_AEA | 16 | - | - | - | - | - | 0 |

**Table B-1. Completeness Summarized by Method (3 pages)**

| HEIS Method Name | Total Results | Suspect Results | Rejected Results | Field QC Flags | Missed Holding Time | Method Blank Qualifiers | Results Flagged |
|---|---|---|---|---|---|---|---|
| PUISO_PLATE_AEA | 8 | - | - | - | - | - | 0 |
| SE79_SEP_IE_LSC | 9 | - | - | - | - | - | 0 |
| SRTOT_SEP_PRECIP_GPC | 34 | - | - | - | - | - | 0 |
| TC99_3MDSK_LSC | 119 | - | - | 18 | - | - | 18 |
| TC99_ETVDSK_LSC | 4 | - | - | - | - | - | 0 |
| TC99_SEP_LSC | 26 | - | - | - | - | - | 0 |
| TRITIUM_EIE_LSC | 157 | - | - | - | - | - | 0 |
| UISO_PLATE_AEA | 12 | - | - | - | - | - | 0 |
| UTOT_KPA | 4 | - | - | - | - | - | 0 |

HEIS = *Hanford Environmental Information System*
QC = quality control

The majority of flagged results were for metals which were flagged due to QC failures (duplicates and blanks). Metals data generated at the WSCF laboratory by the U.S. Environmental Protection Agency's (EPA) SW-846 (*Test Methods for Evaluating Solid Waste: Physical/Chemical Methods*), Method 6010C ("Inductively Coupled Plasma-Atomic Emission Spectrometry [ICP/AES]") has been closely monitored the past several quarters due to data quality issues (SGW-37533, *Quarterly RCRA Groundwater Monitoring, October through December 2007*, Section B1.0; SGW-38743, *Quarterly RCRA Groundwater Monitoring, January 2008 through March 2008*, Section B1.0; and SGW-40204, *Quarterly RCRA Groundwater Monitoring, July 2008 through September 2008*, Section B1.0). The S&GRP Analytical Support staff have worked with the laboratory to troubleshoot this method, specifically working to minimize blank failures and false-positive results. Review of the fourth quarter QC data show improvement; however, continued monitoring is necessary to ensure sustained improvement. Overall, 6% of metals data was flagged in the fourth quarter (improved from 8% in the third quarter).

Some of the WSCF gross-beta results continue to be elevated compared to historical values. In past quarters, WSCF has been trending 10% to 20% higher than TestAmerica on blind samples, but some groundwater samples showed an increase of 250% when analyses were shifted to WSCF. There has not been a similar increase in concentration of primary beta emitters at these sites. The WSCF results have better agreement with historical data sites where the primary radionuclides are strontium-90 or uranium. The WSCF uses a different isotope for gross beta calibration (cesium-137; TestAmerica and Eberline Services use strontium-90), which may partially explain why the WSCF values are higher. However, the change in calibration isotope does not account for the large discrepancies observed at some wells. Additional blind samples evaluated the laboratories detection efficiencies for technetium-99. This demonstrated that the WSCF efficiency for detecting technetium-99 by gross beta was nearly two times higher than TARL (59% versus 33%). This difference in efficiency, in conjunction with the difference in calibration isotope, explains the data differences observed between the laboratories. Additional testing has not identified the cause for the efficiency differences. Affected data is being flagged with an explanation for the variance in the Hanford Environmental Information System (HEIS) database.

A total of 42 results for the reporting quarter were flagged with "H" to indicate that the recommended holding time had been exceeded. This is significantly lower than the number from the previous quarters (253, 110, and 102, respectfully). Approximately one-half of the missed holding times were due to samples received at the laboratory without sufficient time for analysis. The remainder of the missed holding times were due to laboratory delays and/or re-analyses required outside of holding times. The improvements in holding time performance are the result of significant efforts on the part of S&GRP to ensure that samples are delivered to the laboratories with sufficient time for analysis and continued emphasis on holding-time requirements with the laboratories.

## B.2 Field Quality Control Data

Field QC samples include field duplicates, split samples, and field blanks. Quadruplicate samples collected at many wells for total organic carbon (TOC) and total organic halides (TOX) analyses also provide useful QC data. Field blanks collected during the fourth quarter of CY08 included full trip blanks, field transfer blanks, and equipment blanks. The minimum collection frequency for field duplicates and full trip blanks is one sample per 20 well trips. The minimum collection frequency for field transfer blanks is one blank on each day in which routine well samples are collected for analysis of volatile organic compounds. Equipment blanks are collected once per 10 well trips for portable Grundfos® pumps, or as needed for special projects. Six portable Grundfos pump-sampling events were performed in the fourth quarter and three other sampling events used non-dedicated equipment. Eight equipment blanks were performed.

Split samples are collected on an as needed basis. Seven split samples were collected during the reporting quarter. The split samples this quarter were sampled to evaluate inter-laboratory performance. Table B-2 lists the number of QC samples and their frequencies of collection for the reporting quarter. The results from each type of QC sample are summarized in the following sections.

**Table B-2. Quality Control Samples (2 pages)**

| QC Samples | Number of Well Trips | Number of QC Samples[a] | Frequency |
|---|---|---|---|
| Field duplicates | 305 | 22 | 7% |
| Split samples | 305 | 7[b] | 2% |
| TOC quadruplicates | 79[c] | 56 | 71% |
| TOX quadruplicates | 61[c] | 45 | 74% |
| Full trip blanks | 305 | 20 | 7% |
| Field transfer blanks | VOC samples collected on 32 days | 43 | 134%[d] |
| Equipment blanks | 9[e] | 8 | 89% |

a. Values listed do not include field duplicates, split samples, and blanks collected for non-routine sampling events (i.e., special projects).

b. Total number of wells for which split samples were collected.

c. Number of well trips in which TOC or TOX samples were collected.

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| QC Samples | Number of Well Trips | Number of QC Samples[a] | Frequency |
|---|---|---|---|

d. Number of days with field transfer blanks divided by the number of days that VOC samples were collected (i.e., 43/32).

e. Number of routine sampling events in which non-dedicated sampling equipment was used.

QC = quality control

TOC = total organic carbon

TOX = total organic halides

VOC = volatile organic compounds

## B2.1 Field Duplicates

Field duplicates provide a measure of the overall sampling and analysis precision. Evaluation o field duplicate data is based on the relative percent difference (RPD) statistic, which is calculated for each matching pair of results. Field duplicates with at least one result greater than five times the method detection limit (MDL) or minimum detectable activity (MDA) must have RPDs <20% to be considered acceptable. Duplicates with RPDs outside of this range are flagged with a "Q" in the database.

Twenty-two field duplicates were collected and analyzed during the reporting quarter to produce 1,035 pairs of results. The results demonstrate good sampling and analysis precision. Eleven pairs of results have RPDs >20%, including results for fluoride, copper, hexavalent chromium, iron, methylene chloride, gross beta, iodine-129, potassium-40, and technetium-99.

Fluoride continues to show poor precision on a small number of samples. Additional testing will be performed to evaluate the cause in fiscal year 2009.

An issue was identified with inductively coupled plasma metals data generated at WSCF during the fourth quarter of CY07. Low precision in duplicate samples was one effect of this issue. In past quarters, the metals with poor precision were iron, nickel, and zinc; however, this quarter, copper and iron demonstrated poor precision, but the samples with poor iron precision are unfiltered. The variability in the results is likely due to particulates in the sample. The copper samples appear to be an isolated issue; the sample is being re-analyzed to confirm the results. One pair of results for hexavalent chromium also failed to meet the acceptance criteria. During recent reviews of 100 Area chromium data, a number of anomalies were identified, including many hexavalent chromium results being greater than the total chromium values for the same well. This indicates a bias in chromium data that warrants further investigation. The poor precision may be an indicator of analytical problems. In addition, two pair of results for potassium-40 demonstrated poor precision, which may be due to analytical error and requests for re-analysis have been submitted to the laboratory. Table B-3 lists the pairs of results with poor precision.

A total of 42 results for the reporting quarter were flagged with "H" to indicate that the recommended holding time had been exceeded. This is significantly lower than the number from the previous quarters (253, 110, and 102, respectfully). Approximately one-half of the missed holding times were due to samples received at the laboratory without sufficient time for analysis. The remainder of the missed holding times were due to laboratory delays and/or re-analyses required outside of holding times. The improvements in holding time performance are the result of significant efforts on the part of S&GRP to ensure that samples are delivered to the laboratories with sufficient time for analysis and continued emphasis on holding-time requirements with the laboratories.

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a. Values listed do not include field duplicates, split samples, and blanks collected for non-routine sampling events (i.e., special projects).

b. Total number of wells for which split samples were collected.

c. Number of well trips in which TOC or TOX samples were collected.

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**Table B-2. Quality Control Samples (2 pages)**

| QC Samples | Number of Well Trips | Number of QC Samples[a] | Frequency |
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e. Number of routine sampling events in which non-dedicated sampling equipment was used.

QC = quality control

TOC = total organic carbon

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VOC = volatile organic compounds

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**Table B-3. Field Duplicate Results that Exceeded Quality Control Limits**

| Constituent | Well | Lab | Method | Filtered | Result 1 | | | Result 2 | | | RPD |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Anions** | | | | | | | | | | | |
| Fluoride | 299-E17-23 | WSCF | 300.0 | N | 249 | µg/L | D | 196 | µg/L | D | 24 |
| Fluoride | 299-W18-30 | WSCF | 300.0 | N | 340 | µg/L | D | 247 | µg/L | D | 32 |
| **Metals** | | | | | | | | | | | |
| Copper | 199-K-132 | WSCF | 6010 | Y | 34 | µg/L | | 6 | µg/L | U | 140 |
| Hexavalent chromium | 699-32-76 | WSCF | 7196 | N | 13.1 | µg/L | | 17 | µg/L | | 26 |
| Iron | 299-E27-10 | WSCF | 6010 | N | 159 | µg/L | | 270 | µg/L | C | 52 |
| **Volatile Organic Compounds** | | | | | | | | | | | |
| Methylene chloride | 699-74-44 | WSCF | 8260 | N | 1 | µg/L | U | 40.7 | µg/L | B | 190 |
| **Radiological Constituents** | | | | | | | | | | | |
| Gross beta | 699-53-47A | WSCF | Lab-specific | N | 864 | pCi/L | | 1100 | pCi/L | | 24 |
| Iodine-129 | 699-43-45 | TARL | Lab-specific | N | 5.05 | pCi/L | | 7.99 | pCi/L | | 45 |
| Potassium-40 | 299-E33-48 | TARL | Lab-specific | N | -25.9 | pCi/L | U | 204 | pCi/L | | 258 |
| Potassium-40 | 299-W14-11 | TARL | Lab-specific | N | -33.9 | pCi/L | U | 190 | pCi/L | | 287 |
| Technetium-99 | 299-E27-10 | WSCF | Lab-specific | N | 94 | pCi/L | | 4.2 | pCi/L | U | 183 |

B = analyte was detected in both the associated QC blank and the sample
C = analyte was detected in both the sample and the associated QC blank
D = result was reported from a sample dilution
U = analyzed for but not detected above limiting criteria
MDL = method detection limit
QC = quality control
RPD = relative percent difference
TARL = TestAmerica, Richland
WSCF= Waste Sampling and Characterization Facility

## B2.2 Total Organic Carbon and Total Organic Halides Quadruplicates

Samples for TOC and TOX analyses are typically collected in quadruplicate in accordance with *Resource Conservation and Recovery Act of 1976* (RCRA) requirements. While these samples are not intended as QC samples, quadruplicates may provide useful information about overall sampling and analysis precision for organic indicator parameters. For the purposes of this discussion, TOC and TOX quadruplicate data were evaluated based on the relative standard deviation (RSD) for each set of quadruplicate results. Each quadruplicate set having an RSD >20% and at least one result greater than five times the MDL was considered to have poor precision.

For the fourth quarter, none of the 45 data sets for TOX met the evaluation criteria. Three out of 56 TOC quadruplicates were evaluated, and two demonstrated acceptable precision. Results for quadruplicate samples are provided in Table B-4. The WSCF analyzed 57% of the quadruplicates for TOC and 24% of

the quadruplicates for TOX. The remaining quadruplicates were analyzed at TestAmerica. In the past, TOX data generated at WSCF has had issues with high variability and anomalous results. The laboratory identified and implemented corrective actions, which, based on the split sample results, appear to be effective. The number of TOX samples sent to WSCF is being slowly increased and the method is being closely monitored. If WSCF continues to demonstrate acceptable performance, they will be reinstated as the primary laboratory for TOX analyses.

One of the TOC quadruplicates shown in Table B-4 appeared to contain an error (see the shaded value in the table). It appears that a data entry occurred resulting in the nondetect value being ten times higher than expected. The laboratory has been requested to re-evaluate the result. One set of TOC quadruplicates demonstrated high variability, which is an improvement over past quarters where multiple sets of quadruplicates demonstrated poor precision. However, this method will be closely monitored in upcoming quarters to ensure the laboratory corrective actions have resolved the issues.

**Table B-4. Total Organic Carbon and Total Organic Halides Quadruplicates (4 pages)**

| Well[a] | Lab | MDL, µg/L | Result 1, µg/L | | Result 2, µg/L | | Result 3, µg/L | | Result 4, µg/L | | RSD % |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **TOC** | | | | | | | | | | | |
| 299-E25-26 | TASL | 200 | 310 | B | 240 | B | 200 | U | 310 | B | |
| 299-E25-28 | TASL | 200 | 270 | B | 200 | U | 200 | U | 200 | U | |
| 299-E25-34 | TASL | 200 | 200 | U | 210 | B | 200 | U | 310 | B | |
| 299-E25-35 | TASL | 200 | 380 | B | 250 | B | 220 | B | 230 | B | |
| 299-E25-48 | TASL | 200 | 280 | B | 240 | B | 350 | B | 280 | B | |
| 299-E26-12 | TASL | 200 | 200 | U | 200 | U | 200 | B | 200 | U | |
| 299-E26-13 | TASL | 200 | 200 | U | 200 | U | 200 | U | 200 | U | |
| 299-E27-10 | TASL | 200 | 450 | B | 370 | B | 360 | B | 420 | B | |
| 299-E27-11 | TASL | 200 | 200 | U | 200 | U | 200 | U | 200 | U | |
| 299-E27-16 | TASL | 200 | 200 | U | 200 | U | 200 | U | 200 | U | |
| 299-E27-17 | TASL | 200 | 200 | U | 200 | U | 200 | U | 200 | U | |
| 299-E27-19 | TASL | 200 | 200 | U | 200 | U | 200 | U | 200 | U | |
| 299-E27-8 | TASL | 200 | 200 | U | 200 | U | 200 | U | 200 | U | |
| 299-E27-9 | TASL | 200 | 340 | B | 460 | B | 390 | B | 390 | B | |
| 299-E33-36 | TASL | 200 | 200 | U | 200 | U | 200 | U | 200 | U | |
| 299-E33-37 | TASL | 200 | 200 | U | 200 | U | 200 | U | 200 | U | |
| 299-E34-10 | TASL | 200 | 200 | U | 200 | U | 200 | U | 200 | U | |
| 299-E34-12 | TASL | 200 | 200 | U | 200 | U | 200 | U | 200 | U | |
| 299-E34-2 | TASL | 200 | 200 | U | 200 | U | 200 | U | 200 | U | |
| 299-E34-9 | TASL | 200 | 200 | U | 200 | U | 200 | U | 200 | U | |
| 699-25-34A | TASL | 200 | 200 | U | 200 | U | 200 | U | 200 | U | |
| 699-25-34B | TASL | 200 | 2,000 | | 2,100 | | 2,000 | | 2,000 | | 2.5% |

**Table B-4. Total Organic Carbon and Total Organic Halides Quadruplicates (4 pages)**

| Well[a] | Lab | MDL, µg/L | Result 1, µg/L | | Result 2, µg/L | | Result 3, µg/L | | Result 4, µg/L | | RSD % |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 699-43-45 | TASL | 200 | 200 | U | 200 | U | 200 | U | 200 | U | |
| 299-E24-20 | WSCF | 300 | 3,000 | U | 300 | U | 300 | U | 300 | U | |
| 299-E24-22 | WSCF | 300 | 800 | | 686 | | 674 | | 685 | | |
| 299-E24-33 | WSCF | 300 | 580 | | 576 | | 580 | | 557 | | |
| 299-E25-2 | WSCF | 300 | 301 | | 300 | U | 305 | | 432 | | |
| 299-E25-40 | WSCF | 300 | 469 | | 416 | | 375 | | 383 | | |
| 299-E25-41 | WSCF | 300 | 314 | | 303 | | 300 | U | 338 | | |
| 299-E27-12 | WSCF | 300 | 432 | | 300 | U | 300 | U | 300 | U | |
| 299-E27-13 | WSCF | 300 | 306 | | 300 | U | 305 | | 319 | | |
| 299-E27-15 | WSCF | 300 | 300 | U | 300 | U | 300 | U | 300 | U | |
| 299-E27-21 | WSCF | 300 | 430 | | 387 | | 392 | | 391 | | |
| 299-E27-22 | WSCF | 300 | 461 | | 374 | | 393 | | 384 | | |
| 299-E27-23 | WSCF | 300 | 1,160 | | 1,100 | | 1,210 | | 1,080 | | |
| 299-E27-4 | WSCF | 300 | 506 | | 479 | | 510 | | 480 | | |
| 299-E27-7 | WSCF | 300 | 452 | | 450 | | 450 | | 449 | | |
| 299-E28-26 | WSCF | 300 | 300 | U | 300 | U | 300 | U | 300 | U | |
| 299-E28-28 | WSCF | 300 | 300 | U | 300 | U | 300 | U | 300 | U | |
| 299-E32-10 | WSCF | 300 | 553 | | 543 | | 555 | | 539 | | |
| 299-E32-2 | WSCF | 300 | 300 | U | 300 | U | 300 | U | 300 | U | |
| 299-E32-3 | WSCF | 300 | 300 | U | 300 | U | 300 | U | 300 | U | |
| 299-E32-4 | WSCF | 300 | 300 | U | 300 | U | 300 | U | 300 | U | |
| 299-E32-5 | WSCF | 300 | 300 | U | 300 | U | 300 | U | 300 | U | |
| 299-E32-6 | WSCF | 300 | 300 | U | 300 | U | 300 | U | 300 | U | |
| 299-E32-7 | WSCF | 300 | 300 | U | 356 | | 300 | U | 300 | U | |
| 299-E32-8 | WSCF | 300 | 306 | | 306 | | 308 | | 300 | U | |
| 299-E33-28 | WSCF | 300 | 319 | | 300 | U | 330 | | 326 | | |
| 299-E33-29 | WSCF | 300 | 300 | U | 300 | U | 300 | U | 328 | | |
| 299-E33-30 | WSCF | 300 | 300 | U | 524 | | 611 | | 300 | U | |
| 299-E33-34 | WSCF | 300 | 565 | | 728 | | 556 | | 581 | | |
| 299-E33-35 | WSCF | 300 | 300 | U | 300 | U | 511 | | 300 | U | |
| 299-W26-14 | WSCF | 300 | 322 | | 300 | U | 357 | | 328 | | |
| 699-25-34A | WSCF | 300 | 532 | B | 596 | B | 1,640 | | 1,790 | | **58.6%** |
| 699-25-34B | WSCF | 300 | 2,380 | | 2,330 | | 2,280 | | 2,340 | | 1.8% |

**Table B-4. Total Organic Carbon and Total Organic Halides Quadruplicates (4 pages)**

| Well[a] | Lab | MDL, µg/L | Result 1, µg/L | | Result 2, µg/L | | Result 3, µg/L | | Result 4, µg/L | | RSD % |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **TOX** | | | | | | | | | | | |
| 299-E25-28 | TASL | 3.5 | 3.5 | U | 3.5 | U | 3.5 | U | 3.5 | U | |
| 299-E25-34 | TASL | 3.5 | 3.5 | U | 3.5 | U | 3.5 | U | 3.5 | U | |
| 299-E25-35 | TASL | 3.5 | 3.5 | U | 3.5 | U | 3.5 | U | 3.5 | U | |
| 299-E25-48 | TASL | 3.5 | 3.9 | B | 3.5 | U | 3.5 | U | 3.6 | B | |
| 299-E26-12 | TASL | 3.5 | 3.5 | U | 3.5 | U | 3.5 | U | 3.5 | U | |
| 299-E26-13 | TASL | 3.5 | 10.4 | | 3.5 | U | 3.5 | U | 3.5 | U | |
| 299-E27-11 | TASL | 3.5 | 3.5 | U | 3.5 | U | 3.5 | U | 3.5 | U | |
| 299-E27-12 | TASL | 3.5 | 3.5 | U | 3.5 | U | 3.5 | U | 3.5 | U | |
| 299-E27-16 | TASL | 3.5 | 3.5 | U | 3.5 | U | 3.5 | U | 3.5 | U | |
| 299-E27-17 | TASL | 3.5 | 3.5 | U | 3.5 | U | 3.5 | U | 3.5 | U | |
| 299-E27-19 | TASL | 3.5 | 3.5 | U | 3.5 | U | 3.5 | U | 3.5 | U | |
| 299-E27-21 | TASL | 3.5 | 3.5 | U | 4.5 | B | 3.5 | U | 3.5 | U | |
| 299-E27-22 | TASL | 3.5 | 5 | | 3.5 | U | 3.5 | U | 3.5 | U | |
| 299-E27-4 | TASL | 3.5 | 3.5 | U | 3.5 | U | 3.5 | U | 3.5 | U | |
| 299-E27-7 | TASL | 3.5 | 3.5 | U | 3.5 | U | 3.5 | U | 3.5 | U | |
| 299-E27-8 | TASL | 3.5 | 3.5 | U | 3.5 | U | 3.5 | U | 3.5 | U | |
| 299-E27-9 | TASL | 3.5 | 3.5 | U | 3.5 | U | 3.5 | U | 3.5 | U | |
| 299-E28-26 | TASL | 3.5 | 3.5 | U | 3.5 | U | 3.5 | U | 3.5 | U | |
| 299-E28-28 | TASL | 3.5 | 3.5 | U | 3.5 | U | 3.5 | U | 3.5 | U | |
| 299-E32-4 | TASL | 3.5 | 3.5 | U | 3.5 | U | 3.5 | U | 3.5 | U | |
| 299-E32-5 | TASL | 3.5 | 3.5 | U | 3.5 | U | 3.5 | U | 3.5 | U | |
| 299-E32-6 | TASL | 3.5 | 4.8 | B | 3.5 | U | 3.5 | U | 3.5 | U | |
| 299-E32-7 | TASL | 3.5 | 4.4 | B | 3.5 | U | 3.5 | U | 3.5 | U | |
| 299-E33-28 | TASL | 3.5 | 3.5 | U | 3.5 | U | 3.5 | U | 3.5 | U | |
| 299-E33-29 | TASL | 3.5 | 3.8 | B | 3.5 | U | 5.4 | | 3.7 | B | |
| 299-E33-35 | TASL | 3.5 | 3.5 | U | 3.5 | U | 3.5 | U | 3.5 | U | |
| 299-E33-37 | TASL | 3.5 | 3.5 | U | 3.5 | U | 3.5 | U | 3.5 | U | |
| 299-E34-10 | TASL | 3.5 | 3.5 | U | 3.5 | U | 3.5 | U | 3.5 | U | |
| 299-E34-12 | TASL | 3.5 | 4.1 | B | 4.1 | B | 3.5 | U | 3.5 | U | |
| 299-E34-2 | TASL | 3.5 | 5.5 | | 3.5 | U | 3.5 | U | 3.5 | U | |
| 299-W26-14 | TASL | 3.5 | 3.8 | B | 3.5 | U | 3.5 | U | 4.4 | B | |
| 699-25-34A | TASL | 3.5 | 3.5 | U | 3.5 | U | 3.5 | U | 3.5 | U | |

**Table B-4. Total Organic Carbon and Total Organic Halides Quadruplicates (4 pages)**

| Well[a] | Lab | MDL, µg/L | Result 1, µg/L | | Result 2, µg/L | | Result 3, µg/L | | Result 4, µg/L | | RSD % |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 699-25-34B | TASL | 3.5 | 6.3 | | 6.6 | | 6.4 | | 6.7 | | |
| 299-E25-26 | WSCF | 5 | 5 | U | 5 | U | 5 | U | 5 | U | |
| 299-E27-10 | WSCF | 5 | 5.04 | BX | 5.24 | BX | 5.89 | BX | 7.39 | BX | |
| 299-E27-13 | WSCF | 5 | 5 | U | 5 | U | 5 | U | 5 | U | |
| 299-E27-23 | WSCF | 5 | 5 | U | 5 | U | 5 | U | 5 | U | |
| 299-E32-2 | WSCF | 5 | 5 | U | 5 | U | 5 | U | 5 | U | |
| 299-E32-8 | WSCF | 5 | 5 | U | 5 | U | 5 | U | 5 | U | |
| 299-E33-34 | WSCF | 5 | 5.31 | | 5 | U | 5 | U | 5 | U | |
| 299-E33-36 | WSCF | 5 | 5.78 | B | 5 | U | 5 | U | 5 | U | |
| 299-E34-9 | WSCF | 5 | 5 | U | 5 | U | 5 | U | 5 | U | |
| 699-25-34A | WSCF | 5 | 5.66 | B | 6.78 | B | 5 | U | 7.04 | B | |
| 699-25-34B | WSCF | 5 | 5.52 | B | 5 | U | 5.49 | B | 5 | U | |
| 699-43-45 | WSCF | 5 | 5 | U | 5.18 | B | 5 | U | 5 | U | |

NOTE: Shading indicates one sample is an outlier among quadruplicates.

B = sample results is less than the contract-required detection limit but greater than the MDL

U = nondetected result (value listed is the laboratory's detection limit)

X = result-specific comment, for these samples, breakthrough was observed >25%

MDL = method detection limit

RSD = relative standard deviation

TASL = TestAmerica, St. Louis

TOC = total organic carbon

TOX = total organic halide

WSCF = Waste Sampling and Characterization Facility

## B2.3 Split Samples

Split samples are replicate samples that are sequentially collected from the same location and analyzed by different laboratories. The results from split samples are useful for confirming out-of-trend results and assessing one laboratory's performance relative to another laboratory. Like field duplicates, split samples should have RPDs <20% to be considered acceptable. However, split sample results are evaluated to this criterion only when the results from both laboratories are greater than five times the respective detection limits. Laboratories often have different detection limits, and concentrations that are quantifiable at one laboratory may be undetected at the other laboratory.

Seven split samples were taken during the fourth quarter. Splits were performed for TOC, TOX, anions, hexavalent chromium, uranium, volatile organic compounds, gross alpha, gross beta, plutonium-238, plutonium-239/240, technetium-99 and tritium. These splits were used to assess inter-laboratory performance for these methods. The split sample results for key constituents are listed in Table B-5. The laboratories had very good agreement for most constituents when the concentration levels and associated

detection limits are taken into account. One result pair for technetium-99 failed to meet the 20% RPD requirement (i.e., where both results are greater than five times the MDL) and is highlighted in Table B-5. The technetium-99 results evaluated are an average of duplicate results. There is high variability between the duplicates at WSCF, which indicates a potential error. The samples are being re-analyzed.

## B2.4 Field Blanks

Full trip blanks, field transfer blanks, and equipment blanks are used to check for contamination resulting from field activities and/or bottle preparation. Definitions of full trip blanks, field transfer blanks, and equipment blanks are provided in Section B4. The QC limit for blank results is two times the MDL or instrument detection limit for chemistry methods, and the limit is two times the MDA for radiochemistry methods. However, for common laboratory contaminants such as acetone, methylene chloride, 2-butanone, toluene, and phthalate esters, the QC limit is five times the MDL. Because MDAs are not available for radiochemistry components from WSCF, two times the practical quantitation limit (PQL) was used as the QC limit for WSCF. Blank results that exceed these limits may indicate contamination or false-detection problem for regular groundwater samples. Results from groundwater samples that are associated with an out-of-limit field blank are flagged with a "Q" in the database.

A total of 2,050 results were produced from the fourth quarter field blank samples. Approximately 3% of the results (i.e., 69 results) exceeded the QC limits for field blanks. The percentage of out-of-limit results is the same as the previous quarter (3%). The WSCF analyzed approximately 74% of the field blanks (i.e., 1,526 results) for the quarter and TestAmerica analyzed 26% (i.e., 524 results). Approximately 2.5% of WSCF's field blank results were out of limits, and TestAmerica had approximately 3% that were out of limit; both similar to last quarter. Table B-6 lists the fourth quarter field blank results that were greater than the QC limits. Results that exceeded the QC limits by a factor of five or more are shaded in the table. Most of the flagged results were for calcium, sodium, and methylene chloride. The potential impacts on the data are minor. For example, although calcium and sodium had field blank results that were greater than the QC limits, all of the blank concentrations were significantly lower than the levels of these constituents in most of the quarter's groundwater samples. Nonetheless, all samples associated with out-of-limit blank results are flagged "Q" in the database.

Of the 69 out-of-limit blank results, 31 were associated with metals analysis. This is less than the amount from last quarter (40) and shows continued improvement. Based on these latest results, the corrective actions taken at WSCF with regard to metals analyses should continue to be monitored closely but appear to be effective.

The number of failed methylene chloride blanks in the fourth quarter was 25. The number of failed methylene chloride blanks has fluctuated over the past several quarters (17, 22, 25, 11, 36). About 67% of the methylene chloride blanks performed were analyzed by WSCF and 39% were out of limits. Only 33% of the methylene chloride blanks were performed by TASL; however, 87% of the blanks for methylene chloride were out of limits. This performance is similar to last quarter. The S&GRP staff is continuing to work with the laboratories to reduce the number of blank detections for methylene chloride. Two of the constituents (i.e., calcium, and methylene chloride) that had out-of-limit field blank results also had out-of-limit method blank results. Consequently, some of the results provided in Table B-6 may have been caused by laboratory contamination or false-positive detection. Low-level detection of these constituents in Hanford Site groundwater samples flagged "Q" should be viewed as tentative.

Table B-5. Split Sample Results (2 pages)

| Constituent | Well | Method[a] | Result 1 (WSCF) | | | MDL/ MDA 1 | Result 2 (TA) | | | MDL/ MDA 2 | RPD |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **General Chemistry Parameters** | | | | | | | | | | | |
| Total organic halides | 699-25-34A | 9020 | 6.12[b] | µg/L | B | 5 | 3.5[b] | µg/L | U | 3.5 | |
| Total organic halides | 699-25-34B | 9020 | 5.25[b] | µg/L | U | 5 | 6.5[b] | µg/L | | 3.5 | |
| Total organic halides | 699-49-100C | 9020 | 6.54[b] | µg/L | B | 5 | 3.5 | µg/L | U | 3.5 | |
| Total organic carbon | 299-W15-224 | 9060 | 2.69[c] | mg/L | | 0.3 | 2.2[c] | mg/L | | 0.2 | 12.3% |
| Total organic carbon | 699-25-34A | 9060 | 1.14[b] | mg/L | | 0.3 | 0.2[b] | mg/L | U | 0.2 | |
| Total organic carbon | 699-25-34B | 9060 | 2.33[b] | mg/L | | 0.3 | 2[b] | mg/L | | 0.2 | 10.8% |
| **Anions** | | | | | | | | | | | |
| Chloride | 699-19-88 | 300 | 3.78 | µg/mL | D | 0.09 | 3.7 | mg/L | | 0.02 | 1.5% |
| Fluoride | 699-19-88 | 300 | 0.135 | µg/mL | BD | 0.05 | 0.31 | mg/L | | 0.01 | |
| Nitrogen in Nitrate | 699-19-88 | 300 | 0.362 | µg/mL | D | 0.02 | 0.38 | mg/L | | 0.0086 | 3.4% |
| Nitrogen in Nitrite | 699-19-88 | 300 | 0.03 | µg/mL | UD | 0.03 | 0.002 | mg/L | U | 0.002 | |
| Sulfate | 699-19-88 | 300 | 12.7 | µg/mL | D | 0.3 | 13.4 | mg/L | | 0.05 | 3.8% |
| **Metals** | | | | | | | | | | | |
| Hexavalent Chromium | 699-19-88 | 7196 | 0.002 | mg/L | U | 0.002 | 0.0037 | mg/L | U | 0.0037 | |
| Uranium | 699-49-100C | Lab-specific | 2.12 | µg/L | | 0.05 | 2.1 | µg/L | | 0.0838 | 0.7% |
| **Volatile Organic Compounds** | | | | | | | | | | | |
| Acetone | 699-49-100C | 8260 | 1 | µg/L | U | 1 | 0.56 | µg/L | U | 0.56 | |
| Acetone | 299-W15-224 | 8260 | 1 | µg/L | U | 1 | 0.7[c] | µg/L | J | 0.56 | |
| Benzene | 699-49-100C | 8260 | 1 | µg/L | U | 1 | 0.032 | µg/L | U | 0.032 | |
| Benzene | 299-W15-224 | 8260 | 1 | µg/L | U | 1 | 0.032[c] | µg/L | U | 0.032 | |
| Carbon tetrachloride | 699-49-100C | 8260 | 1 | µg/L | U | 1 | 0.042 | µg/L | U | 0.042 | |
| Carbon tetrachloride | 299-W15-224 | 8260 | 1 | µg/L | U | 1 | 26[c] | µg/L | U | 0.042 | |
| Chlorobenzene | 299-W15-224 | 8260 | 1 | µg/L | U | 1 | 0.48[c] | µg/L | U | 0.48 | |
| Chloroform | 699-49-100C | 8260 | 1 | µg/L | U | 1 | 0.08 | µg/L | U | 0.08 | |
| Chloroform | 299-W15-224 | 8260 | 1 | µg/L | U | 1 | 0.3[c] | µg/L | J | 0.08 | |
| Methylene chloride | 699-49-100C | 8260 | 1 | µg/L | U | 1 | 0.091 | µg/L | U | 0.091 | |

## Table B-5. Split Sample Results (2 pages)

| Constituent | Well | Method[a] | Result 1 (WSCF) | | | MDL/ MDA 1 | Result 2 (TA) | | | MDL/ MDA 2 | RPD |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Methylene chloride | 299-W15-224 | 8260 | 2.8 | µg/L | J | 1 | 0.8[c] | µg/L | B | 0.091 | |
| Trichloroethene | 699-49-100C | 8260 | 1 | µg/L | U | 1 | 0.11 | µg/L | U | 0.11 | |
| Trichloroethene | 299-W15-224 | 8260 | 1 | µg/L | U | 1 | 0.11[c] | µg/L | U | 0.11 | |
| **Radiological Constituents** | | | | | | | | | | | |
| Gross alpha | 699-49-100C | Lab-specific | 0.419 | pCi/L | U | 1.7 | 2.01 | pCi/L | | 1.55 | |
| Gross beta | 699-49-100C | Lab-specific | 5.29 | pCi/L | | 4.1 | 9.68 | pCi/L | | 2.96 | |
| Plutonium-238 | 699-49-100C | Lab-specific | 0.0734 | pCi/L | U | 0.27 | -0.00732 | pCi/L | U | 0.175 | |
| Plutonium-239/240 | 699-49-100C | Lab-specific | 0.0734 | pCi/L | | 0.028 | -0.0366 | pCi/L | U | 0.269 | |
| Technetium-99 | 299-E27-10 | Lab-specific | 49.1[c] | pCi/L | | 5.9 | 76.7[c] | pCi/L | | 10.3 | 31.0% |
| Technetium-99 | 699-49-100C | Lab-specific | -2.2 | pCi/L | U | 6.1 | -2.84 | pCi/L | U | 9.97 | |
| Tritium | 699-49-100C | Lab-specific | -420 | pCi/L | U | 220 | -121 | pCi/L | U | 263 | |

a. Numbers refer to standard EPA methods (SW-846, *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods*; or EPA-600/4-79/020, *Methods for Chemical Analysis of Water and Wastes*).

b. Values reported are average of quadruplicate samples.

c. Values reported are average of duplicate sample.

B = sample result is greater than the MDL but less than the laboratory's contract-required detection limit

D = analyte was diluted

J = estimated value; analyte was detected above the MDL but less than the RDL

U = nondetected result (value listed is the laboratory's detection limit)

EPA = U.S. Environmental Protection Agency

MDA = minimum detectable activity

MDL = method detection limit

RPD = relative percent difference

TA = TestAmerica Laboratories, Inc.

WSCF= Waste Sampling and Characterization Facility

EXHIBIT C:

Groundwater Quality Assessment Report for the Nonradioactive Dangerous Landfill (SGW-41904 and SGW-40274)

S

Date Received for Clearance Process (MM/DD/YYYY)
01/30/2009

# INFORMATION CLEARANCE FORM

A. Information Category

- ☐ Abstract
- ☐ Journal Article
- ☐ Summary
- ☐ Internet
- ☐ Visual Aid
- ☐ Software
- ☐ Full Paper
- ☐ Report
- ☐ Other _____

B. Document Number
SGW-40274 Revision 0

C. Title
Groundwater Quality Assessment Plan for the Non-Radioactive Dangerous Waste Landfill

D. Internet Address

E. Required Information (MANDATORY)
1. Is document potentially Classified? No

L. Craig Swanson LC Swanson
Manager Required (Print and Sign)

If Yes _____
ADC Required (Print and Sign)

2. Official Use Only — No — Exemption No.
3. Export controlled Information — No — OUO Exemption No. 3
4. UCNI — No
5. Applied Technology — No
6. Other (Specify) _____

7. Does Information Contain the Following:
a. New or Novel FH (Patentable) Subject Matter ? No
If "Yes", OUO Exemption No. 3
If "Yes", Disclosure No.:
b. Commercial Proprietary Information Received in Confidence, Such as Proprietary and/or Inventions? No
c. Corporate Privileged Information? No
If "Yes", OUO Exemption No. 4
d. Government Privileged Information? No
If "Yes", Exemption NO. 5
e. **Copyrights**? No
f. Trademarks? No
8. Is Information Requiring submission to OSTI? No
9. Release Level? Public

F. Complete for a Journal Article

1. Title of Journal

G. Complete for a Presentation

1. Title for Conference or Meeting
2. Group Sponsoring
3. Date of Conference
4. City/State
5. Will Information be Published in Proceedings?No
6. Will material be Handed Out?No

H. Information Owner/Author/Requestor

S.P. Luttrell
(Print and Sign)

Responsible Manager

L.C. Swanson LC Swanson
(Print and Sign)

Approval by Direct Report to FH President (Speech/Articles Only)

~~D.L. Foss~~ NA
(Print and Sign)

| I. Reviewers | Print | Signature | Public Y/N (If N, complete J) |
|---|---|---|---|
| General Counsel | R.T. Swenson | (E-mail Pg. 2) | (Y)/N |
| Office of External Affairs | ~~R.D. Hildebrand~~ | R D Hildebrand | Y/N |
| DOE | R.D. Hildebrand | R D Hildebrand | (Y)/N |
| OUO-SME | N. A. Homan | Nancy Homan | (Y)/N |
| Clearance | J.A. Aardal | Janis Aardal | (Y)/N |
| Other | | | Y/N |
| Other | | | Y/N |

J. Comments

Information Clearance Approval

APPROVED FOR RELEASE
OFFICIAL DOCUMENT
Date 01/30/2009



A-6001-401

## Davis, Susan C

SGW-40274
Rev. 0

**From:** LeBaron, Gregory J
**Sent:** Thursday, January 29, 2009 3:10 PM
**To:** Davis, Susan C
**Subject:** FW: Review for Public Release

---

**From:** Swenson, Raymond T
**Sent:** Thursday, January 29, 2009 3:05 PM
**To:** LeBaron, Gregory J
**Cc:** Swenson, Raymond T; Malek, Debra D
**Subject:** RE: Review for Public Release

Greg: I have read the document and can find no legal reasons to hold up its release.

Raymond Takashi Swenson
CHPRC Legal Department
509-376-3511 Office
509-308-7456 BlackBerry
Raymond_T_Swenson@rl.gov

---

**From:** LeBaron, Gregory J
**Sent:** Thursday, January 29, 2009 1:01 PM
**To:** Swenson, Raymond T
**Subject:** Review for Public Release

The regulations require that we provide an assessment plan for Ecology within 15 days. We issued the attached to RL as an attachment to a letter and now they are asking us to release it as a document with an information release form. The end of the 30 days is tomorrow, January 30. Would you please look at the attached document for release to the public. I will try to catch up with you tomorrow morning if possible.

The document isn't that involved -- there are only two pages of text, one page of references, a figure and three tables. The bulk of the document consists of a list of chemicals from the CFR.

<< File: GW Qual Assessment Plan NRDWL.pdf >>
Thanks,

Greg

# ADMINISTRATIVE DOCUMENT PROCESSING AND APPROVAL



**DOCUMENT TITLE:**
Groundwater Quality Assessment Plan for the Non-Radioactive Dangerous Waste Landfill

**OWNING ORGANIZATION/FACILITY:**
CHPRC - Soil & Groundwater Remediation Project - RCRA Groundwater Monitoring & Reporting

**Document Number:** SGW-40274

**Revision/Change Number:** 0~~1~~

**DOCUMENT TYPE** *(Check Applicable)*

☐ Plan ☒ Report ☐ Study ☐ Description Document ☐ Other

**DOCUMENT ACTION** ◉ New ○ Revision ○ Cancellation

**RESPONSIBLE CONTACTS**

| | Name | Phone Number |
|---|---|---|
| Author: | S.P. Luttrell | 376-4531 |
| Manager: | L.C. Swanson | 373-3807 |

**DOCUMENT CONTROL**

Does document contain scientific or technical information intended for public use? ☒ Yes ○ No

Does document contain controlled-use information? ○ Yes ☒ No

*("Yes" requires information clearance review in accordance with HNF-PRO-184)*

**DOCUMENT REVISION SUMMARY**

*NOTE: Provide a brief description or summary of the changes for the document listed.*

**REVIEWERS** Others

| Name *(print)* | Organization |
|---|---|
| D. L. Norman (E-mail Pg. 3) | BOS Surveillance & Maint |
| J.A. Winterhalder (E-mail Pg. 4) | Environmental Protection |
| W. R. Thackaberry (E-mail Pg. 5) | Environmental QA |
| R. W. Oldham | Field Services & NF Monitoring |
| G.J. LeBaron | Field Services & NF Monitoring |
| J.A. Archuleta (E-mail Pg. 6) | Environmental QA |
| L.C. Tuott (E-mail Pg. 7) | Document Review & Standards |

**APPROVAL SIGNATURES**

| | | |
|---|---|---|
| **Author:** | | 1/29/2009 Date |
| Name: (Print) S.P. Luttrell | | |
| **Responsible Manager:** | | 1/29/09 Date |
| Name: (Print) L.C. Swanson | | |
| **Other:** Environmental Waste | | |
| Name: (Print) C.B. Walker (E-mail Pg. 2) | | Date 1/29/09 |

RELEASE / ISSUE
JAN 30 2009
DATE:
STA: 15
HANFORD RELEASE
ID: 20

## Davis, Susan C

**From:** Walker, Curtis B
**Sent:** Thursday, January 29, 2009 3:20 PM
**To:** LeBaron, Gregory J
**Cc:** Davis, Susan C
**Subject:** NRDWL Assessment Plan Approval

I approve the NRDWL Assessment Plan.

**Davis, Susan C**

**From:** Norman, Dottie L
**Sent:** Thursday, January 29, 2009 4:20 PM
**To:** Davis, Susan C; Winterhalder, John A; Thackaberry, W R (Bill); Oldham, Richard W; Archuleta, Jose A; Tuott, Lee C
**Subject:** Re: Assessment Plan for NRDWL

*I approve/concur*
*Dottie Norman*

*---- Original Message ----*
*From: Davis, Susan C*
*To: Winterhalder, John A; Thackaberry, W R (Bill); Oldham, Richard W; Archuleta, Jose A; Tuott, Lee C; Norman, Dottie L*
*Sent: Thu Jan 29 15:31:49 2009*
*Subject: FW: Assessment Plan for NRDWL*

*We are on a very tight schedule, as this has to be to DOE tomorrow before lunch. This document was sent to you in January and we are now issuing the same document showing you as reviewers. I just need an e-mail message from each of you telling me that you have reviewed the document. Please respond ASAP. If you have any questions, I can be reached on the number listed below.*

*Susan Chris Davis 376-4422*

*Administrative Assistant, Supporting*

*Craig Swanson, Technical Reporting*

*Soil and Groundwater Remediation*

*"Beautiful young people are accidents of nature, but beautiful old people are works of art."*

*From: Luttrell, Stuart P*
*Sent: Thursday, January 29, 2009 3:27 PM*
*To: Davis, Susan C*
*Subject: FW: Assessment Plan for NRDWL*

*Here it is with the attachment*

## Davis, Susan C

**From:** Winterhalder, John A
**Sent:** Thursday, January 29, 2009 3:36 PM
**To:** Davis, Susan C
**Subject:** RE: Assessment Plan for NRDWL

It's okay by me as written.

John

---

**From:** Davis, Susan C
**Sent:** Thursday, January 29, 2009 3:32 PM
**To:** Winterhalder, John A; Thackaberry, W R (Bill); Oldham, Richard W; Archuleta, Jose A; Tuott, Lee C; Norman, Dottie L
**Subject:** FW: Assessment Plan for NRDWL

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*Susan Chris Davis 376-4422*
**Administrative Assistant, Supporting**
**Craig Swanson, Technical Reporting**
**Soil and Groundwater Remediation**

"Beautiful young people are accidents of nature, but beautiful old people are works of art."

**From:** Luttrell, Stuart P
**Sent:** Thursday, January 29, 2009 3:27 PM
**To:** Davis, Susan C
**Subject:** FW: Assessment Plan for NRDWL

Here it is with the attachment

*Stuart Luttrell*
Manager, RCRA Monitoring and Reporting
Soil and Groundwater Remediation Project
CH2M Hill Plateau Remediation Company
376-4531
366-4944 (cell)

**From:** Luttrell, Stuart P
**Sent:** Monday, January 19, 2009 7:15 PM
**To:** Hildebrand, R D (Doug)
**Cc:** Swanson, L Craig; Rossi, Amadeo J; LeBaron, Gregory J; Walker, Curtis B; Cawrse, Allan E; Engelmann, Richard H; Winterhalder, John A; Lindberg, Jon W; Norman, Dottie L; Prignano, Andrea L; Luttrell, Stuart P; Miskho, Anthony G; Oldham, Richard W
**Subject:** Assessment Plan for NRDWL

## Davis, Susan C

**From:** Thackaberry, W R (Bill)
**Sent:** Thursday, January 29, 2009 4:28 PM
**To:** Davis, Susan C; Winterhalder, John A; Oldham, Richard W; Archuleta, Jose A; Tuott, Lee C; Norman, Dottie L
**Subject:** RE: Assessment Plan for NRDWL

I have reviewed this plan and have no comments.
Bill Thackaberry

---

**From:** Davis, Susan C
**Sent:** Thursday, January 29, 2009 3:32 PM
**To:** Winterhalder, John A; Thackaberry, W R (Bill); Oldham, Richard W; Archuleta, Jose A; Tuott, Lee C; Norman, Dottie L
**Subject:** FW: Assessment Plan for NRDWL

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*Susan Chris Davis 376-4422*
**Administrative Assistant, Supporting**
**Craig Swanson, Technical Reporting**
**Soil and Groundwater Remediation**

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**From:** Luttrell, Stuart P
**Sent:** Thursday, January 29, 2009 3:27 PM
**To:** Davis, Susan C
**Subject:** FW: Assessment Plan for NRDWL

Here it is with the attachment

*Stuart Luttrell*
Manager, RCRA Monitoring and Reporting
Soil and Groundwater Remediation Project
CH2M Hill Plateau Remediation Company
376-4531
366-4944 (cell)

**From:** Luttrell, Stuart P
**Sent:** Monday, January 19, 2009 7:15 PM
**To:** Hildebrand, R D (Doug)
**Cc:** Swanson, L Craig; Rossi, Amadeo J; LeBaron, Gregory J; Walker, Curtis B; Cawrse, Allan E; Engelmann, Richard H; Winterhalder, John A; Lindberg, Jon W; Norman, Dottie L; Prignano, Andrea L; Luttrell, Stuart P; Miskho, Anthony G; Oldham, Richard W
**Subject:** Assessment Plan for NRDWL

## Davis, Susan C

**From:** Archuleta, Jose A
**Sent:** Thursday, January 29, 2009 4:28 PM
**To:** Davis, Susan C
**Subject:** RE: Assessment Plan for NRDWL

Susan

I have read the assessment plan and discussed it with Bill Thackaberry. I have no comments and concur with the plan.

Joe Archuleta, CHPRC
INTERA QA Manager
Jose_A_Archuleta@rl.gov
509.376.0777

**From:** Davis, Susan C
**Sent:** Thursday, January 29, 2009 3:32 PM
**To:** Winterhalder, John A; Thackaberry, W R (Bill); Oldham, Richard W; Archuleta, Jose A; Tuott, Lee C; Norman, Dottie L
**Subject:** FW: Assessment Plan for NRDWL

We are on a very tight schedule, as this has to be to DOE tomorrow before lunch. This document was sent to you in January and we are now issuing the same document showing you as reviewers. I just need an e-mail message from each of you telling me that you have reviewed the document. Please respond ASAP. If you have any questions, I can be reached on the number listed below.

*Susan Chris Davis 376-4422*
**Administrative Assistant, Supporting**
**Craig Swanson, Technical Reporting**
**Soil and Groundwater Remediation**

"Beautiful young people are accidents of nature, but beautiful old people are works of art."

**From:** Luttrell, Stuart P
**Sent:** Thursday, January 29, 2009 3:27 PM
**To:** Davis, Susan C
**Subject:** FW: Assessment Plan for NRDWL

Here it is with the attachment

*Stuart Luttrell*
Manager, RCRA Monitoring and Reporting
Soil and Groundwater Remediation Project
CH2M Hill Plateau Remediation Company
376-4531
366-4944 (cell)

## Davis, Susan C

**From:** Tuott, Lee C
**Sent:** Thursday, January 22, 2009 12:09 PM
**To:** Davis, Susan C
**Subject:** RE: Document Review and Release, Correspondence review - DRS won't be reviewing

Susan, Document Review and Standardization (DRS) is currently focusing on developing annotated outlines for key documents, developing desk instructions and procedures, and reviewing TPA primary documents. Therefore, DRS **won't** be reviewing the document indentified in your attached note.

Thank you for contacting me and offering the review.

Lee Tuott
Manager, Document Review and Standardization
CHPRC
509.376.1045 (office)
208.351.0568 (cell)
email: lee_c_tuott@rl.gov

**From:** Davis, Susan C
**Sent:** Thursday, January 22, 2009 10:46 AM
**To:** Lindberg, Jon W; Swanson, L Craig; Swenson, Raymond T; Lowe, Steven S (Steve); Archuleta, Jose A; Tuott, Lee C; Cawrse, Allan E; Thackaberry, W R (Bill); Winterhalder, John A; Rossi, Amadeo J; Foss, Dyan L; Bang, Reese
**Cc:** Luttrell, Stuart P; Fritz, Lori L; Barnes, Brett M; Miskho, Anthony G
**Subject:** FW: Document Review and Release, Correspondence review
**Importance:** High

Attached is the final draft of the document that is coming your way later after we have it formatted-hopefully this week. This document is on a very fast track and DOE needs to sent it to Ecology by the 30th of this month. Please review and send any comments as soon as possible. Some of you will be getting the final copy with the signature page, and others will be getting the letter by next week. Please look at the review and approval list, if you feel that there are any others that need to be added please let us know.

If you have any questions, I can be reached on the number listed below or for all technical questions please call Stuart Luttrell at 373-3807.

*Susan Chris Davis 376-4422*
**Administrative Assistant, Supporting**
**Craig Swanson, Technical Reporting**
**Soil and Groundwater Remediation**

"Beautiful young people are accidents of nature, but beautiful old people are works of art."

**From:** Luttrell, Stuart P
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SGW-40274
Revision 0

# Groundwater Quality Assessment Plan for the Non-Radioactive Dangerous Waste Landfill

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

Project Hanford Management Contractor for the
U.S. Department of Energy under Contract DE-AC06-08RL14788

CH2MHILL
Plateau Remediation Company

P.O. Box 1600
Richland, Washington 99352

Approved for Public Release
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# Groundwater Quality Assessment Plan for the Non-Radioactive Dangerous Waste Landfill

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# LIST OF TERMS

| | |
|---|---|
| CAS | Chemical Abstract Services |
| CFR | *Code of Federal Regulations* |
| CRDL | contract-required detection limit |
| DOE | U.S. Department of Energy |
| NRDWL | Nonradioactive Dangerous Waste Landfill |
| RCRA | *Resource Conservation and Recovery Act of 1976* |
| TOC | total organic carbon |
| TPH | total petroleum hydrocarbon |
| Tri-Party Agreement | *Hanford Federal Facility Agreement and Consent Order* |
| WAC | *Washington Administrative Code* |

# METRIC CONVERSION CHART

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

# 1.0 INTRODUCTION

The groundwater beneath the Nonradioactive Dangerous Waste Landfill (NRDWL) has been monitored under the *Resource, Conservation, and Recovery Act of 1976* (RCRA) in interim status under a groundwater indicator parameters evaluation program (*Washington Administrative Code* [WAC] 173-303-400, "Dangerous Waste Regulations; Interim Status Facility Standards"; and by reference, 40 *Code of Federal Regulations* [CFR] 265.92, "Interim Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities; Sampling and Analysis") (*Groundwater Monitoring Plan for the Nonradioactive Dangerous Waste Landfill* [PNNL-12227] and ICN-1).

Results from August 24, 2008, samples from downgradient wells 699-25-34A and 699-25-34B exceeded the critical mean value of 1,020 µg/L for total organic carbon (TOC), an indicator parameter. The quadruplicate results averaged 1,525 µg/L for well 699-25-34A and 1,803 µg/L for well 699-25-34B. The wells were re-sampled on October 29, 2008, and the resulting quadruplicate average for well 699-25-34A was below the laboratory detection level of 200 µg/L, but the result for well 699-25-34B averaged 2,025 µg/L. Verification sampling results for well 699-25-34B confirmed the initial results, indicating that the NRDWL may be impacting groundwater quality.

The source of the elevated organic carbon is uncertain. One possible source is chlorinated hydrocarbons, which were disposed at the NRDWL and at the adjacent Solid Waste Landfill (Figure 1). Although low levels (less than 1 µg/L) of chlorinated hydrocarbons are detected in the NRDWL well network, the concentrations are too low to cause TOC levels as high as 2,000 µg/L. Sewage was disposed to two liquid discharge trenches at the nearby Solid Waste Landfill (*Groundwater Monitoring Plan for the Solid Waste Landfill* [PNNL-13014]) and is a more likely source for the elevated TOC.

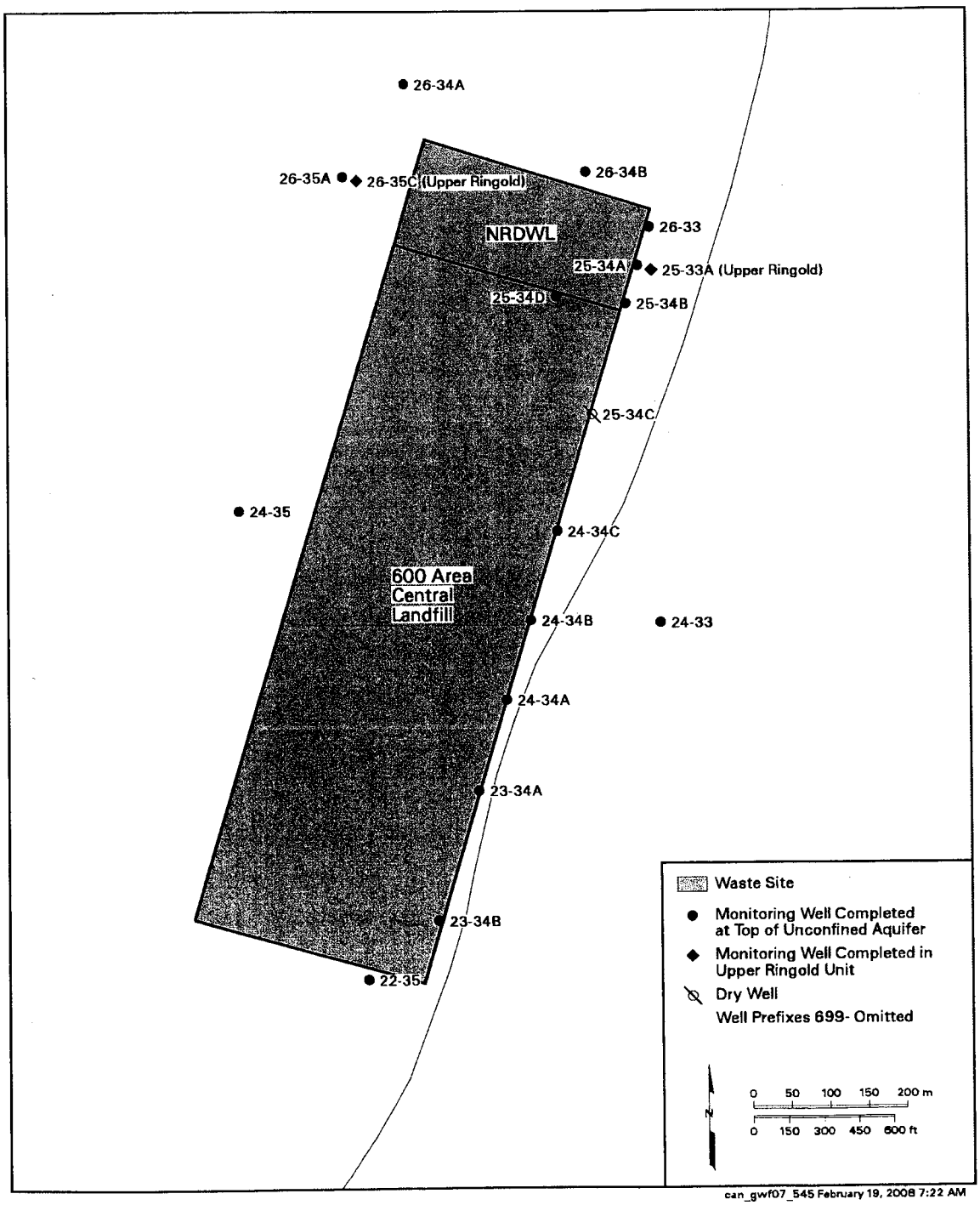
# 2.0 THE ASSESSMENT PLAN

In accordance with WAC 173-303-400 (and by reference to 40 CFR 265.93[d][2], "Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities; Preparation, Evaluation, and Response"), this groundwater assessment will be carried out in two parts. The first part of the assessment will consist of a "first determination" (40 CFR 265.93[d)][4]) to evaluate specific organic compounds to determine whether they are present in groundwater. The presence of potential dangerous waste or dangerous waste constituents in groundwater will be determined by monitoring well 699-25-34B and nearby wells 699-25-34A and 699-25-34D) (Figure 1) for 40 CFR 264, Appendix IX[1], "Standards for Owners and Operator of Hazardous Waste Treatment, Storage, and Disposal Facilities; Ground-Water Monitoring List," organic constituents and other constituents potentially responsible for elevated TOC. Additional constituents will include total petroleum hydrocarbons (TPH) and parameters

[1] The U.S. Department of Energy (DOE) is proposing to use 40 CFR 264, Appendix IX in order to be consistent with the final status requirements in WAC 173-303-645, and that all Hanford treatment, storage, and disposal units must be closed to final status standards in the *Hanford Federal Facility Agreement and Consent Order* (Tri-Party Agreement), Section 5.3 (Ecology et al. 2003). Otherwise, the interim status requirements would result in a different conclusion.

to investigate possible sewage impacts from the adjacent Solid Waste Landfill. Both new and existing data will be evaluated. If dangerous waste or 40 CFR 264, Appendix IX constituents are below their respective contract-required detection limits (CRDLs), it will be concluded that the NRDWL has not impacted groundwater quality, and the indicator parameter evaluation program for groundwater monitoring will be reinstated.

Figure 1. Location of Nonradioactive Dangerous Waste Landfill and Solid Waste Landfill Groundwater Monitoring Wells.



If results from the first determination indicate the presence of dangerous waste or other constituents identified in 40 CFR 264, Appendix IX above the respective CRDL, the second part of assessment will be initiated by expanding this assessment plan to assess the rate and extent of migration of dangerous constituents[1] and concentrations in groundwater.

Details of the first determination portion of the assessment are provided below.

## 2.1 NUMBER, LOCATION, AND DEPTH OF WELLS

Three of the NRDWL downgradient groundwater monitoring wells (Figure 1 and Table 1) will be sampled initially. All three wells are screened at the water table and are compliant with WAC 173-160, "Minimum Standards for Construction and Maintenance of Wells." The water table lies at approximately 40 to 43 m below ground surface, at an elevation of approximately 122 m. Groundwater flow direction is generally toward the east-southeast, and these wells are considered adequate for the first determination to evaluate potential contamination that may have impacted groundwater in well 699-25-34B.

The remainder of the wells in the NRDWL monitoring network may be included if groundwater monitoring continues under a groundwater quality assessment program, under an expanded assessment plan, for the second part of the assessment.

## 2.2 SAMPLING AND ANALYSIS METHODS

The indicator parameter exceeding its critical mean was TOC. Therefore, the groundwater analytes will include the organic compounds portion of the 40 CFR 264, Appendix IX constituent list; TPH for oil, gas, and diesel; and oil and grease. The analyses will also include coliform bacteria and chemical oxygen demand because of the potential that the elevated TOC was caused by the sewage disposed at the Solid Waste Landfill. Field parameters, temperature, and pH will be measured (as well as TOC) for comparison to previous measurements and any other detected analytes.

General analysis groups, analytical methods, and CRDLs for key constituents are provided in Table 2. The list of organic constituents from 40 CFR 264, Appendix IX that will be requested is provided in Table 3, with respective Chemical Abstract Services (CAS) registry numbers. The routine analyses, including anions and metals, will continue as described in the original groundwater monitoring plan (PNNL-12227 and ICN-1).

### 2.2.1 Sampling

Sampling methods will be consistent with current sample collection, preservation, documentation, shipment, and chain-of-custody requirements. Three wells in the NRDWL network will be sampled once. If constituents identified in 40 CFR 264, Appendix IX are detected above CRDLs, sampling and analysis will be performed in these wells for the specific constituents detected to confirm the presence of these constituents.

[1] DOE is proposing to use the definition of "dangerous constituent" in WAC 173-303-645(4), "Dangerous Waste Regulations"; "Releases from Regulated Units," for the purposes of groundwater monitoring in order to be consistent with final status requirements.

Table 1. Monitoring Wells That Will Be Evaluated in First Determination for the Nonradioactive Dangerous Waste Landfill.

| Well Number | Upgradient/ Downgradient | Date Completed | WAC Compliant? | Depth to Water August 2008 | Water Remaining In Well |
|---|---|---|---|---|---|
| 699-25-34A | Downgradient | 1986 | Yes | 40.7 m | 2.9 m |
| 699-25-34B | Downgradient | 1986 | Yes | 40.5 m | 3.4 m |
| 699-25-34D | Downgradient | 1992 | Yes | 43.2 m | 8.3 m |

WAC = *Washington Administrative Code*

Table 2. Preservation Techniques, Analytical Methods, and Contract-Required Detection Limit for Selected Organic Constituents. (2 sheets)

| Constituent | Collection and Preservation[a,b] | Analysis Methods[c] | Method Quantitation Limit (µg/L)[d] |
|---|---|---|---|
| ***Pesticides*** | | | |
| Endrin | G, none | SW-846[e], #8081A | 0.1 |
| Methoxychlor | | | 0.5 |
| Toxaphene | | | 2 |
| Lindane (four isomers) | | | 0.05 |
| ***Herbicides*** | | | |
| 2,4-D | G, none | SW-846, #8151A | 20 |
| 2,4-5-TP silvex | | | 1 |
| 2,4,5-T | | | 1 |
| ***Volatile Organic Analyses*** | | | |
| Carbon tetrachloride | G, no headspace | SW-846, #8260B | 5 |
| Benzene | | | 5 |
| Methyl ethyl ketone | | | 10 |
| Toluene | | | 5 |
| 1,1,1-trichloroethane | | | 5 |
| 1,1,2-trichloroethane | | | 5 |
| Trichloroethylene | | | 5 |
| Tetrachloroethylene | | | 5 |
| Xylene-o, p | | | 10 |
| Chloroform | | | 5 |
| 1, 1-dichloroethane | | | 10 |
| 1, 2-dichloroethane | | | 5 |
| Trans-1, 2-dichloroethylene | | | 5 |
| Methylene chloride | | | 5 |
| Vinyl chloride | | | 10 |
| Xylene-m | | | 10 |
| Methyl isobutyl ketone | | | 10 |
| Acetone by volatile organic analysis | | | 20 |
| Tetrahydrofuran | | | 50 |
| P-dichlorobenzene | | | 5 |

Table 2. Preservation Techniques, Analytical Methods, and Contract-Required Detection Limit for Selected Organic Constituents. (2 sheets)

| Constituent | Collection and Preservation[a,b] | Analysis Methods[c] | Method Quantitation Limit (µg/L)[d] |
|---|---|---|---|
| ***Semi-Volatile Organic Analyses*** | | | |
| Bis(2ethylhexyl)phthalate (DEHP) | Amber glass, cool to 4°C | SW-846, #8270D | 10 |
| Cresol (o,p,m) | | | 10 |
| n-nitrosodimethylamine | | | 10 |
| ***Other*** | | | |
| Coliform bacteria | P, none | SW-846, #9223 [f] | 2.2 [g] |
| Chemical oxygen demand | P,G, $H_2SO_4$ to pH<2 | EPA, 410.4 | 10,000 |
| Oil and grease | G, HCl or $H_2SO_4$ to pH<2 | EPA, 413.1<br>SW-846, #9070 | 2,000<br>1,000 |
| Total petroleum hydrocarbons | G, HCl to pH <2 | EPA, 418.1 | 500 |
| Total organic carbon | G, HCl or $H_2SO_4$ to pH<2 | SW-846, #9060 | 1,000 |

[a] P = plastic; G = glass.
[b] All samples will be cooled to 4°C upon collection.
[c] Constituents grouped together are analyzed by the same method, unless otherwise indicated.
[d] Detection limit units, except where indicated.
[e] EPA SW-846, *Methods for Evaluation of Solid Waste, Physical/Chemical Methods.*
[f] Enzyme substrate test.
[g] Most probable number.
EPA = U.S. Environmental Protection Agency

Table 3. Selected 40 CFR 264, Appendix IX Groundwater Constituents for Nonradioactive Dangerous Waste Landfill First Determination Assessment. (7 sheets)

| Common Name | CAS Number [a] |
|---|---|
| 1,1,1,2-Tetrachloroethane | 630-20-6 |
| 1,1,1-Trichloroethane; Methylchloroform | 71-55-6 |
| 1,1,2,2-Tetrachloroethane | 79-34-5 |
| 1,1,2-Trichloroethane | 79-00-5 |
| 1,1-Dichloroethane | 75-34-3 |
| 1,1-Dichloroethylene; Vinylidene chloride | 75-35-4 |
| 1,2,3-Trichloropropane | 96-18-4 |
| 1,2,4,5-Tetrachlorobenzene | 95-94-3 |
| 1,2,4-Trichlorobenzene | 120-82-1 |
| 1,2-Dibromo-3-chloropropane; DBCP | 96-12-8 |
| 1,2-Dibromoethane; Ethylene dibromide | 106-93-4 |
| 1,2-Dichloroethane; Ethylene dichloride | 107-06-2 |
| 1,2-Dichloropropane | 78-87-5 |
| 1,4-Dioxane | 123-91-1 |
| 1,4-Naphthoquinone | 130-15-4 |

Table 3. Selected 40 CFR 264, Appendix IX Groundwater Constituents for Nonradioactive Dangerous Waste Landfill First Determination Assessment. (7 sheets)

| Common Name | CAS Number [a] |
|---|---|
| 1-Naphthylamine | 134-32-7 |
| 2,3,4,6-Tetrachlorophenol | 58-90-2 |
| 2,3,7,8-TCDD; 2,3,7,8-Tetrachlorodibenzo-p- dioxin | 1746-01-6 |
| 2,4,5-T; 2,4,5-Trichlorophenoxyacetic acid | 93-76-5 |
| 2,4,5-Trichlorophenol | 95-95-4 |
| 2,4,6-Trichlorophenol | 88-06-2 |
| 2,4-D; 2,4-Dichlorophenoxyacetic acid | 94-75-7 |
| 2,4-Dichlorophenol | 120-83-2 |
| 2,4-Dimethylphenol | 105-67-9 |
| 2,4-Dinitrophenol | 51-28-5 |
| 2,4-Dinitrotoluene | 121-14-2 |
| 2,6-Dichlorophenol | 87-65-0 |
| 2,6-Dinitrotoluene | 606-20-2 |
| 2-Acetylaminofluorene; 2-AAF | 53-96-3 |
| 2-Chloronaphthalene | 91-58-7 |
| 2-Chlorophenol | 95-57-8 |
| 2-Hexanone | 591-78-6 |
| 2-Methylnaphthalene | 91-57-6 |
| 2-Naphthylamine | 91-59-8 |
| 2-Picoline | 109-06-8 |
| 3,3[prime]-Dichlorobenzidine | 91-94-1 |
| 3,3[prime]-Dimethylbenzidine | 119-93-7 |
| 3-Methylcholanthrene | 56-49-5 |
| 4,4[prime]-DDD | 72-54-8 |
| 4,4[prime]-DDE | 72-55-9 |
| 4,4[prime]-DDT | 50-29-3 |
| 4,6-Dinitro-o-cresol | 534-52-1 |
| 4-Aminobiphenyl | 92-67-1 |
| 4-Bromophenyl phenyl ether | 101-55-3 |
| 4-Chlorophenyl phenyl ether | 7005-72-3 |
| 4-Methyl-2-pentanone; Methyl isobutyl ketone | 108-10-1 |
| 4-Nitroquinoline 1-oxide | 56-57-5 |
| 5-Nitro-o-toluidine | 99-55-8 |
| 7,12-Dimethylbenz[a]anthracene | 57-97-6 |
| Acenaphthene | 83-32-9 |
| Acenaphthylene | 208-96-8 |
| Acetone | 67-64-1 |

Table 3. Selected 40 CFR 264, Appendix IX Groundwater Constituents for Nonradioactive Dangerous Waste Landfill First Determination Assessment. (7 sheets)

| Common Name | CAS Number [a] |
|---|---|
| Acetonitrile; Methyl cyanide | 75-05-8 |
| Acetophenone | 98-86-2 |
| Acrolein | 107-02-8 |
| Acrylonitrile | 107-13-1 |
| Aldrin | 309-00-2 |
| Allyl chloride | 107-05-1 |
| alpha, alpha-Dimethylphenethylamine | 122-09-8 |
| alpha-BHC | 319-84-6 |
| Aniline | 62-53-3 |
| Anthracene | 120-12-7 |
| Aramite | 140-57-8 |
| Benzene | 71-43-2 |
| Benzo[a]anthracene; Benzanthracene | 56-55-3 |
| Benzo[a]pyrene | 50-32-8 |
| Benzo[b]fluoranthene | 205-99-2 |
| Benzo[ghi]perylene | 191-24-2 |
| Benzo[k]fluoranthene | 207-08-9 |
| Benzyl alcohol | 100-51-6 |
| beta-BHC | 319-85-7 |
| Bis(2-chloro-1-methylethyl) ether; 2,2[prime]-Di- chlorodiisopropyl ether | 108-60-1 |
| Bis(2-chloroethoxy)methane | 111-91-1 |
| Bis(2-chloroethyl)ether | 111-44-4 |
| Bis(2-ethylhexyl) phthalate | 117-81-7 |
| Bromodichloromethane | 75-27-4 |
| Bromoform; Tribromomethane | 75-25-2 |
| Butyl benzyl phthalate; Benzyl butyl phthalate | 85-68-7 |
| Carbon tetrachloride | 56-23-5 |
| Chlordane | 57-74-9 |
| Chlorobenzene | 108-90-7 |
| Chlorobenzilate | 510-15-6 |
| Chloroethane; Ethyl chloride | 75-00-3 |
| Chloroform | 67-66-3 |
| Chloroprene | 126-99-8 |
| Chrysene | 218-01-9 |
| cis-1,3-Dichloropropene | 10061-01-5 |
| Delta-BHC | 319-86-8 |
| Diallate | 2303-16-4 |

Table 3. Selected 40 CFR 264, Appendix IX Groundwater Constituents for Nonradioactive Dangerous Waste Landfill First Determination Assessment. (7 sheets)

| Common Name | CAS Number [a] |
|---|---|
| Dibenz[a,h]anthracene | 53-70-3 |
| Dibenzofuran | 132-64-9 |
| Dibromochloromethane; Chlorodibromomethane | 124-48-1 |
| Dichlorodifluoromethane | 75-71-8 |
| Dieldrin | 60-57-1 |
| Diethyl phthalate | 84-66-2 |
| Dimethoate | 60-51-5 |
| Dimethyl phthalate | 131-11-3 |
| Di-n-butyl phthalate | 84-74-2 |
| Di-n-octyl phthalate | 117-84-0 |
| Dinoseb; DNBP; 2-sec-Butyl- 4,6-dinitrophenol | 88-85-7 |
| Diphenylamine | 122-39-4 |
| Disulfoton | 298-04-4 |
| Endosulfan I | 959-98-8 |
| Endosulfan II | 33213-65-9 |
| Endosulfan sulfate | 1031-07-8 |
| Endrin aldehyde | 7421-93-4 |
| Endrin | 72-20-8 |
| Ethyl methacrylate | 97-63-2 |
| Ethyl methanesulfonate | 62-50-0 |
| Ethylbenzene | 100-41-4 |
| Famphur | 52-85-7 |
| Fluoranthene | 206-44-0 |
| Fluorene | 86-73-7 |
| Gamma-BHC; Lindane | 58-89-9 |
| Heptachlor epoxide | 1024-57-3 |
| Heptachlor | 76-44-8 |
| Hexachlorobenzene | 118-74-1 |
| Hexachlorobutadiene | 87-68-3 |
| Hexachlorocyclopentadiene | 77-47-4 |
| Hexachloroethane | 67-72-1 |
| Hexachlorophene | 70-30-4 |
| Hexachloropropene | 1888-71-7 |
| Indeno(1,2,3-cd)pyrene | 193-39-5 |
| Isobutyl alcohol | 78-83-1 |
| Isodrin | 465-73-6 |
| Isophorone | 78-59-1 |

Table 3. Selected 40 CFR 264, Appendix IX Groundwater Constituents for Nonradioactive Dangerous Waste Landfill First Determination Assessment. (7 sheets)

| Common Name | CAS Number [a] |
|---|---|
| Isosafrole | 120-58-1 |
| Kepone | 143-50-0 |
| m-Cresol | 108-39-4 |
| m-Dichlorobenzene | 541-73-1 |
| m-Dinitrobenzene | 99-65-0 |
| Methacrylonitrile | 126-98-7 |
| Methapyrilene | 91-80-5 |
| Methoxychlor | 72-43-5 |
| Methyl bromide; Bromomethane | 74-83-9 |
| Methyl chloride; Chloromethane | 74-87-3 |
| Methyl ethyl ketone; MEK | 78-93-3 |
| Methyl iodide; Iodomethane | 74-88-4 |
| Methyl methacrylate | 80-62-6 |
| Methyl methanesulfonate | 66-27-3 |
| Methyl parathion; Parathion methyl | 298-00-0 |
| Methylene bromide; Dibromomethane | 74-95-3 |
| Methylene chloride; Dichloromethane | 75-09-2 |
| m-Nitroaniline | 99-09-2 |
| Naphthalene | 91-20-3 |
| Nitrobenzene | 98-95-3 |
| N-Nitrosodiethylamine | 55-18-5 |
| N-Nitrosodimethylamine | 62-75-9 |
| N-Nitrosodi-n-butylamine | 924-16-3 |
| N-Nitrosodiphenylamine | 86-30-6 |
| N-Nitrosodipropylamine; Di-n-propylnitrosamine | 621-64-7 |
| N-Nitrosomethylethylamine | 10595-95-6 |
| N-Nitrosomorpholine | 59-89-2 |
| N-Nitrosopiperidine | 100-75-4 |
| N-Nitrosopyrrolidine | 930-55-2 |
| O,O,O-Triethyl phosphorothioate | 126-68-1 |
| O,O-Diethyl O-2-pyrazinyl phosphorothioate; Thionazin | 297-97-2 |
| o-Cresol | 95-48-7 |
| o-Dichlorobenzene | 95-50-1 |
| o-Nitroaniline | 88-74-4 |
| o-Nitrophenol | 88-75-5 |
| o-Toluidine | 95-53-4 |
| p-(Dimethylamino)azobenzene | 60-11-7 |

Table 3. Selected 40 CFR 264, Appendix IX Groundwater Constituents for Nonradioactive Dangerous Waste Landfill First Determination Assessment. (7 sheets)

| Common Name | CAS Number [a] |
|---|---|
| Parathion | 56-38-2 |
| p-Chloroaniline | 106-47-8 |
| p-Chloro-m-cresol | 59-50-7 |
| p-Cresol | 106-44-5 |
| p-Dichlorobenzene | 106-46-7 |
| Pentachlorobenzene | 608-93-5 |
| Pentachloroethane | 76-01-7 |
| Pentachloronitrobenzene | 82-68-8 |
| Pentachlorophenol | 87-86-5 |
| Phenacetin | 62-44-2 |
| Phenanthrene | 85-01-8 |
| Phenol | 108-95-2 |
| Phorate | 298-02-2 |
| p-Nitroaniline | 100-01-6 |
| p-Nitrophenol | 100-02-7 |
| Polychlorinated biphenyls; PCBs | 1336-36-3[b] |
| Polychlorinated dibenzofurans; PCDFs | d |
| Polychlorinated dibenzo-p-dioxins; PCDDs | c |
| p-Phenylenediamine | 106-50-3 |
| Pronamide | 23950-58-5 |
| Propionitrile; Ethyl cyanide | 107-12-0 |
| Pyrene | 129-00-0 |
| Pyridine | 110-86-1 |
| Safrole | 94-59-7 |
| Silvex; 2,4,5-TP | 93-72-1 |
| Styrene | 100-42-5 |
| sym-Trinitrobenzene | 99-35-4 |
| Tetrachloroethylene; Perchloroethylene;Tetrachloroethene | 127-18-4 |
| Tetraethyl dithiopyrophosphate; Sulfotepp | 3689-24-5 |
| Toluene | 108-88-3 |
| Toxaphene | 8001-35-2 |
| trans-1,2-Dichloroethylene | 156-60-5 |
| trans-1,3-Dichloropropene | 10061-02-6 |
| trans-1,4-Dichloro-2-butene | 110-57-6 |
| Trichloroethylene; Trichloroethene | 79-01-6 |
| Trichlorofluoromethane | 75-69-4 |
| Vinyl acetate | 108-05-4 |

Table 3. Selected 40 CFR 264, Appendix IX Groundwater Constituents for Nonradioactive Dangerous Waste Landfill First Determination Assessment. (7 sheets)

| Common Name | CAS Number [a] |
|---|---|
| Vinyl chloride | 75-01-4 |
| Xylene (total) | 1330-20-7 |

[a] Chemical Abstract Services (CAS) registry number.
[b] Polychlorinated biphenyls contains congener chemicals, including aroclors.
[c] This category contains congenor chemicals including dioxins.
[d] This category contains congenor chemicals including benzofurans.

### 2.2.2 Evaluation Procedures

Data evaluation will initially include quality assurance reviews to ensure that the requested analyses were received and meet the analytical performance requirements. The evaluation of results will primarily consist of determining if the selected analytes are detected in concentrations greater than the respective CRDLs. Data evaluation will also include evaluating concentrations of TPH (oil and grease), coliform bacteria, and chemical oxygen demand. The presence of these may indicate an impact from the Solid Waste Landfill. If constituents identified in 40 CFR 264, Appendix IX are not detected above CRDLs, then an indicator parameter evaluation program will be reinstated.

If constituents identified in 40 CFR 264, Appendix IX are detected and confirmed, this assessment plan will be revised and the second part of the assessment will be initiated to evaluate the rate and extent of contaminant migration.

## 3.0 SCHEDULE

The first sampling event will occur as soon as practical after the Washington State Department of Ecology's receipt of this assessment plan. The next scheduled sampling month for NRDWL is February 2009. However, this sampling event will be delayed, tentatively to March 2009, to include the analyses required under this plan. Laboratory analysis results should be received within 45 days of sample collection, and the data are expected to be available to complete the first determination by June 30, 2009, if constituents identified in 40 CFR 264, Appendix IX are not detected.

If constituents identified in 40 CFR 264, Appendix IX are detected above CRDLs, sampling and analysis to confirm the presence of these constituents will add approximately 6 weeks to the schedule to complete the first determination.

After the data are evaluated and conclusions are reached, a report will be transmitted to the Washington State Department of Ecology within 15 days, stating whether groundwater monitoring will return to indicator evaluation, or if a groundwater quality assessment program will be continued.

## 4.0 REFERENCES

40 CFR 264, Appendix IX, "Standards for Owners and Operator of Hazardous Waste Treatment, Storage, and Disposal Facilities; Ground-Water Monitoring List," *Code of Federal Regulations*.

40 CFR 265.92, "Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities; Sampling and Analysis," *Code of Federal Regulations*.

40 CFR 265.93, "Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities; Preparation, Evaluation, and Response," *Code of Federal Regulations*.

APHA, AWWA, and WEF, 1998, *Standard Methods for the Examination of Water and Wastewater, 20th Edition*, American Public Health Association, American Water Works Association, and Water Environmental Federation, Washington, D.C.

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EPA-600/4-84-017, 1984, *Test Methods for Determination of Inorganic Anions in Water by Ion Chromatography*, EPA Method 300.0, U.S. Environmental Protection Agency, Washington, D.C.

PNNL-12227, 1999, *Groundwater Monitoring Plan for the Nonradioactive Dangerous Waste Landfill*, Rev. 0, Pacific Northwest National Laboratory, Richland, Washington.

PNNL-12227-ICN-1, 2001, *Groundwater Monitoring Plan for the Nonradioactive Dangerous Waste Landfill*, Rev. 0, Pacific Northwest National Laboratory, Richland, Washington.

PNNL-13014, 2000, *Groundwater Monitoring Plan for the Solid Waste Landfill*, Rev. 0, Pacific Northwest National Laboratory, Richland, Washington.

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

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

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

WAC 173-303-400, "Dangerous Waste Regulations; Interim Status Facility Standards," *Washington Administrative Code*.

WAC 173-303-645, "Dangerous Waste Regulations"; "Releases from Regulated Units," *Washington Administrative Code*.

# DISTRIBUTION

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SGW-41904
Revision 0

# Groundwater Quality Assessment Report for the Nonradioactive Dangerous Waste Landfill

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

Contractor for the U.S. Department of Energy
under Contract DE-AC06-08RL14788

CH2MHILL
Plateau Remediation Company

P.O. Box 1600
Richland, Washington 99352

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Further Dissemination Unlimited

SGW-41904
Revision 0

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Date Published
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# 1 Introduction and Background

Groundwater beneath the Nonradioactive Dangerous Waste Landfill (NRDWL) has been monitored under the *Resource, Conservation, and Recovery Act of 1976* in interim status under a groundwater indicator parameters evaluation program. This groundwater program is in accordance with WAC 173-303-400, "Interim Status Facility Standards" (and by reference, 40 CFR 265.92, "Sampling and Analysis"), as stated in PNNL-12227, *Groundwater Monitoring Plan for the Nonradioactive Dangerous Waste Landfill.*

Results for total organic carbon (TOC) for the August 2008 sampling event exceeded the 1,020 µg/L critical mean at two wells, 699-25-34A and 699-25-34B. Results for well 699-25-34A ranged from 1,400 to 1,800 µg/L. Results for well 699-25-34B ranged from 520 to 3,600 µg/L. Verification samples for TOC were collected from the two wells in October 2008. The sample from well 699-25-34B was split and sent to two laboratories. All quadruplicate replicate results for well 699-25-34A were nondetect (less than 200 µg/L). The quadruplicate replicates for well 699-25-34B ranged from 2,000 to 2,100 µg/L at one laboratory and ranged from 2,280 to 2,380 µg/L at the other laboratory. In December 2008, the sample split (quadruplicate aliquots) sent to the first laboratory was re-analyzed with results ranging from 1,900 to 2,000 µg/L. Because the verification sampling and re-analyses indicated that TOC has exceeded the 1,020 µg/L critical mean for TOC at NRDWL, the Department of Energy notified the Washington State Department of Ecology (09-AMCP-0058, "Notification of Exceedance of Critical Mean Values for an Indicator Parameter at Non-Radioactive Dangerous Waste Landfill and Low-Level Burial Grounds, Low-Level Waste Management Area 4").

The Soil and Groundwater Remediation Project prepared a groundwater quality assessment plan to evaluate the elevated TOC (SGW-40274, *Groundwater Quality Assessment Plan for the Non-Radioactive Dangerous Waste Landfill).* The assessment plan was written for "first determination," as allowed under 40 CFR 265.93(d)(5), "Preparation, Evaluation, and Response," to determine if dangerous waste from the facility has entered groundwater. The first determination assessment plan included three wells (699-25-34B, 699-25-34A, and 699-25-34D). Groundwater samples were analyzed for the organic compounds portion of 40 CFR 264, "Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities," "Ground Water Monitoring List,"Appendix IX constituent list, and total petroleum hydrocarbon diesel, total petroleum hydrocarbon gasoline, oil and grease, coliform bacteria, dissolved oxygen, oxidation-reduction potential, TOC, inductively coupled plasma metals, anions, and chemical oxygen demand. The coliform bacteria, dissolved oxygen, oxidation-reduction potential, and chemical oxygen demand were added to address the potential for elevated TOC caused by sewage. The first determination assessment plan sampling was scheduled for March 2009, and samples were collected March 16 and 17, 2009.

# 2 Results of First Determination Sampling

Of the approximate 924 analytical results received from the March 2009 first determination, nine organic compounds were detected. Table 1 lists the detected organic compounds. Table 2 lists the associated field parameters. Table 3 contains results for coliform bacteria, dissolved oxygen, oxidation-reduction potential, and chemical oxygen demand.

**Table 1. Organic Compounds Detected in the March 2009 First Determination Sampling at NRDWL**

| Well | Constituent | Analytical Method[a] | Concentration (µg/L) | Associated Laboratory Flag[b] |
|---|---|---|---|---|
| 699-25-34A | 1,1,1-Trichloroethane | 8260 VOA GCMS | 0.3 | J |
| 699-25-34B | 1,1,1-Trichloroethane | 8260 VOA GCMS | 0.4 | J |
| 699-25-34D | 1,1,1-Trichloroethane | 8260 VOA GCMS | 0.4 | J |
| 699-25-34D | 1,1-Dichloroethane | 8260 VOA GCMS | 0.094 | J |
| 699-25-34A | bis(2-Ethylhexyl)phthalate | 8270 SVOA GCMS | 14 | |
| 699-25-34B | bis(2-Ethylhexyl)phthalate | 8270 SVOA GCMS | 3.2 | J |
| 699-25-34D | Carbon tetrachloride | 8260 VOA GCMS | 0.098 | J |
| 699-25-34A | Chloroform | 8260 VOA GCMS | 0.23 | J |
| 699-25-34B | Chloroform | 8260 VOA GCMS | 0.23 | J |
| 699-25-34D | Chloroform | 8260 VOA GCMS | 0.18 | J |
| 699-25-34A | Tetrachloroethene | 8260 VOA GCMS | 0.28 | J |
| 699-25-34B | Tetrachloroethene | 8260 VOA GCMS | 0.5 | J |
| 699-25-34D | Tetrachloroethene | 8260 VOA GCMS | 0.34 | J |
| 699-25-34A | Total Organic Carbon | 9060 TOC | 579 | B |
| 699-25-34B | Total Organic Carbon | 9060 TOC | 1,990 | |
| 699-25-34D | Total Organic Carbon | 9060 TOC | 568 | B |
| 699-25-34A | Trichloroethene | 8260 VOA GCMS | 0.4 | J |
| 699-25-34B | Trichloroethene | 8260 VOA GCMS | 0.51 | J |
| 699-25-34D | Trichloroethene | 8260 VOA GCMS | 0.5 | J |
| 699-25-34A | Trichloromonofluoro-methane | 8260 VOA GCMS | 0.29 | J |
| 699-25-34B | Trichloromonofluoro-methane | 8260 VOA GCMS | 0.51 | J |
| 699-25-34D | Trichloromonofluoro-methane | 8260 VOA GCMS | 0.5 | J |

a. Analytical Methods (method numbers are from SW-846, *Test Methods for Evaluating Solid Waste – Physical/Chemical Methods*)

SVOA GCMS = semivolatile organic analysis gas chromatograph mass spectrometer

VOA GCMS = volatile organic analysis gas chromatograph mass spectrometer

b. Laboratory Flags

J = Estimated value; constituent detected at a level less than the required detection limit or practical quantitation limit and greater than or equal to the minimum detection limit.

B = The analyte was detected in both the associated quality control blank and the sample.

**Table 2. Field Parameters Associated with the March 2009 First Determination Sampling**

| Field Parameter | Well 699-25-34A | Well 699-25-34B | Well 699-25-34D |
|---|---|---|---|
| pH | 7.37 | 7.18 | 7.16 |
| Specific Conductance (μS/cm) | 638 | 630 | 567 |
| Temperature (°C) | 18.8 | 19.4 | 19.0 |
| Turbidity (NTUs) | 0.39 | 0.1 | 0.89 |

**Table 3. Results for Coliform Bacteria, Dissolved Oxygen, Oxidation-Reduction Potential, and Chemical Oxygen Demand Associated with the March 2009 First Determination Sampling**

| Parameter | Well 699-25-34A | Well 699-25-34B | Well 699-25-34D |
|---|---|---|---|
| Coliform Bacteria (col./100 mL) | 1 U* | 1 U | 1 U |
| Dissolved Oxygen (μg/L) | 11,380 | 7,240 | 7,570 |
| Oxidation-Reduction Potential (mV) | 401 | 415.6 | 356.5 |
| Chemical Oxygen Demand (μg/L) | 10,000 U | 10,000 U | 10,000 U |

*U = Not detected, result was less than the method detection limit.

Eight volatile or semivolatile organic compounds were tentatively identified in the first determination sampling (Table 1). Of those, one occurrence of bis(2-ethylhexyl)phthalate did not have an associated laboratory qualifier. Bis(2-ethylhexyl)phthalate is a plasticizer that is a common laboratory contaminant. Detection of this semivolatile compound is not likely attributable to actual contamination in the groundwater from the NRDWL. All of the remaining identified compounds have the "J" qualifier with the results indicating they are estimated values, and the constituents were detected at levels less than the required detection limits or practical quantitation limits and greater than or equal to the minimum detection limits.

Data verification on these samples discovered no major issues affecting data quality. However, two of the three results for TOC had the "B" qualifier indicating that TOC was detected in both the associated quality control blank and the sample. The highest of the three results (1,990 μg/L at well 699-25-34B) did not have the "B" qualifier.

Table 2 lists the field parameters associated with the first determination samples. The field parameters also give an indication that the samples were representative of groundwater. All the field parameters are within the historical range for groundwater at NRDWL.

Table 3 lists results for parameters that could have indicated the presence of sewage. Sewage was discharged to trenches at the nearby Solid Waste Landfill. Historically, wells at NRDWL and Solid Waste Landfill have had sporadically elevated coliform bacteria. However, coliform bacteria were not detected in the first determination samples. Dissolved oxygen, oxidation-reduction potential, and chemical oxygen demand are three other parameters that may indicate the presence of sewage byproducts. However, results

for these parameters are typical of wells in the area (such as NRDWL upgradient wells) that are likely to be uncontaminated with sewage.

# 3 Conclusion

No identified dangerous waste constituent is responsible for the elevated total organic carbon in well 699-25-34B. It is possible that the elevated TOC resulted from sewage disposed at the nearby Solid Waste Landfill, but the parameters tested (Table 3) do not support that conclusion.

It is concluded that the NRDWL has not contaminated the unconfined aquifer with dangerous waste constituents, and the monitoring regime at NRDWL will revert to an interim status indicator parameters evaluation program.

# 4 References

090-AMCP-0058, 2009, "Notification of Exceedance of Critical Mean Values for an Indicator Parameter at Non-Radioactive Dangerous Waste Landfill and Low-Level Burial Grounds, Low-Level Waste Management Area 4" (external letter to J.A. Hedges, Washington State Department of Ecology), from M.S. McCormick, U.S. Department of Energy, Richland Operations Office, Richland, Washington, January 20. Available at: http://www5.hanford.gov/arpir/?content=findpage&AKey=0901300164.

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40 CFR 265.92, "Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities," "Sampling and Analysis," *Code of Federal Regulations*. Available at: http://edocket.access.gpo.gov/cfr_2008/julqtr/pdf/40cfr265.92.pdf.

40 CFR 265.93, "Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities," "Preparation, Evaluation, and Response," *Code of Federal Regulations*. Available at: http://law.justia.com/us/cfr/title40/40-25.0.1.1.6.6.1.4.html.

PNNL-12227, 1999, *Groundwater Monitoring Plan for the Nonradioactive Dangerous Waste Landfill*. Pacific Northwest National Laboratory, Richland, Washington. Available at: http://www5.hanford.gov/arpir/?content=findpage&AKey=D1660026.

*Resource Conservation and Recovery Act of 1976*, 42 USC 6901, et seq. Available at: http://www.epa.gov/epawaste/inforesources/online/index.htm.

SGW-40274, 2009, *Groundwater Quality Assessment Plan for the Non-Radioactive Dangerous Waste Landfill*, CH2M HILL Plateau Remediation Company, Richland, Washington. Available at: http://www2.hanford.gov/ARPIR/?content=findpage&AKey=0902180704.

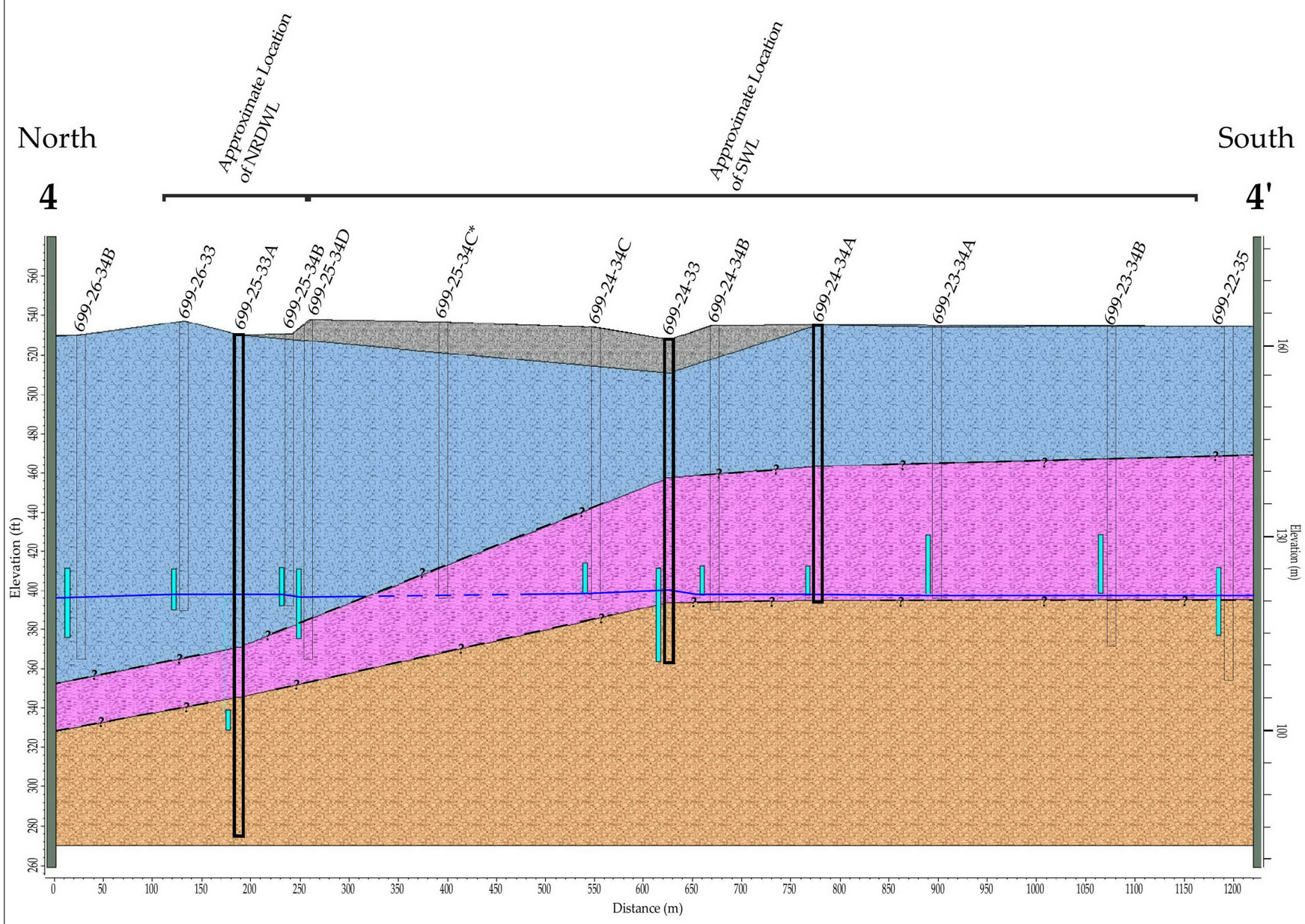
SW-846, *Test Methods for Evaluating Solid Waste – Physical/Chemical Methods*, (3rd Edition), Office of Solid Waste and Energy Response, U.S. Environmental Protection Agency, Washington, D.C. Available at: http://www.epa.gov/osw/hazard/testmethods/sw846/online/index.htm.

WAC 173-303-400, "Interim Status Facility Standards," *Washington Administrative Code,* Olympia, Washington. Available at: http://apps.leg.wa.gov/WAC/default.aspx?cite=173-303-400.

EXHIBIT D:

Geologic Cross Sections of the NRDW/SWL AREA

# NRDWL Cross Section 4




| Hydrostratigraphic Unit | Associated Lithologic Units |
|---|---|
| Recent Fill | Recent Fill |
| HSU 1 | Undifferentiated Hanford fm.<br>- H1<br>- H2<br>- H3 |
| HSU 3 | Undifferentiated Cold Creek Unit<br>- CCU G (Pre-Missoula Gravels) |
| HSU 5 | Undifferentiated Ringold<br>- Upper Ringold Unit<br>- Ringold Unit E<br>- Ringold Unit C |

Approximate Contact

Water level from March 2008 (dashed where inferred)

Well screen

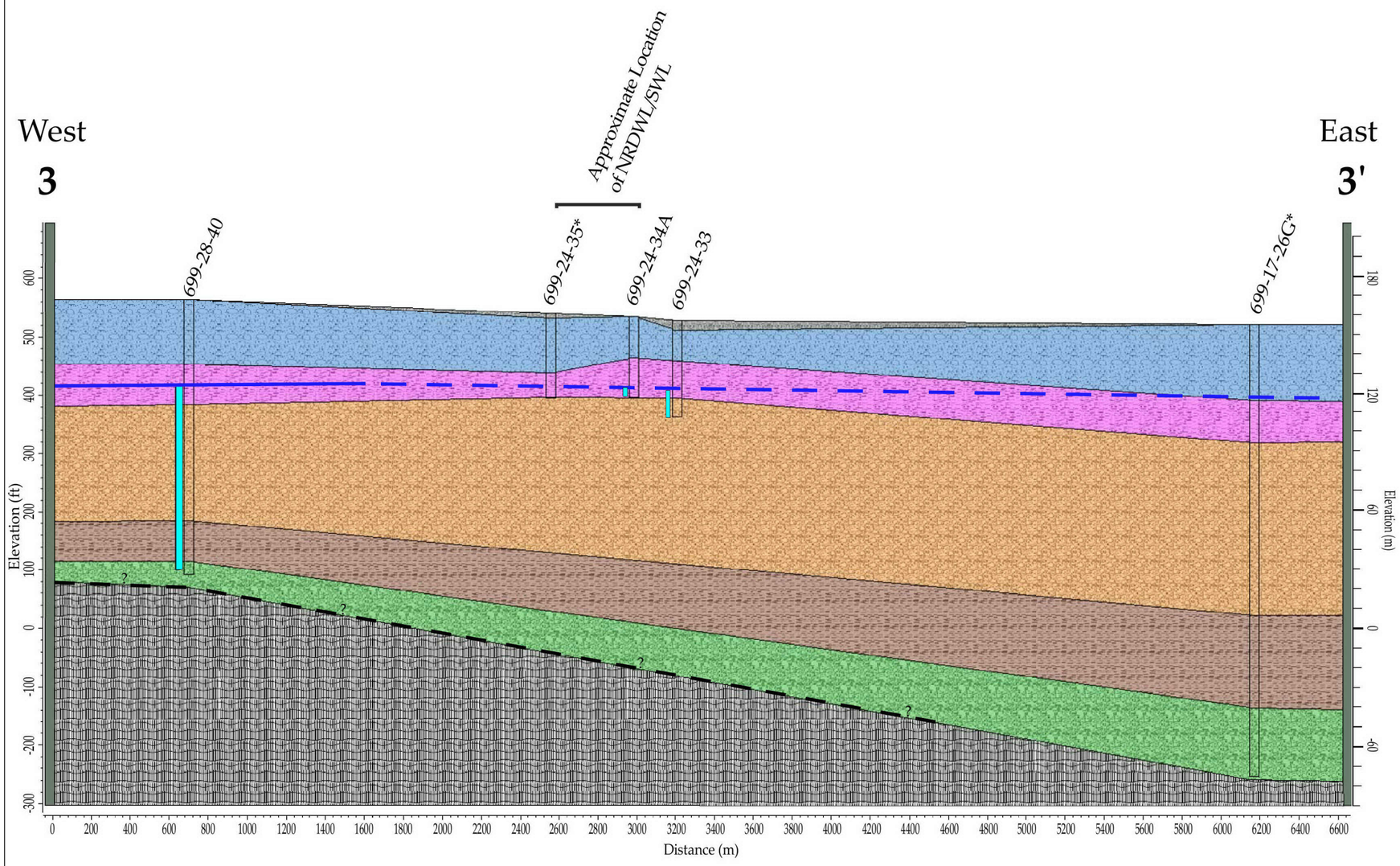
Total depth drilled

Wells used for hydrogeologic interpretation (699-25-33A, 699-24-33, 699-24-34A)

* Well with no screen data available

2X Vertical Exaggeration

# NRDWL Cross Section 3




| Hydrostratigraphic Unit | Associated Lithologic Units |
|---|---|
| Recent Fill | Recent Fill |
| HSU 1 | Undifferentiated Hanford fm.<br>- H1<br>- H2<br>- H3 |
| HSU 3 | Undifferentiated Cold Creek Unit<br>- CCU G (Pre-Missoula Gravels) |
| HSU 5 | Undifferentiated Ringold<br>- Upper Ringold Unit<br>- Ringold Unit E<br>- Ringold Unit C |
| HSU 8 | Undifferentiated Ringold Lower Mud<br>- Rlm, upper<br>- Rwib&d<br>- Rlm, lower |
| HSU 9 | Undifferentiated Ringold Unit A<br>- Rwia, upper<br>- Rwia, mud<br>- Rwia, lower |
| HSU 10 | Basalt |

Approximate Contact

Water level from March 2008 (dashed where inferred)

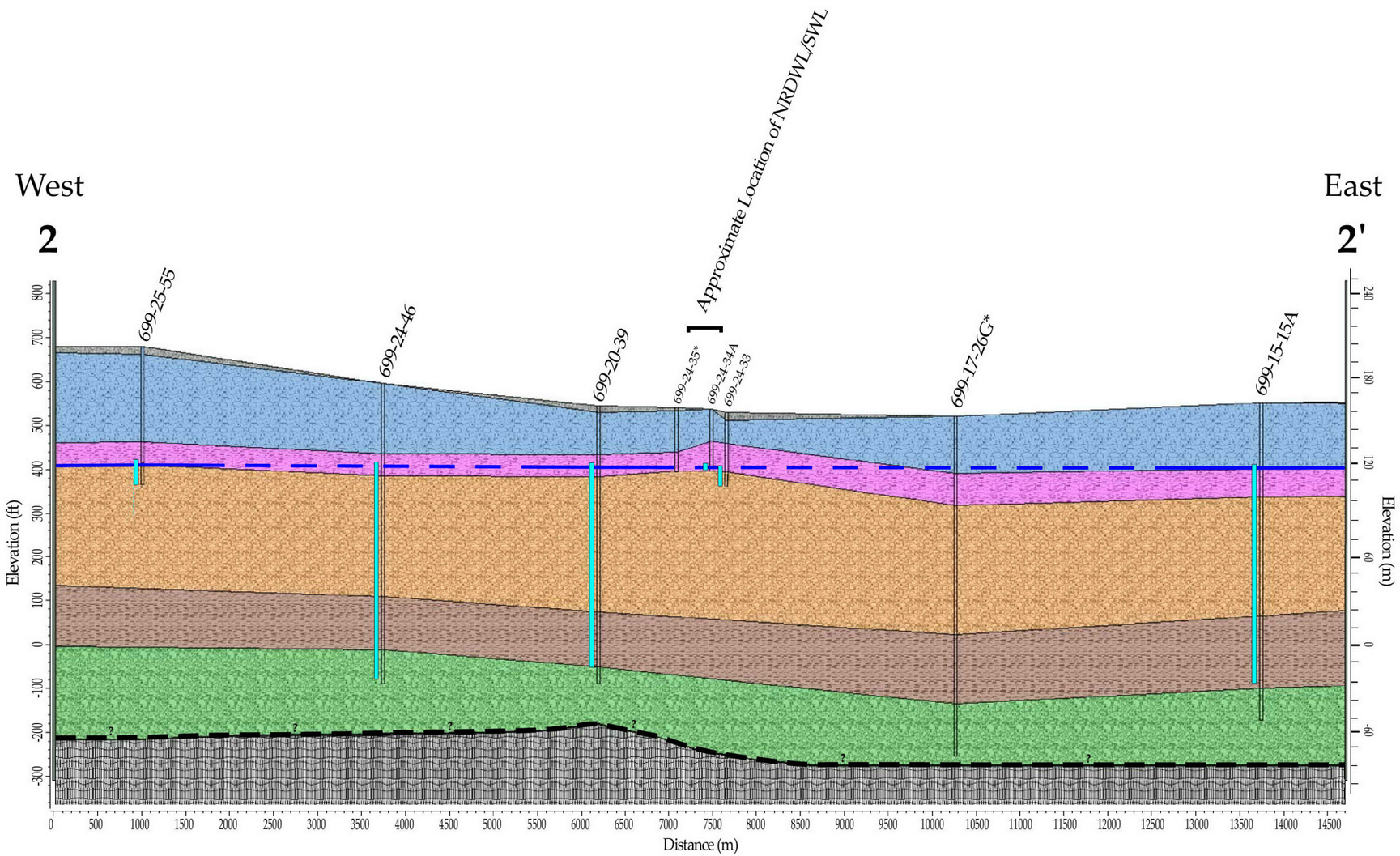
Well screen

Total depth drilled

* Wells with no screen data available

3X Vertical Exaggeration

# NRDWL Cross-Section 2




| Hydrostratigraphic Unit | Associated Lithologic Units |
|---|---|
| Recent Fill | Recent Fill |
| HSU 1 | Undifferentiated Hanford fm.<br>- H1<br>- H2<br>- H3 |
| HSU 3 | Undifferentiated Cold Creek Unit<br>- CCU G (Pre-Missoula Gravels) |
| HSU 5 | Undifferentiated Ringold<br>- Upper Ringold Unit<br>- Ringold Unit E<br>- Ringold Unit C |
| HSU 8 | Undifferentiated Ringold Lower Mud<br>- Rlm, upper<br>- Rwib&d<br>- Rlm, lower |
| HSU 9 | Undifferentiated Ringold Unit A<br>- Rwia, upper<br>- Rwia, mud<br>- Rwia, lower |
| HSU 10 | Basalt |

Approximate Contact

Water level from March 2008 (dashed where inferred)

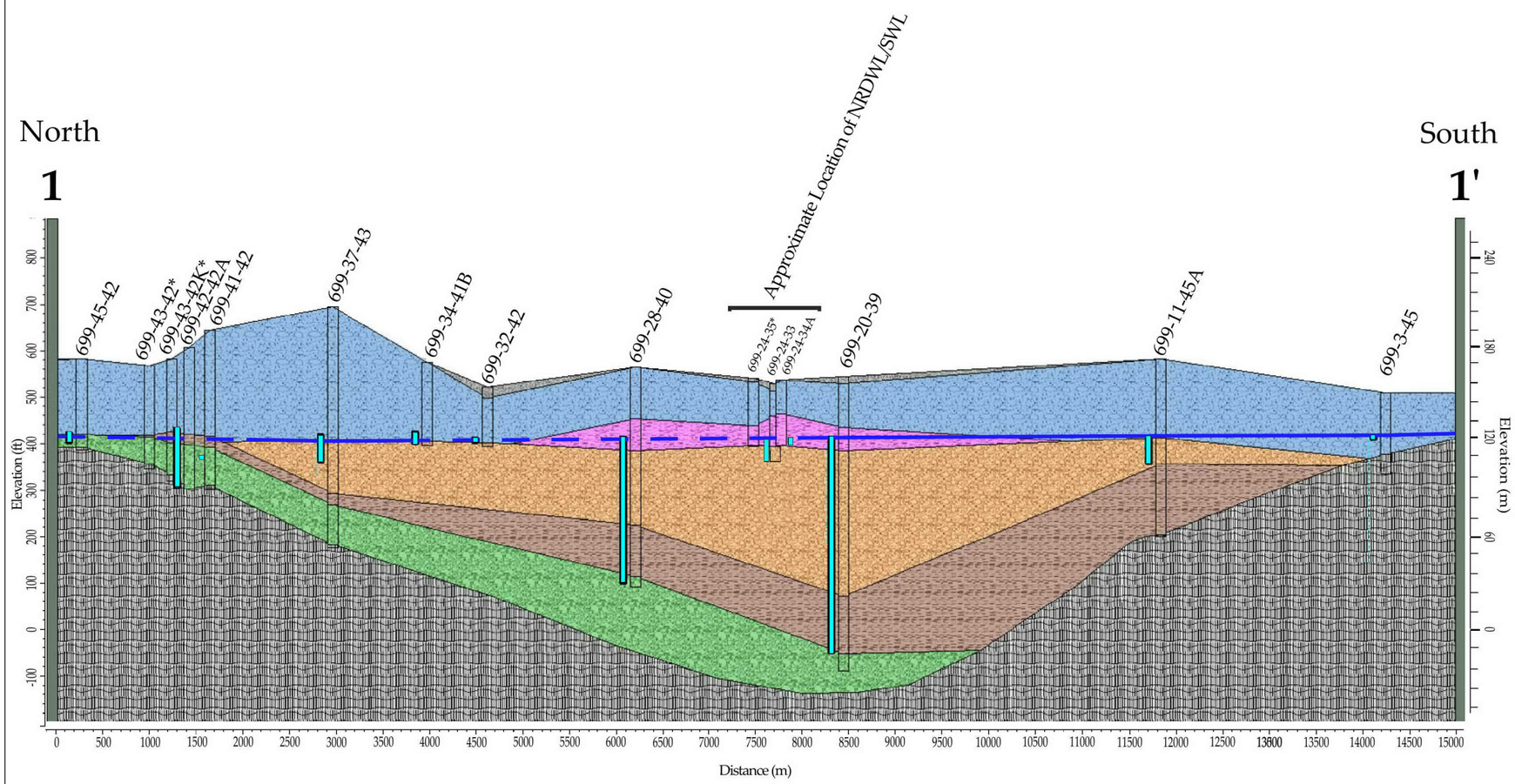
Well screen

Total depth drilled

* Wells with no screen data available

5X Vertical Exaggeration

# NRDWL Cross-Section 1




| Hydrostratigraphic Unit | Associated Lithologic Units |
|---|---|
| Recent Fill | Recent Fill |
| HSU 1 | Undifferentiated Hanford fm.<br>- H1<br>- H2<br>- H3 |
| HSU 3 | Undifferentiated Cold Creek Unit<br>- CCU G (Pre-Missoula Gravels) |
| HSU 5 | Undifferentiated Ringold<br>- Upper Ringold Unit<br>- Ringold Unit E<br>- Ringold Unit C |
| HSU 8 | Undifferentiated Ringold Lower Mud<br>- Rlm, upper<br>- Rwib&d<br>- Rlm, lower |
| HSU 9 | Undifferentiated Ringold Unit A<br>- Rwia, upper<br>- Rwia, mud<br>- Rwia, lower |
| HSU 10 | Basalt |

Water level from March 2008 (dashed where inferred)

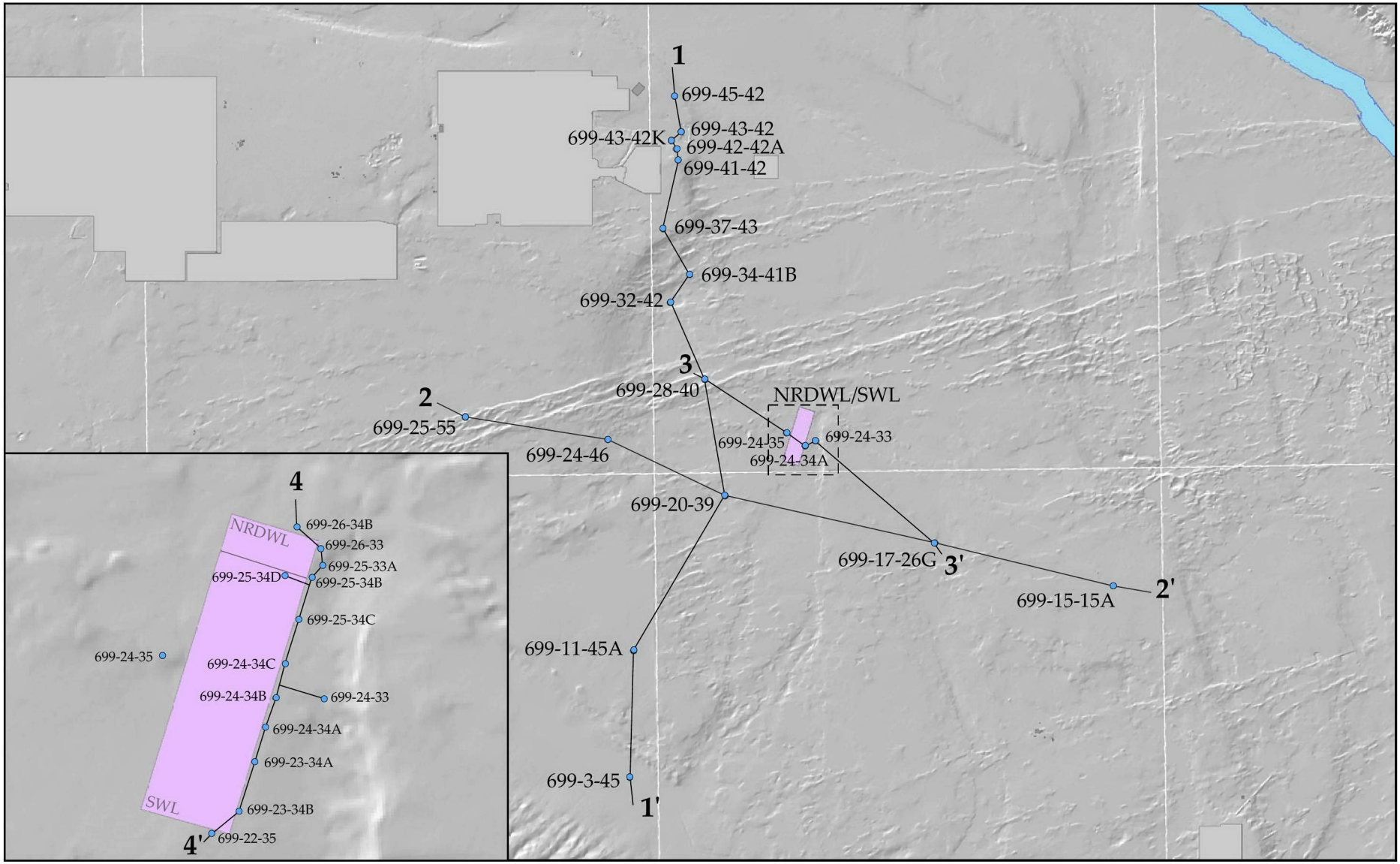
Well screen

Total depth drilled

* Wells with no screen data available

5X Vertical Exaggeration

# Location Map for NRDWL Cross-Sections



DRAFT

# Typical Lithologic Hydrogeoliogic Cross-Section for NRDWL Area

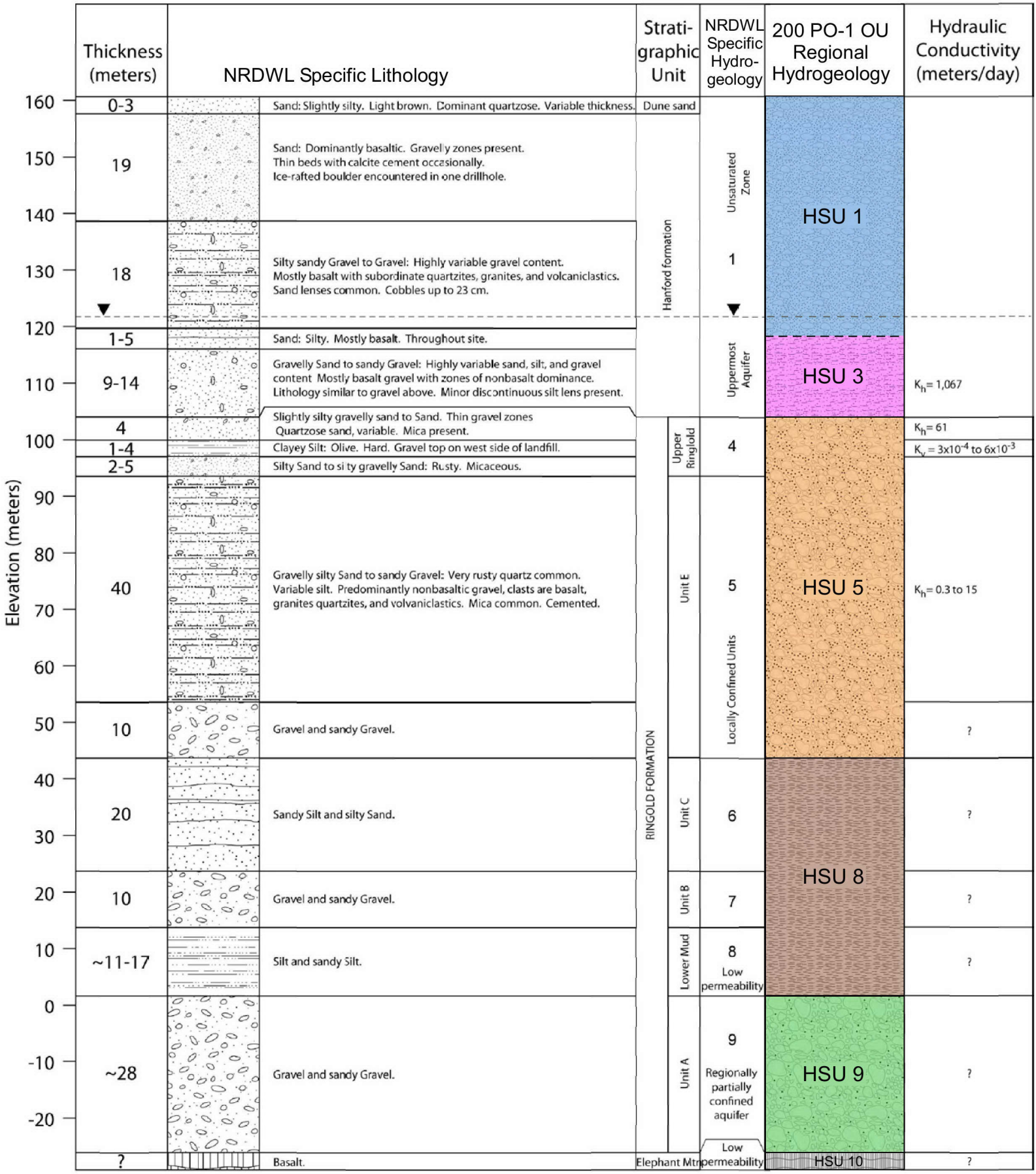


EXHIBIT E: GROUNDWATER DATABASE:

Analytical results from all active SWL and NRDWL Monitoring Wells from 1997 to Present (on CD)

| WELL_NAME | CON_LONG_NAME | METHOD_NAME | LAB_QUALIFIER | STD_VALUE_RPTD | STD_ANAL_UNITS | SAMP_DATE_TIME | RESULT_COMMENT |
|---|---|---|---|---|---|---|---|
| 699-25-33A | (m+p)-Xylene | 524.2_VOA_GCMS | U | 0.25 | ug/L | 8/24/1998 | |
| 699-25-33A | 1,1,1,2-Tetrachloroethane | 8260_VOA_GCMS | U | 0.1 | ug/L | 11/3/2008 | |
| 699-25-33A | 1,1,1-Trichloroethane | 524.2_VOA_GCMS | U | 0.34 | ug/L | 8/24/1998 | |
| 699-25-33A | 1,1,1-Trichloroethane | 524.2_VOA_GCMS | U | 0.34 | ug/L | 2/8/1999 | |
| 699-25-33A | 1,1,1-Trichloroethane | 524.2_VOA_GCMS | U | 0.34 | ug/L | 8/16/1999 | |
| 699-25-33A | 1,1,1-Trichloroethane | 8010_VOA_GC | U | 0.2 | ug/L | 2/18/1997 | |
| 699-25-33A | 1,1,1-Trichloroethane | 8010_VOA_GC | U | 0.028 | ug/L | 8/13/1997 | |
| 699-25-33A | 1,1,1-Trichloroethane | 8010_VOA_GC | U | 0.028 | ug/L | 2/23/1998 | |
| 699-25-33A | 1,1,1-Trichloroethane | 8010_VOA_GC | U | 0.028 | ug/L | 2/23/1998 | |
| 699-25-33A | 1,1,1-Trichloroethane | 8260_VOA_GCMS | U | 0.23 | ug/L | 2/29/2000 | |
| 699-25-33A | 1,1,1-Trichloroethane | 8260_VOA_GCMS | U | 0.23 | ug/L | 2/29/2000 | |
| 699-25-33A | 1,1,1-Trichloroethane | 8260_VOA_GCMS | U | 0.23 | ug/L | 10/6/2000 | |
| 699-25-33A | 1,1,1-Trichloroethane | 8260_VOA_GCMS | U | 0.23 | ug/L | 2/26/2001 | |
| 699-25-33A | 1,1,1-Trichloroethane | 8260_VOA_GCMS | U | 0.31 | ug/L | 8/14/2001 | |
| 699-25-33A | 1,1,1-Trichloroethane | 8260_VOA_GCMS | J | 0.97 | ug/L | 2/12/2002 | |
| 699-25-33A | 1,1,1-Trichloroethane | 8260_VOA_GCMS | U | 0.31 | ug/L | 9/3/2002 | |
| 699-25-33A | 1,1,1-Trichloroethane | 8260_VOA_GCMS | U | 0.17 | ug/L | 2/20/2003 | |
| 699-25-33A | 1,1,1-Trichloroethane | 8260_VOA_GCMS | U | 0.17 | ug/L | 8/18/2003 | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 699-25-33A | 1,1,1-Trichloroethane | 8260_VOA_GCMS | U | 0.17 | ug/L | 2/18/2004 | |
| 699-25-33A | 1,1,1-Trichloroethane | 8260_VOA_GCMS | U | 0.07 | ug/L | 8/31/2004 | |
| 699-25-33A | 1,1,1-Trichloroethane | 8260_VOA_GCMS | U | 0.08 | ug/L | 2/17/2005 | |
| 699-25-33A | 1,1,1-Trichloroethane | 8260_VOA_GCMS | U | 0.08 | ug/L | 8/2/2005 | |
| 699-25-33A | 1,1,1-Trichloroethane | 8260_VOA_GCMS | U | 0.15 | ug/L | 2/23/2006 | |
| 699-25-33A | 1,1,1-Trichloroethane | 8260_VOA_GCMS | U | 0.15 | ug/L | 9/1/2006 | |
| 699-25-33A | 1,1,1-Trichloroethane | 8260_VOA_GCMS | U | 0.15 | ug/L | 9/1/2006 | |
| 699-25-33A | 1,1,1-Trichloroethane | 8260_VOA_GCMS | U | 0.035 | ug/L | 2/13/2007 | |
| 699-25-33A | 1,1,1-Trichloroethane | 8260_VOA_GCMS | U | 0.1 | ug/L | 9/24/2007 | |
| 699-25-33A | 1,1,1-Trichloroethane | 8260_VOA_GCMS | U | 1 | ug/L | 2/26/2008 | |
| 699-25-33A | 1,1,1-Trichloroethane | 8260_VOA_GCMS | U | 1 | ug/L | 8/24/2008 | |
| 699-25-33A | 1,1,1-Trichloroethane | 8260_VOA_GCMS | U | 0.099 | ug/L | 11/3/2008 | |
| 699-25-33A | 1,1,1-Trichloroethane | 8260_VOA_GCMS | U | 1 | ug/L | 1/29/2009 | |
| 699-25-33A | 1,1,1-Trichloroethane | 8260_VOA_GCMS | U | 1 | ug/L | 7/20/2009 | |
| 699-25-33A | 1,1,2,2-Tetrachloroethane | 8260_VOA_GCMS | U | 0.27 | ug/L | 11/3/2008 | |
| 699-25-33A | 1,1,2-Trichloroethane | 524.2_VOA_GCMS | U | 0.27 | ug/L | 8/24/1998 | |
| 699-25-33A | 1,1,2-Trichloroethane | 524.2_VOA_GCMS | U | 0.27 | ug/L | 2/8/1999 | |
| 699-25-33A | 1,1,2-Trichloroethane | 524.2_VOA_GCMS | U | 0.27 | ug/L | 8/16/1999 | |
| 699-25-33A | 1,1,2-Trichloroethane | 8010_VOA_GC | U | 0.2 | ug/L | 2/18/1997 | |

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|---|---|---|---|---|---|---|---|
| 699-25-33A | 1,1,2-Trichloroethane | 8010_VOA_GC | U | 0.036 | ug/L | 8/13/1997 | |
| 699-25-33A | 1,1,2-Trichloroethane | 8010_VOA_GC | U | 0.036 | ug/L | 2/23/1998 | |
| 699-25-33A | 1,1,2-Trichloroethane | 8010_VOA_GC | U | 0.036 | ug/L | 2/23/1998 | |
| 699-25-33A | 1,1,2-Trichloroethane | 8260_VOA_GCMS | U | 0.31 | ug/L | 2/29/2000 | |
| 699-25-33A | 1,1,2-Trichloroethane | 8260_VOA_GCMS | U | 0.31 | ug/L | 2/29/2000 | |
| 699-25-33A | 1,1,2-Trichloroethane | 8260_VOA_GCMS | U | 0.31 | ug/L | 10/6/2000 | |
| 699-25-33A | 1,1,2-Trichloroethane | 8260_VOA_GCMS | U | 0.31 | ug/L | 2/26/2001 | |
| 699-25-33A | 1,1,2-Trichloroethane | 8260_VOA_GCMS | U | 0.27 | ug/L | 8/14/2001 | |
| 699-25-33A | 1,1,2-Trichloroethane | 8260_VOA_GCMS | U | 0.27 | ug/L | 2/12/2002 | |
| 699-25-33A | 1,1,2-Trichloroethane | 8260_VOA_GCMS | U | 0.27 | ug/L | 9/3/2002 | |
| 699-25-33A | 1,1,2-Trichloroethane | 8260_VOA_GCMS | U | 0.05 | ug/L | 2/20/2003 | |
| 699-25-33A | 1,1,2-Trichloroethane | 8260_VOA_GCMS | U | 0.05 | ug/L | 8/18/2003 | |
| 699-25-33A | 1,1,2-Trichloroethane | 8260_VOA_GCMS | U | 0.05 | ug/L | 2/18/2004 | |
| 699-25-33A | 1,1,2-Trichloroethane | 8260_VOA_GCMS | U | 0.21 | ug/L | 8/31/2004 | |
| 699-25-33A | 1,1,2-Trichloroethane | 8260_VOA_GCMS | U | 0.07 | ug/L | 2/17/2005 | |
| 699-25-33A | 1,1,2-Trichloroethane | 8260_VOA_GCMS | U | 0.07 | ug/L | 8/2/2005 | |
| 699-25-33A | 1,1,2-Trichloroethane | 8260_VOA_GCMS | U | 0.23 | ug/L | 2/23/2006 | |
| 699-25-33A | 1,1,2-Trichloroethane | 8260_VOA_GCMS | U | 0.23 | ug/L | 9/1/2006 | |
| 699-25-33A | 1,1,2-Trichloroethane | 8260_VOA_GCMS | U | 0.23 | ug/L | 9/1/2006 | |

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|---|---|---|---|---|---|---|---|
| 699-25-33A | 1,1,2-Trichloroethane | 8260_VOA_GCMS | U | 0.092 | ug/L | 2/13/2007 | |
| 699-25-33A | 1,1,2-Trichloroethane | 8260_VOA_GCMS | U | 0.092 | ug/L | 9/24/2007 | |
| 699-25-33A | 1,1,2-Trichloroethane | 8260_VOA_GCMS | U | 1 | ug/L | 2/26/2008 | |
| 699-25-33A | 1,1,2-Trichloroethane | 8260_VOA_GCMS | U | 1 | ug/L | 8/24/2008 | |
| 699-25-33A | 1,1,2-Trichloroethane | 8260_VOA_GCMS | U | 0.19 | ug/L | 11/3/2008 | |
| 699-25-33A | 1,1,2-Trichloroethane | 8260_VOA_GCMS | U | 1 | ug/L | 1/29/2009 | |
| 699-25-33A | 1,1,2-Trichloroethane | 8260_VOA_GCMS | U | 1 | ug/L | 7/20/2009 | |
| 699-25-33A | 1,1-Dichloroethane | 524.2_VOA_GCMS | U | 0.18 | ug/L | 8/24/1998 | |
| 699-25-33A | 1,1-Dichloroethane | 524.2_VOA_GCMS | U | 0.18 | ug/L | 2/8/1999 | |
| 699-25-33A | 1,1-Dichloroethane | 524.2_VOA_GCMS | U | 0.18 | ug/L | 8/16/1999 | |
| 699-25-33A | 1,1-Dichloroethane | 8010_VOA_GC | U | 0.2 | ug/L | 2/18/1997 | |
| 699-25-33A | 1,1-Dichloroethane | 8010_VOA_GC | U | 0.024 | ug/L | 8/13/1997 | |
| 699-25-33A | 1,1-Dichloroethane | 8010_VOA_GC | U | 0.024 | ug/L | 2/23/1998 | |
| 699-25-33A | 1,1-Dichloroethane | 8010_VOA_GC | U | 0.024 | ug/L | 2/23/1998 | |
| 699-25-33A | 1,1-Dichloroethane | 8260_VOA_GCMS | U | 0.19 | ug/L | 2/29/2000 | |
| 699-25-33A | 1,1-Dichloroethane | 8260_VOA_GCMS | U | 0.19 | ug/L | 2/29/2000 | |
| 699-25-33A | 1,1-Dichloroethane | 8260_VOA_GCMS | U | 0.19 | ug/L | 10/6/2000 | |
| 699-25-33A | 1,1-Dichloroethane | 8260_VOA_GCMS | U | 0.19 | ug/L | 2/26/2001 | |
| 699-25-33A | 1,1-Dichloroethane | 8260_VOA_GCMS | U | 0.25 | ug/L | 8/14/2001 | |

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|---|---|---|---|---|---|---|---|
| 699-25-33A | 1,1-Dichloroethane | 8260_VOA_GCMS | J | 0.27 | ug/L | 2/12/2002 | |
| 699-25-33A | 1,1-Dichloroethane | 8260_VOA_GCMS | U | 0.25 | ug/L | 9/3/2002 | |
| 699-25-33A | 1,1-Dichloroethane | 8260_VOA_GCMS | U | 0.2 | ug/L | 2/20/2003 | |
| 699-25-33A | 1,1-Dichloroethane | 8260_VOA_GCMS | U | 0.2 | ug/L | 8/18/2003 | |
| 699-25-33A | 1,1-Dichloroethane | 8260_VOA_GCMS | U | 0.2 | ug/L | 2/18/2004 | |
| 699-25-33A | 1,1-Dichloroethane | 8260_VOA_GCMS | U | 0.12 | ug/L | 8/31/2004 | |
| 699-25-33A | 1,1-Dichloroethane | 8260_VOA_GCMS | U | 0.07 | ug/L | 2/17/2005 | |
| 699-25-33A | 1,1-Dichloroethane | 8260_VOA_GCMS | U | 0.07 | ug/L | 8/2/2005 | |
| 699-25-33A | 1,1-Dichloroethane | 8260_VOA_GCMS | U | 0.16 | ug/L | 2/23/2006 | |
| 699-25-33A | 1,1-Dichloroethane | 8260_VOA_GCMS | U | 0.16 | ug/L | 9/1/2006 | |
| 699-25-33A | 1,1-Dichloroethane | 8260_VOA_GCMS | U | 0.16 | ug/L | 9/1/2006 | |
| 699-25-33A | 1,1-Dichloroethane | 8260_VOA_GCMS | U | 0.046 | ug/L | 2/13/2007 | |
| 699-25-33A | 1,1-Dichloroethane | 8260_VOA_GCMS | U | 0.046 | ug/L | 9/24/2007 | |
| 699-25-33A | 1,1-Dichloroethane | 8260_VOA_GCMS | U | 1 | ug/L | 2/26/2008 | |
| 699-25-33A | 1,1-Dichloroethane | 8260_VOA_GCMS | U | 1 | ug/L | 8/24/2008 | |
| 699-25-33A | 1,1-Dichloroethane | 8260_VOA_GCMS | U | 0.07 | ug/L | 11/3/2008 | |
| 699-25-33A | 1,1-Dichloroethane | 8260_VOA_GCMS | U | 1 | ug/L | 1/29/2009 | |
| 699-25-33A | 1,1-Dichloroethane | 8260_VOA_GCMS | U | 1 | ug/L | 7/20/2009 | |
| 699-25-33A | 1,1-Dichloroethene | 8260_VOA_GCMS | U | 0.16 | ug/L | 2/20/2003 | |

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|---|---|---|---|---|---|---|---|
| 699-25-33A | 1,1-Dichloroethene | 8260_VOA_GCMS | U | 0.16 | ug/L | 8/18/2003 | |
| 699-25-33A | 1,1-Dichloroethene | 8260_VOA_GCMS | U | 0.04 | ug/L | 2/17/2005 | |
| 699-25-33A | 1,1-Dichloroethene | 8260_VOA_GCMS | U | 0.04 | ug/L | 8/2/2005 | |
| 699-25-33A | 1,1-Dichloroethene | 8260_VOA_GCMS | U | 0.21 | ug/L | 2/23/2006 | |
| 699-25-33A | 1,1-Dichloroethene | 8260_VOA_GCMS | U | 0.21 | ug/L | 9/1/2006 | |
| 699-25-33A | 1,1-Dichloroethene | 8260_VOA_GCMS | U | 0.21 | ug/L | 9/1/2006 | |
| 699-25-33A | 1,1-Dichloroethene | 8260_VOA_GCMS | U | 0.045 | ug/L | 2/13/2007 | |
| 699-25-33A | 1,1-Dichloroethene | 8260_VOA_GCMS | U | 0.045 | ug/L | 9/24/2007 | |
| 699-25-33A | 1,1-Dichloroethene | 8260_VOA_GCMS | U | 1 | ug/L | 2/26/2008 | |
| 699-25-33A | 1,1-Dichloroethene | 8260_VOA_GCMS | U | 1 | ug/L | 8/24/2008 | |
| 699-25-33A | 1,1-Dichloroethene | 8260_VOA_GCMS | U | 0.085 | ug/L | 11/3/2008 | |
| 699-25-33A | 1,1-Dichloroethene | 8260_VOA_GCMS | U | 1 | ug/L | 1/29/2009 | |
| 699-25-33A | 1,1-Dichloroethene | 8260_VOA_GCMS | U | 1 | ug/L | 7/20/2009 | |
| 699-25-33A | 1,2,3-Trichloropropane | 8260_VOA_GCMS | U | 0.22 | ug/L | 11/3/2008 | |
| 699-25-33A | 1,2-Dibromo-3-chloropropane | 8260_VOA_GCMS | U | 0.48 | ug/L | 11/3/2008 | |
| 699-25-33A | 1,2-Dibromoethane | 8260_VOA_GCMS | U | 0.15 | ug/L | 11/3/2008 | |
| 699-25-33A | 1,2-Dichloroethane | 524.2_VOA_GCMS | U | 0.22 | ug/L | 8/24/1998 | |
| 699-25-33A | 1,2-Dichloroethane | 524.2_VOA_GCMS | U | 0.22 | ug/L | 2/8/1999 | |

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|---|---|---|---|---|---|---|---|
| 699-25-33A | 1,2-Dichloroethane | 524.2_VOA_GCMS | U | 0.22 | ug/L | 8/16/1999 | |
| 699-25-33A | 1,2-Dichloroethane | 8010_VOA_GC | U | 0.2 | ug/L | 2/18/1997 | |
| 699-25-33A | 1,2-Dichloroethane | 8010_VOA_GC | U | 0.018 | ug/L | 8/13/1997 | |
| 699-25-33A | 1,2-Dichloroethane | 8010_VOA_GC | U | 0.018 | ug/L | 2/23/1998 | |
| 699-25-33A | 1,2-Dichloroethane | 8010_VOA_GC | U | 0.018 | ug/L | 2/23/1998 | |
| 699-25-33A | 1,2-Dichloroethane | 8260_VOA_GCMS | U | 0.17 | ug/L | 2/29/2000 | |
| 699-25-33A | 1,2-Dichloroethane | 8260_VOA_GCMS | U | 0.17 | ug/L | 2/29/2000 | |
| 699-25-33A | 1,2-Dichloroethane | 8260_VOA_GCMS | U | 0.17 | ug/L | 10/6/2000 | |
| 699-25-33A | 1,2-Dichloroethane | 8260_VOA_GCMS | U | 0.17 | ug/L | 2/26/2001 | |
| 699-25-33A | 1,2-Dichloroethane | 8260_VOA_GCMS | U | 0.27 | ug/L | 8/14/2001 | |
| 699-25-33A | 1,2-Dichloroethane | 8260_VOA_GCMS | U | 0.27 | ug/L | 2/12/2002 | |
| 699-25-33A | 1,2-Dichloroethane | 8260_VOA_GCMS | U | 0.27 | ug/L | 9/3/2002 | |
| 699-25-33A | 1,2-Dichloroethane | 8260_VOA_GCMS | U | 0.08 | ug/L | 2/20/2003 | |
| 699-25-33A | 1,2-Dichloroethane | 8260_VOA_GCMS | U | 0.08 | ug/L | 8/18/2003 | |
| 699-25-33A | 1,2-Dichloroethane | 8260_VOA_GCMS | U | 0.08 | ug/L | 2/18/2004 | |
| 699-25-33A | 1,2-Dichloroethane | 8260_VOA_GCMS | U | 0.21 | ug/L | 8/31/2004 | |
| 699-25-33A | 1,2-Dichloroethane | 8260_VOA_GCMS | U | 0.09 | ug/L | 2/17/2005 | |
| 699-25-33A | 1,2-Dichloroethane | 8260_VOA_GCMS | U | 0.09 | ug/L | 8/2/2005 | |
| 699-25-33A | 1,2-Dichloroethane | 8260_VOA_GCMS | U | 0.21 | ug/L | 2/23/2006 | |

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|---|---|---|---|---|---|---|---|
| 699-25-33A | 1,2-Dichloroethane | 8260_VOA_GCMS | U | 0.21 | ug/L | 9/1/2006 | |
| 699-25-33A | 1,2-Dichloroethane | 8260_VOA_GCMS | U | 0.21 | ug/L | 9/1/2006 | |
| 699-25-33A | 1,2-Dichloroethane | 8260_VOA_GCMS | U | 0.11 | ug/L | 2/13/2007 | |
| 699-25-33A | 1,2-Dichloroethane | 8260_VOA_GCMS | U | 0.11 | ug/L | 9/24/2007 | |
| 699-25-33A | 1,2-Dichloroethane | 8260_VOA_GCMS | U | 1 | ug/L | 2/26/2008 | |
| 699-25-33A | 1,2-Dichloroethane | 8260_VOA_GCMS | U | 1 | ug/L | 8/24/2008 | |
| 699-25-33A | 1,2-Dichloroethane | 8260_VOA_GCMS | U | 0.18 | ug/L | 11/3/2008 | |
| 699-25-33A | 1,2-Dichloroethane | 8260_VOA_GCMS | U | 1 | ug/L | 1/29/2009 | |
| 699-25-33A | 1,2-Dichloroethane | 8260_VOA_GCMS | U | 1 | ug/L | 7/20/2009 | |
| 699-25-33A | 1,2-Dichloroethene (Total) | 8260_VOA_GCMS | U | 0.14 | ug/L | 11/3/2008 | |
| 699-25-33A | 1,2-Dichloropropane | 8260_VOA_GCMS | U | 0.077 | ug/L | 11/3/2008 | |
| 699-25-33A | 1,4-Dichlorobenzene | 524.2_VOA_GCMS | U | 0.17 | ug/L | 8/24/1998 | |
| 699-25-33A | 1,4-Dichlorobenzene | 524.2_VOA_GCMS | U | 0.17 | ug/L | 2/8/1999 | |
| 699-25-33A | 1,4-Dichlorobenzene | 524.2_VOA_GCMS | U | 0.17 | ug/L | 8/16/1999 | |
| 699-25-33A | 1,4-Dichlorobenzene | 8010_VOA_GC | U | 0.2 | ug/L | 2/18/1997 | |
| 699-25-33A | 1,4-Dichlorobenzene | 8010_VOA_GC | U | 0.026 | ug/L | 8/13/1997 | |
| 699-25-33A | 1,4-Dichlorobenzene | 8010_VOA_GC | U | 0.026 | ug/L | 2/23/1998 | |
| 699-25-33A | 1,4-Dichlorobenzene | 8010_VOA_GC | U | 0.026 | ug/L | 2/23/1998 | |
| 699-25-33A | 1,4-Dichlorobenzene | 8020_VOA_GC | U | 0.2 | ug/L | 2/18/1997 | |

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|---|---|---|---|---|---|---|---|
| 699-25-33A | 1,4-Dichlorobenzene | 8020_VOA_GC | U | 0.028 | ug/L | 2/23/1998 | |
| 699-25-33A | 1,4-Dichlorobenzene | 8020_VOA_GC | U | 0.028 | ug/L | 2/23/1998 | |
| 699-25-33A | 1,4-Dichlorobenzene | 8260_VOA_GCMS | JB | 0.23 | ug/L | 2/29/2000 | |
| 699-25-33A | 1,4-Dichlorobenzene | 8260_VOA_GCMS | U | 0.14 | ug/L | 2/29/2000 | |
| 699-25-33A | 1,4-Dichlorobenzene | 8260_VOA_GCMS | U | 0.14 | ug/L | 10/6/2000 | |
| 699-25-33A | 1,4-Dichlorobenzene | 8260_VOA_GCMS | U | 0.14 | ug/L | 2/26/2001 | |
| 699-25-33A | 1,4-Dichlorobenzene | 8260_VOA_GCMS | U | 0.25 | ug/L | 8/14/2001 | |
| 699-25-33A | 1,4-Dichlorobenzene | 8260_VOA_GCMS | U | 0.25 | ug/L | 2/12/2002 | |
| 699-25-33A | 1,4-Dichlorobenzene | 8260_VOA_GCMS | U | 0.25 | ug/L | 9/3/2002 | |
| 699-25-33A | 1,4-Dichlorobenzene | 8260_VOA_GCMS | U | 0.11 | ug/L | 2/20/2003 | |
| 699-25-33A | 1,4-Dichlorobenzene | 8260_VOA_GCMS | U | 0.11 | ug/L | 8/18/2003 | |
| 699-25-33A | 1,4-Dichlorobenzene | 8260_VOA_GCMS | U | 0.11 | ug/L | 2/18/2004 | |
| 699-25-33A | 1,4-Dichlorobenzene | 8260_VOA_GCMS | U | 0.11 | ug/L | 8/31/2004 | |
| 699-25-33A | 1,4-Dichlorobenzene | 8260_VOA_GCMS | U | 0.09 | ug/L | 2/17/2005 | |
| 699-25-33A | 1,4-Dichlorobenzene | 8260_VOA_GCMS | U | 0.09 | ug/L | 8/2/2005 | |
| 699-25-33A | 1,4-Dichlorobenzene | 8260_VOA_GCMS | U | 0.2 | ug/L | 2/23/2006 | |
| 699-25-33A | 1,4-Dichlorobenzene | 8260_VOA_GCMS | U | 0.2 | ug/L | 9/1/2006 | |
| 699-25-33A | 1,4-Dichlorobenzene | 8260_VOA_GCMS | U | 0.2 | ug/L | 9/1/2006 | |
| 699-25-33A | 1,4-Dichlorobenzene | 8260_VOA_GCMS | U | 0.047 | ug/L | 2/13/2007 | |

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|---|---|---|---|---|---|---|---|
| 699-25-33A | 1,4-Dichlorobenzene | 8260_VOA_GCMS | U | 0.1 | ug/L | 9/24/2007 | |
| 699-25-33A | 1,4-Dichlorobenzene | 8260_VOA_GCMS | U | 1 | ug/L | 2/26/2008 | |
| 699-25-33A | 1,4-Dichlorobenzene | 8260_VOA_GCMS | U | 1 | ug/L | 8/24/2008 | |
| 699-25-33A | 1,4-Dichlorobenzene | 8260_VOA_GCMS | U | 0.1 | ug/L | 11/3/2008 | |
| 699-25-33A | 1,4-Dichlorobenzene | 8260_VOA_GCMS | U | 1 | ug/L | 1/29/2009 | |
| 699-25-33A | 1,4-Dichlorobenzene | 8260_VOA_GCMS | U | 1 | ug/L | 7/20/2009 | |
| 699-25-33A | 1,4-Dichlorobenzene | 8270_SVOA_GCMS | U | 1 | ug/L | 11/3/2008 | |
| 699-25-33A | 1,4-Dioxane | 8260_VOA_GCMS | U | 13 | ug/L | 2/12/2002 | |
| 699-25-33A | 1,4-Dioxane | 8260_VOA_GCMS | U | 13 | ug/L | 9/3/2002 | |
| 699-25-33A | 1,4-Dioxane | 8260_VOA_GCMS | U | 11 | ug/L | 2/20/2003 | |
| 699-25-33A | 1,4-Dioxane | 8260_VOA_GCMS | U | 11 | ug/L | 2/18/2004 | |
| 699-25-33A | 1,4-Dioxane | 8260_VOA_GCMS | U | 11 | ug/L | 8/31/2004 | |
| 699-25-33A | 1,4-Dioxane | 8260_VOA_GCMS | U | 2.6 | ug/L | 2/17/2005 | |
| 699-25-33A | 1,4-Dioxane | 8260_VOA_GCMS | U | 2.6 | ug/L | 8/2/2005 | |
| 699-25-33A | 1,4-Dioxane | 8260_VOA_GCMS | U | 12 | ug/L | 2/23/2006 | |
| 699-25-33A | 1,4-Dioxane | 8260_VOA_GCMS | U | 12 | ug/L | 9/1/2006 | |
| 699-25-33A | 1,4-Dioxane | 8260_VOA_GCMS | U | 12 | ug/L | 9/1/2006 | |
| 699-25-33A | 1,4-Dioxane | 8260_VOA_GCMS | U | 12 | ug/L | 2/13/2007 | |
| 699-25-33A | 1,4-Dioxane | 8260_VOA_GCMS | U | 12 | ug/L | 9/24/2007 | |
| 699-25-33A | 1,4-Dioxane | 8260_VOA_GCMS | U | 7 | ug/L | 11/3/2008 | |
| 699-25-33A | 1,4-Dioxane | 8270_SVOA_GCMS | U | 2 | ug/L | 8/24/2008 | |
| 699-25-33A | 1,4-Dioxane | 8270_SVOA_GCMS | U | 5 | ug/L | 11/3/2008 | |
| 699-25-33A | 1-Butanol | 8260_VOA_GCMS | U | 6.6 | ug/L | 2/29/2000 | |
| 699-25-33A | 1-Butanol | 8260_VOA_GCMS | U | 6.6 | ug/L | 2/29/2000 | |
| 699-25-33A | 1-Butanol | 8260_VOA_GCMS | U | 6.6 | ug/L | 10/6/2000 | |

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|---|---|---|---|---|---|---|---|
| 699-25-33A | 1-Butanol | 8260_VOA_GCMS | U | 6.6 | ug/L | 2/26/2001 | |
| 699-25-33A | 1-Butanol | 8260_VOA_GCMS | U | 4.9 | ug/L | 8/14/2001 | |
| 699-25-33A | 1-Butanol | 8260_VOA_GCMS | U | 4.9 | ug/L | 2/12/2002 | |
| 699-25-33A | 1-Butanol | 8260_VOA_GCMS | U | 4.9 | ug/L | 9/3/2002 | |
| 699-25-33A | 1-Butanol | 8260_VOA_GCMS | U | 4.6 | ug/L | 2/20/2003 | |
| 699-25-33A | 1-Butanol | 8260_VOA_GCMS | U | 4.6 | ug/L | 8/31/2004 | |
| 699-25-33A | 1-Butanol | 8260_VOA_GCMS | U | 1.1 | ug/L | 2/17/2005 | |
| 699-25-33A | 1-Butanol | 8260_VOA_GCMS | U | 1.1 | ug/L | 8/2/2005 | |
| 699-25-33A | 1-Butanol | 8260_VOA_GCMS | U | 2.6 | ug/L | 2/23/2006 | |
| 699-25-33A | 1-Butanol | 8260_VOA_GCMS | U | 2.6 | ug/L | 9/1/2006 | |
| 699-25-33A | 1-Butanol | 8260_VOA_GCMS | U | 2.6 | ug/L | 9/1/2006 | |
| 699-25-33A | 1-Butanol | 8260_VOA_GCMS | U | 14 | ug/L | 2/13/2007 | |
| 699-25-33A | 1-Butanol | 8260_VOA_GCMS | U | 14 | ug/L | 9/24/2007 | |
| 699-25-33A | 1-Butanol | 8260_VOA_GCMS | U | 100 | ug/L | 2/26/2008 | |
| 699-25-33A | 1-Butanol | 8260_VOA_GCMS | U | 100 | ug/L | 8/24/2008 | |
| 699-25-33A | 1-Butanol | 8260_VOA_GCMS | U | 14 | ug/L | 11/3/2008 | |
| 699-25-33A | 1-Butanol | 8260_VOA_GCMS | U | 100 | ug/L | 1/29/2009 | |
| 699-25-33A | 1-Butanol | 8260_VOA_GCMS | U | 100 | ug/L | 7/20/2009 | |
| 699-25-33A | 2,3,4,6-Tetrachlorophenol | 8040_PHENOLIC_GC | U | 4.8 | ug/L | 2/18/1997 | |
| 699-25-33A | 2,3,4,6-Tetrachlorophenol | 8040_PHENOLIC_GC | U | 1.4 | ug/L | 2/23/1998 | |
| 699-25-33A | 2,3,4,6-Tetrachlorophenol | 8040_PHENOLIC_GC | U | 1.4 | ug/L | 2/23/1998 | |
| 699-25-33A | 2,3,4,6-Tetrachlorophenol | 8040_PHENOLIC_GC | U | 2.1 | ug/L | 2/8/1999 | |
| 699-25-33A | 2,3,4,6-Tetrachlorophenol | 8040_PHENOLIC_GC | U | 2.1 | ug/L | 2/29/2000 | |
| 699-25-33A | 2,3,4,6-Tetrachlorophenol | 8040_PHENOLIC_GC | U | 2.1 | ug/L | 2/29/2000 | |
| 699-25-33A | 2,3,4,6-Tetrachlorophenol | 8040_PHENOLIC_GC | U | 4.9 | ug/L | 2/26/2001 | |

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|---|---|---|---|---|---|---|---|
| 699-25-33A | 2,3,4,6-Tetrachlorophenol | 8040_PHENOLIC_GC | U | 4.9 | ug/L | 2/12/2002 | |
| 699-25-33A | 2,3,4,6-Tetrachlorophenol | 8040_PHENOLIC_GC | U | 3.7 | ug/L | 2/20/2003 | |
| 699-25-33A | 2,3,4,6-Tetrachlorophenol | 8040_PHENOLIC_GC | U | 4.8 | ug/L | 2/18/2004 | |
| 699-25-33A | 2,3,4,6-Tetrachlorophenol | 8040_PHENOLIC_GC | U | 2.8 | ug/L | 2/17/2005 | |
| 699-25-33A | 2,3,4,6-Tetrachlorophenol | 8040_PHENOLIC_GC | U | 2 | ug/L | 2/23/2006 | |
| 699-25-33A | 2,3,4,6-Tetrachlorophenol | 8040_PHENOLIC_GC | U | 2 | ug/L | 2/13/2007 | |
| 699-25-33A | 2,3,4,6-Tetrachlorophenol | 8040_PHENOLIC_GC | U | 2 | ug/L | 2/26/2008 | |
| 699-25-33A | 2,3,4,6-Tetrachlorophenol | 8040_PHENOLIC_GC | U | 2 | ug/L | 1/29/2009 | |
| 699-25-33A | 2,4,5-Trichlorophenol | 8040_PHENOLIC_GC | U | 4.8 | ug/L | 2/18/1997 | |
| 699-25-33A | 2,4,5-Trichlorophenol | 8040_PHENOLIC_GC | U | 1.8 | ug/L | 2/23/1998 | |
| 699-25-33A | 2,4,5-Trichlorophenol | 8040_PHENOLIC_GC | U | 1.8 | ug/L | 2/23/1998 | |
| 699-25-33A | 2,4,5-Trichlorophenol | 8040_PHENOLIC_GC | U | 4.7 | ug/L | 2/8/1999 | |
| 699-25-33A | 2,4,5-Trichlorophenol | 8040_PHENOLIC_GC | U | 4.7 | ug/L | 2/29/2000 | |
| 699-25-33A | 2,4,5-Trichlorophenol | 8040_PHENOLIC_GC | U | 4.7 | ug/L | 2/29/2000 | |
| 699-25-33A | 2,4,5-Trichlorophenol | 8040_PHENOLIC_GC | U | 3.5 | ug/L | 2/26/2001 | |
| 699-25-33A | 2,4,5-Trichlorophenol | 8040_PHENOLIC_GC | U | 3.5 | ug/L | 2/12/2002 | |
| 699-25-33A | 2,4,5-Trichlorophenol | 8040_PHENOLIC_GC | U | 2.9 | ug/L | 2/20/2003 | |
| 699-25-33A | 2,4,5-Trichlorophenol | 8040_PHENOLIC_GC | U | 4.6 | ug/L | 2/18/2004 | |
| 699-25-33A | 2,4,5-Trichlorophenol | 8040_PHENOLIC_GC | U | 3 | ug/L | 2/17/2005 | |

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|---|---|---|---|---|---|---|---|
| 699-25-33A | 2,4,5-Trichlorophenol | 8040_PHENOLIC_GC | U | 2.2 | ug/L | 2/23/2006 | |
| 699-25-33A | 2,4,5-Trichlorophenol | 8040_PHENOLIC_GC | U | 2.2 | ug/L | 2/13/2007 | |
| 699-25-33A | 2,4,5-Trichlorophenol | 8040_PHENOLIC_GC | U | 2.2 | ug/L | 2/26/2008 | |
| 699-25-33A | 2,4,5-Trichlorophenol | 8040_PHENOLIC_GC | U | 2.2 | ug/L | 1/29/2009 | |
| 699-25-33A | 2,4,6-Trichlorophenol | 8040_PHENOLIC_GC | U | 4.8 | ug/L | 2/18/1997 | |
| 699-25-33A | 2,4,6-Trichlorophenol | 8040_PHENOLIC_GC | U | 2.4 | ug/L | 2/23/1998 | |
| 699-25-33A | 2,4,6-Trichlorophenol | 8040_PHENOLIC_GC | U | 2.4 | ug/L | 2/23/1998 | |
| 699-25-33A | 2,4,6-Trichlorophenol | 8040_PHENOLIC_GC | U | 5 | ug/L | 2/8/1999 | |
| 699-25-33A | 2,4,6-Trichlorophenol | 8040_PHENOLIC_GC | U | 5 | ug/L | 2/29/2000 | |
| 699-25-33A | 2,4,6-Trichlorophenol | 8040_PHENOLIC_GC | U | 5 | ug/L | 2/29/2000 | |
| 699-25-33A | 2,4,6-Trichlorophenol | 8040_PHENOLIC_GC | U | 4.4 | ug/L | 2/26/2001 | |
| 699-25-33A | 2,4,6-Trichlorophenol | 8040_PHENOLIC_GC | U | 4.4 | ug/L | 2/12/2002 | |
| 699-25-33A | 2,4,6-Trichlorophenol | 8040_PHENOLIC_GC | U | 2.6 | ug/L | 2/20/2003 | |
| 699-25-33A | 2,4,6-Trichlorophenol | 8040_PHENOLIC_GC | U | 4.1 | ug/L | 2/18/2004 | |
| 699-25-33A | 2,4,6-Trichlorophenol | 8040_PHENOLIC_GC | U | 3.2 | ug/L | 2/17/2005 | |
| 699-25-33A | 2,4,6-Trichlorophenol | 8040_PHENOLIC_GC | U | 2.2 | ug/L | 2/23/2006 | |
| 699-25-33A | 2,4,6-Trichlorophenol | 8040_PHENOLIC_GC | U | 2.2 | ug/L | 2/13/2007 | |
| 699-25-33A | 2,4,6-Trichlorophenol | 8040_PHENOLIC_GC | U | 2.2 | ug/L | 2/26/2008 | |
| 699-25-33A | 2,4,6-Trichlorophenol | 8040_PHENOLIC_GC | U | 2.2 | ug/L | 1/29/2009 | |

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|---|---|---|---|---|---|---|---|
| 699-25-33A | 2,4-Dichlorophenol | 8040_PHENOLIC_GC | U | 4.8 | ug/L | 2/18/1997 | |
| 699-25-33A | 2,4-Dichlorophenol | 8040_PHENOLIC_GC | U | 1.9 | ug/L | 2/23/1998 | |
| 699-25-33A | 2,4-Dichlorophenol | 8040_PHENOLIC_GC | U | 1.9 | ug/L | 2/23/1998 | |
| 699-25-33A | 2,4-Dichlorophenol | 8040_PHENOLIC_GC | U | 1.2 | ug/L | 2/8/1999 | |
| 699-25-33A | 2,4-Dichlorophenol | 8040_PHENOLIC_GC | U | 1.2 | ug/L | 2/29/2000 | |
| 699-25-33A | 2,4-Dichlorophenol | 8040_PHENOLIC_GC | U | 1.2 | ug/L | 2/29/2000 | |
| 699-25-33A | 2,4-Dichlorophenol | 8040_PHENOLIC_GC | U | 2.9 | ug/L | 2/26/2001 | |
| 699-25-33A | 2,4-Dichlorophenol | 8040_PHENOLIC_GC | U | 2.9 | ug/L | 2/12/2002 | |
| 699-25-33A | 2,4-Dichlorophenol | 8040_PHENOLIC_GC | U | 2.9 | ug/L | 2/20/2003 | |
| 699-25-33A | 2,4-Dichlorophenol | 8040_PHENOLIC_GC | U | 3 | ug/L | 2/18/2004 | |
| 699-25-33A | 2,4-Dichlorophenol | 8040_PHENOLIC_GC | U | 3.1 | ug/L | 2/17/2005 | |
| 699-25-33A | 2,4-Dichlorophenol | 8040_PHENOLIC_GC | U | 2.1 | ug/L | 2/23/2006 | |
| 699-25-33A | 2,4-Dichlorophenol | 8040_PHENOLIC_GC | U | 2.1 | ug/L | 2/13/2007 | |
| 699-25-33A | 2,4-Dichlorophenol | 8040_PHENOLIC_GC | U | 2.1 | ug/L | 2/26/2008 | |
| 699-25-33A | 2,4-Dichlorophenol | 8040_PHENOLIC_GC | U | 2.1 | ug/L | 1/29/2009 | |
| 699-25-33A | 2,4-Dichlorophenol | 8270_SVOA_GCMS | U | 1 | ug/L | 11/3/2008 | |
| 699-25-33A | 2,4-Dimethylphenol | 8040_PHENOLIC_GC | U | 4.8 | ug/L | 2/18/1997 | |
| 699-25-33A | 2,4-Dimethylphenol | 8040_PHENOLIC_GC | U | 1.8 | ug/L | 2/23/1998 | |
| 699-25-33A | 2,4-Dimethylphenol | 8040_PHENOLIC_GC | U | 1.8 | ug/L | 2/23/1998 | |

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|---|---|---|---|---|---|---|---|
| 699-25-33A | 2,4-Dimethylphenol | 8040_PHENOLIC_GC | U | 2.9 | ug/L | 2/8/1999 | |
| 699-25-33A | 2,4-Dimethylphenol | 8040_PHENOLIC_GC | U | 2.9 | ug/L | 2/29/2000 | |
| 699-25-33A | 2,4-Dimethylphenol | 8040_PHENOLIC_GC | U | 2.9 | ug/L | 2/29/2000 | |
| 699-25-33A | 2,4-Dimethylphenol | 8040_PHENOLIC_GC | U | 4 | ug/L | 2/26/2001 | |
| 699-25-33A | 2,4-Dimethylphenol | 8040_PHENOLIC_GC | U | 4 | ug/L | 2/12/2002 | |
| 699-25-33A | 2,4-Dimethylphenol | 8040_PHENOLIC_GC | U | 3.8 | ug/L | 2/20/2003 | |
| 699-25-33A | 2,4-Dimethylphenol | 8040_PHENOLIC_GC | U | 2.8 | ug/L | 2/18/2004 | |
| 699-25-33A | 2,4-Dimethylphenol | 8040_PHENOLIC_GC | U | 2.9 | ug/L | 2/17/2005 | |
| 699-25-33A | 2,4-Dimethylphenol | 8040_PHENOLIC_GC | U | 2.1 | ug/L | 2/23/2006 | |
| 699-25-33A | 2,4-Dimethylphenol | 8040_PHENOLIC_GC | U | 2.1 | ug/L | 2/13/2007 | |
| 699-25-33A | 2,4-Dimethylphenol | 8040_PHENOLIC_GC | U | 2.1 | ug/L | 2/26/2008 | |
| 699-25-33A | 2,4-Dimethylphenol | 8040_PHENOLIC_GC | U | 2.1 | ug/L | 1/29/2009 | |
| 699-25-33A | 2,4-Dinitrophenol | 8040_PHENOLIC_GC | U | 4.8 | ug/L | 2/18/1997 | |
| 699-25-33A | 2,4-Dinitrophenol | 8040_PHENOLIC_GC | J | 0.78 | ug/L | 2/23/1998 | /Associated with suspect field blank analysis |
| 699-25-33A | 2,4-Dinitrophenol | 8040_PHENOLIC_GC | J | 2.5 | ug/L | 2/23/1998 | /Associated with suspect field blank analysis |
| 699-25-33A | 2,4-Dinitrophenol | 8040_PHENOLIC_GC | U | 1.8 | ug/L | 2/8/1999 | |
| 699-25-33A | 2,4-Dinitrophenol | 8040_PHENOLIC_GC | U | 1.8 | ug/L | 2/29/2000 | |
| 699-25-33A | 2,4-Dinitrophenol | 8040_PHENOLIC_GC | U | 1.8 | ug/L | 2/29/2000 | |
| 699-25-33A | 2,4-Dinitrophenol | 8040_PHENOLIC_GC | U | 3.2 | ug/L | 2/26/2001 | |
| 699-25-33A | 2,4-Dinitrophenol | 8040_PHENOLIC_GC | U | 3.2 | ug/L | 2/12/2002 | |

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|---|---|---|---|---|---|---|---|
| 699-25-33A | 2,4-Dinitrophenol | 8040_PHENOLIC_GC | U | 3.4 | ug/L | 2/20/2003 | |
| 699-25-33A | 2,4-Dinitrophenol | 8040_PHENOLIC_GC | U | 3.4 | ug/L | 2/18/2004 | |
| 699-25-33A | 2,4-Dinitrophenol | 8040_PHENOLIC_GC | U | 2.9 | ug/L | 2/17/2005 | |
| 699-25-33A | 2,4-Dinitrophenol | 8040_PHENOLIC_GC | U | 2.4 | ug/L | 2/23/2006 | |
| 699-25-33A | 2,4-Dinitrophenol | 8040_PHENOLIC_GC | U | 2.4 | ug/L | 2/13/2007 | |
| 699-25-33A | 2,4-Dinitrophenol | 8040_PHENOLIC_GC | U | 2.4 | ug/L | 2/26/2008 | |
| 699-25-33A | 2,4-Dinitrophenol | 8040_PHENOLIC_GC | U | 2.4 | ug/L | 1/29/2009 | |
| 699-25-33A | 2,4-Dinitrophenol | 8270_SVOA_GCMS | U | 2 | ug/L | 11/3/2008 | |
| 699-25-33A | 2,6-Dichlorophenol | 8040_PHENOLIC_GC | U | 4.8 | ug/L | 2/18/1997 | |
| 699-25-33A | 2,6-Dichlorophenol | 8040_PHENOLIC_GC | U | 1.9 | ug/L | 2/23/1998 | |
| 699-25-33A | 2,6-Dichlorophenol | 8040_PHENOLIC_GC | U | 1.9 | ug/L | 2/23/1998 | |
| 699-25-33A | 2,6-Dichlorophenol | 8040_PHENOLIC_GC | U | 1.1 | ug/L | 2/8/1999 | |
| 699-25-33A | 2,6-Dichlorophenol | 8040_PHENOLIC_GC | U | 1.1 | ug/L | 2/29/2000 | |
| 699-25-33A | 2,6-Dichlorophenol | 8040_PHENOLIC_GC | U | 1.1 | ug/L | 2/29/2000 | |
| 699-25-33A | 2,6-Dichlorophenol | 8040_PHENOLIC_GC | U | 2.9 | ug/L | 2/26/2001 | |
| 699-25-33A | 2,6-Dichlorophenol | 8040_PHENOLIC_GC | U | 2.9 | ug/L | 2/12/2002 | |
| 699-25-33A | 2,6-Dichlorophenol | 8040_PHENOLIC_GC | U | 2.7 | ug/L | 2/20/2003 | |
| 699-25-33A | 2,6-Dichlorophenol | 8040_PHENOLIC_GC | U | 3.3 | ug/L | 2/18/2004 | |
| 699-25-33A | 2,6-Dichlorophenol | 8040_PHENOLIC_GC | U | 3.1 | ug/L | 2/17/2005 | |
| 699-25-33A | 2,6-Dichlorophenol | 8040_PHENOLIC_GC | U | 2.1 | ug/L | 2/23/2006 | |
| 699-25-33A | 2,6-Dichlorophenol | 8040_PHENOLIC_GC | U | 2.1 | ug/L | 2/13/2007 | |

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|---|---|---|---|---|---|---|---|
| 699-25-33A | 2,6-Dichlorophenol | 8040_PHENOLIC_GC | U | 2.1 | ug/L | 2/26/2008 | |
| 699-25-33A | 2,6-Dichlorophenol | 8040_PHENOLIC_GC | U | 2.1 | ug/L | 1/29/2009 | |
| 699-25-33A | 2-Butanone | 8260_VOA_GCMS | U | 0.7 | ug/L | 2/29/2000 | |
| 699-25-33A | 2-Butanone | 8260_VOA_GCMS | U | 0.7 | ug/L | 2/29/2000 | |
| 699-25-33A | 2-Butanone | 8260_VOA_GCMS | U | 0.7 | ug/L | 10/6/2000 | |
| 699-25-33A | 2-Butanone | 8260_VOA_GCMS | U | 0.7 | ug/L | 2/26/2001 | |
| 699-25-33A | 2-Butanone | 8260_VOA_GCMS | U | 0.39 | ug/L | 8/14/2001 | |
| 699-25-33A | 2-Butanone | 8260_VOA_GCMS | U | 0.39 | ug/L | 2/12/2002 | /Associated with suspect field blank (FXR659) |
| 699-25-33A | 2-Butanone | 8260_VOA_GCMS | U | 0.39 | ug/L | 9/3/2002 | |
| 699-25-33A | 2-Butanone | 8260_VOA_GCMS | U | 0.29 | ug/L | 2/20/2003 | |
| 699-25-33A | 2-Butanone | 8260_VOA_GCMS | U | 0.29 | ug/L | 8/18/2003 | |
| 699-25-33A | 2-Butanone | 8260_VOA_GCMS | U | 0.29 | ug/L | 2/18/2004 | |
| 699-25-33A | 2-Butanone | 8260_VOA_GCMS | U | 0.1 | ug/L | 8/31/2004 | |
| 699-25-33A | 2-Butanone | 8260_VOA_GCMS | U | 0.33 | ug/L | 2/17/2005 | |
| 699-25-33A | 2-Butanone | 8260_VOA_GCMS | U | 0.33 | ug/L | 8/2/2005 | |
| 699-25-33A | 2-Butanone | 8260_VOA_GCMS | U | 0.56 | ug/L | 2/23/2006 | |
| 699-25-33A | 2-Butanone | 8260_VOA_GCMS | U | 0.56 | ug/L | 9/1/2006 | |
| 699-25-33A | 2-Butanone | 8260_VOA_GCMS | U | 0.56 | ug/L | 9/1/2006 | |
| 699-25-33A | 2-Butanone | 8260_VOA_GCMS | U | 1.8 | ug/L | 2/13/2007 | |
| 699-25-33A | 2-Butanone | 8260_VOA_GCMS | U | 1.8 | ug/L | 9/24/2007 | |
| 699-25-33A | 2-Butanone | 8260_VOA_GCMS | U | 1 | ug/L | 2/26/2008 | |
| 699-25-33A | 2-Butanone | 8260_VOA_GCMS | U | 1 | ug/L | 8/24/2008 | |
| 699-25-33A | 2-Butanone | 8260_VOA_GCMS | U | 0.96 | ug/L | 11/3/2008 | |
| 699-25-33A | 2-Butanone | 8260_VOA_GCMS | U | 1 | ug/L | 1/29/2009 | |
| 699-25-33A | 2-Butanone | 8260_VOA_GCMS | U | 1 | ug/L | 7/20/2009 | |
| 699-25-33A | 2-Chlorophenol | 8040_PHENOLIC_GC | U | 4.8 | ug/L | 2/18/1997 | |

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|---|---|---|---|---|---|---|---|
| 699-25-33A | 2-Chlorophenol | 8040_PHENOLIC_GC | U | 1.9 | ug/L | 2/23/1998 | |
| 699-25-33A | 2-Chlorophenol | 8040_PHENOLIC_GC | U | 1.9 | ug/L | 2/23/1998 | |
| 699-25-33A | 2-Chlorophenol | 8040_PHENOLIC_GC | U | 2.1 | ug/L | 2/8/1999 | |
| 699-25-33A | 2-Chlorophenol | 8040_PHENOLIC_GC | U | 2.1 | ug/L | 2/29/2000 | |
| 699-25-33A | 2-Chlorophenol | 8040_PHENOLIC_GC | U | 2.1 | ug/L | 2/29/2000 | |
| 699-25-33A | 2-Chlorophenol | 8040_PHENOLIC_GC | U | 2.7 | ug/L | 2/26/2001 | |
| 699-25-33A | 2-Chlorophenol | 8040_PHENOLIC_GC | U | 2.7 | ug/L | 2/12/2002 | |
| 699-25-33A | 2-Chlorophenol | 8040_PHENOLIC_GC | U | 2.6 | ug/L | 2/20/2003 | |
| 699-25-33A | 2-Chlorophenol | 8040_PHENOLIC_GC | U | 3.2 | ug/L | 2/18/2004 | |
| 699-25-33A | 2-Chlorophenol | 8040_PHENOLIC_GC | U | 2.9 | ug/L | 2/17/2005 | |
| 699-25-33A | 2-Chlorophenol | 8040_PHENOLIC_GC | U | 2.2 | ug/L | 2/23/2006 | |
| 699-25-33A | 2-Chlorophenol | 8040_PHENOLIC_GC | U | 2.2 | ug/L | 2/13/2007 | |
| 699-25-33A | 2-Chlorophenol | 8040_PHENOLIC_GC | U | 2.2 | ug/L | 2/26/2008 | |
| 699-25-33A | 2-Chlorophenol | 8040_PHENOLIC_GC | U | 2.2 | ug/L | 1/29/2009 | |
| 699-25-33A | 2-Hexanone | 8260_VOA_GCMS | U | 0.08 | ug/L | 11/3/2008 | |
| 699-25-33A | 2-Methylphenol (cresol, o-) | 8040_PHENOLIC_GC | U | 4.8 | ug/L | 2/18/1997 | |
| 699-25-33A | 2-Methylphenol (cresol, o-) | 8040_PHENOLIC_GC | U | 1.8 | ug/L | 2/23/1998 | |
| 699-25-33A | 2-Methylphenol (cresol, o-) | 8040_PHENOLIC_GC | U | 1.8 | ug/L | 2/23/1998 | |
| 699-25-33A | 2-Methylphenol (cresol, o-) | 8040_PHENOLIC_GC | U | 2.4 | ug/L | 2/8/1999 | |

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|---|---|---|---|---|---|---|---|
| 699-25-33A | 2-Methylphenol (cresol, o-) | 8040_PHENOLIC_GC | U | 2.4 | ug/L | 2/29/2000 | |
| 699-25-33A | 2-Methylphenol (cresol, o-) | 8040_PHENOLIC_GC | U | 2.4 | ug/L | 2/29/2000 | |
| 699-25-33A | 2-Methylphenol (cresol, o-) | 8040_PHENOLIC_GC | U | 2.3 | ug/L | 2/26/2001 | |
| 699-25-33A | 2-Methylphenol (cresol, o-) | 8040_PHENOLIC_GC | U | 2.3 | ug/L | 2/12/2002 | |
| 699-25-33A | 2-Methylphenol (cresol, o-) | 8040_PHENOLIC_GC | U | 2.8 | ug/L | 2/20/2003 | |
| 699-25-33A | 2-Methylphenol (cresol, o-) | 8040_PHENOLIC_GC | U | 4 | ug/L | 2/18/2004 | |
| 699-25-33A | 2-Methylphenol (cresol, o-) | 8040_PHENOLIC_GC | U | 3 | ug/L | 2/17/2005 | |
| 699-25-33A | 2-Methylphenol (cresol, o-) | 8040_PHENOLIC_GC | U | 2.2 | ug/L | 2/23/2006 | |
| 699-25-33A | 2-Methylphenol (cresol, o-) | 8040_PHENOLIC_GC | U | 2.2 | ug/L | 2/13/2007 | |
| 699-25-33A | 2-Methylphenol (cresol, o-) | 8040_PHENOLIC_GC | U | 2.2 | ug/L | 2/26/2008 | |
| 699-25-33A | 2-Methylphenol (cresol, o-) | 8040_PHENOLIC_GC | U | 2.2 | ug/L | 1/29/2009 | |
| 699-25-33A | 2-Methylphenol (cresol, o-) | 8270_SVOA_GCMS | U | 2 | ug/L | 11/3/2008 | |
| 699-25-33A | 2-Nitrophenol | 8040_PHENOLIC_GC | U | 4.8 | ug/L | 2/18/1997 | |
| 699-25-33A | 2-Nitrophenol | 8040_PHENOLIC_GC | U | 1.5 | ug/L | 2/23/1998 | |
| 699-25-33A | 2-Nitrophenol | 8040_PHENOLIC_GC | U | 1.5 | ug/L | 2/23/1998 | |
| 699-25-33A | 2-Nitrophenol | 8040_PHENOLIC_GC | U | 1.9 | ug/L | 2/8/1999 | |
| 699-25-33A | 2-Nitrophenol | 8040_PHENOLIC_GC | U | 1.9 | ug/L | 2/29/2000 | |
| 699-25-33A | 2-Nitrophenol | 8040_PHENOLIC_GC | U | 1.9 | ug/L | 2/29/2000 | |
| 699-25-33A | 2-Nitrophenol | 8040_PHENOLIC_GC | U | 3.2 | ug/L | 2/26/2001 | |
| 699-25-33A | 2-Nitrophenol | 8040_PHENOLIC_GC | U | 3.2 | ug/L | 2/12/2002 | |
| 699-25-33A | 2-Nitrophenol | 8040_PHENOLIC_GC | U | 2.6 | ug/L | 2/20/2003 | |
| 699-25-33A | 2-Nitrophenol | 8040_PHENOLIC_GC | U | 3.2 | ug/L | 2/18/2004 | |

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|---|---|---|---|---|---|---|---|
| 699-25-33A | 2-Nitrophenol | 8040_PHENOLIC_GC | U | 3.3 | ug/L | 2/17/2005 | |
| 699-25-33A | 2-Nitrophenol | 8040_PHENOLIC_GC | U | 2.3 | ug/L | 2/23/2006 | |
| 699-25-33A | 2-Nitrophenol | 8040_PHENOLIC_GC | U | 2.3 | ug/L | 2/13/2007 | |
| 699-25-33A | 2-Nitrophenol | 8040_PHENOLIC_GC | U | 2.3 | ug/L | 2/26/2008 | |
| 699-25-33A | 2-Nitrophenol | 8040_PHENOLIC_GC | U | 2.3 | ug/L | 1/29/2009 | |
| 699-25-33A | 2-Nitrophenol | 8270_SVOA_GCMS | U | 1 | ug/L | 11/3/2008 | |
| 699-25-33A | 2-Pentanone, 4-Methyl | 8260_VOA_GCMS | U | 1.3 | ug/L | 2/29/2000 | |
| 699-25-33A | 2-Pentanone, 4-Methyl | 8260_VOA_GCMS | U | 1.3 | ug/L | 2/29/2000 | |
| 699-25-33A | 2-Pentanone, 4-Methyl | 8260_VOA_GCMS | U | 1.3 | ug/L | 10/6/2000 | |
| 699-25-33A | 2-Pentanone, 4-Methyl | 8260_VOA_GCMS | U | 1.3 | ug/L | 2/26/2001 | |
| 699-25-33A | 2-Pentanone, 4-Methyl | 8260_VOA_GCMS | U | 0.42 | ug/L | 8/14/2001 | |
| 699-25-33A | 2-Pentanone, 4-Methyl | 8260_VOA_GCMS | U | 0.42 | ug/L | 2/12/2002 | |
| 699-25-33A | 2-Pentanone, 4-Methyl | 8260_VOA_GCMS | U | 0.42 | ug/L | 9/3/2002 | |
| 699-25-33A | 2-Pentanone, 4-Methyl | 8260_VOA_GCMS | U | 0.35 | ug/L | 2/20/2003 | |
| 699-25-33A | 2-Pentanone, 4-Methyl | 8260_VOA_GCMS | U | 0.35 | ug/L | 8/18/2003 | |
| 699-25-33A | 2-Pentanone, 4-Methyl | 8260_VOA_GCMS | U | 0.35 | ug/L | 2/18/2004 | |
| 699-25-33A | 2-Pentanone, 4-Methyl | 8260_VOA_GCMS | U | 0.19 | ug/L | 8/31/2004 | |
| 699-25-33A | 2-Pentanone, 4-Methyl | 8260_VOA_GCMS | U | 0.1 | ug/L | 2/17/2005 | |
| 699-25-33A | 2-Pentanone, 4-Methyl | 8260_VOA_GCMS | U | 0.1 | ug/L | 8/2/2005 | |
| 699-25-33A | 2-Pentanone, 4-Methyl | 8260_VOA_GCMS | U | 0.53 | ug/L | 2/23/2006 | |
| 699-25-33A | 2-Pentanone, 4-Methyl | 8260_VOA_GCMS | U | 0.53 | ug/L | 9/1/2006 | |

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|---|---|---|---|---|---|---|---|
| 699-25-33A | 2-Pentanone, 4-Methyl | 8260_VOA_GCMS | U | 0.53 | ug/L | 9/1/2006 | |
| 699-25-33A | 2-Pentanone, 4-Methyl | 8260_VOA_GCMS | U | 0.21 | ug/L | 2/13/2007 | |
| 699-25-33A | 2-Pentanone, 4-Methyl | 8260_VOA_GCMS | U | 0.21 | ug/L | 9/24/2007 | |
| 699-25-33A | 2-Pentanone, 4-Methyl | 8260_VOA_GCMS | U | 1 | ug/L | 2/26/2008 | |
| 699-25-33A | 2-Pentanone, 4-Methyl | 8260_VOA_GCMS | U | 1 | ug/L | 8/24/2008 | |
| 699-25-33A | 2-Pentanone, 4-Methyl | 8260_VOA_GCMS | U | 0.72 | ug/L | 11/3/2008 | |
| 699-25-33A | 2-Pentanone, 4-Methyl | 8260_VOA_GCMS | U | 1 | ug/L | 1/29/2009 | |
| 699-25-33A | 2-Pentanone, 4-Methyl | 8260_VOA_GCMS | U | 1 | ug/L | 7/20/2009 | |
| 699-25-33A | 2-Picoline | 8270_SVOA_GCMS | U | 1 | ug/L | 11/3/2008 | |
| 699-25-33A | 3+4 Methylphenol (cresol, m+p) | 8040_PHENOLIC_GC | U | 4.8 | ug/L | 2/18/1997 | |
| 699-25-33A | 3+4 Methylphenol (cresol, m+p) | 8040_PHENOLIC_GC | U | 3.5 | ug/L | 2/23/1998 | |
| 699-25-33A | 3+4 Methylphenol (cresol, m+p) | 8040_PHENOLIC_GC | U | 3.5 | ug/L | 2/23/1998 | |
| 699-25-33A | 3+4 Methylphenol (cresol, m+p) | 8040_PHENOLIC_GC | U | 3.5 | ug/L | 2/8/1999 | |
| 699-25-33A | 3+4 Methylphenol (cresol, m+p) | 8040_PHENOLIC_GC | U | 3.5 | ug/L | 2/29/2000 | |
| 699-25-33A | 3+4 Methylphenol (cresol, m+p) | 8040_PHENOLIC_GC | U | 3.5 | ug/L | 2/29/2000 | |
| 699-25-33A | 3+4 Methylphenol (cresol, m+p) | 8040_PHENOLIC_GC | U | 4.4 | ug/L | 2/26/2001 | |
| 699-25-33A | 3+4 Methylphenol (cresol, m+p) | 8040_PHENOLIC_GC | U | 4.4 | ug/L | 2/12/2002 | |

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|---|---|---|---|---|---|---|---|
| 699-25-33A | 3+4 Methylphenol (cresol, m+p) | 8040_PHENOLIC_GC | U | 2.8 | ug/L | 2/20/2003 | |
| 699-25-33A | 3+4 Methylphenol (cresol, m+p) | 8040_PHENOLIC_GC | U | 2.8 | ug/L | 2/18/2004 | |
| 699-25-33A | 3+4 Methylphenol (cresol, m+p) | 8040_PHENOLIC_GC | U | 2.9 | ug/L | 2/17/2005 | |
| 699-25-33A | 3+4 Methylphenol (cresol, m+p) | 8040_PHENOLIC_GC | U | 2.2 | ug/L | 2/23/2006 | |
| 699-25-33A | 3+4 Methylphenol (cresol, m+p) | 8040_PHENOLIC_GC | U | 2.2 | ug/L | 2/13/2007 | |
| 699-25-33A | 3+4 Methylphenol (cresol, m+p) | 8040_PHENOLIC_GC | U | 2.2 | ug/L | 2/26/2008 | |
| 699-25-33A | 3+4 Methylphenol (cresol, m+p) | 8040_PHENOLIC_GC | U | 2.2 | ug/L | 1/29/2009 | |
| 699-25-33A | 3+4 Methylphenol (cresol, m+p) | 8270_SVOA_GCMS | U | 1 | ug/L | 11/3/2008 | |
| 699-25-33A | 4,4'-DDD (Dichlorodiphenyldichloroethane) | 8081_PEST_GC | U | 0.0038 | ug/L | 11/3/2008 | |
| 699-25-33A | 4,4'-DDE (Dichlorodiphenyldichloroethylene) | 8081_PEST_GC | U | 0.0027 | ug/L | 11/3/2008 | |
| 699-25-33A | 4,4'-DDT (Dichlorodiphenyltrichloroethane) | 8081_PEST_GC | U | 0.0056 | ug/L | 11/3/2008 | |
| 699-25-33A | 4,6-Dinitro-2-methylphenol | 8040_PHENOLIC_GC | U | 4.8 | ug/L | 2/18/1997 | |
| 699-25-33A | 4,6-Dinitro-2-methylphenol | 8040_PHENOLIC_GC | U | 0.46 | ug/L | 2/23/1998 | |
| 699-25-33A | 4,6-Dinitro-2-methylphenol | 8040_PHENOLIC_GC | U | 0.46 | ug/L | 2/23/1998 | |
| 699-25-33A | 4,6-Dinitro-2-methylphenol | 8040_PHENOLIC_GC | U | 1.4 | ug/L | 2/8/1999 | |

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|---|---|---|---|---|---|---|---|
| 699-25-33A | 4,6-Dinitro-2-methylphenol | 8040_PHENOLIC_GC | U | 1.4 | ug/L | 2/29/2000 | |
| 699-25-33A | 4,6-Dinitro-2-methylphenol | 8040_PHENOLIC_GC | U | 1.4 | ug/L | 2/29/2000 | |
| 699-25-33A | 4,6-Dinitro-2-methylphenol | 8040_PHENOLIC_GC | U | 3.3 | ug/L | 2/26/2001 | |
| 699-25-33A | 4,6-Dinitro-2-methylphenol | 8040_PHENOLIC_GC | U | 3.3 | ug/L | 2/12/2002 | |
| 699-25-33A | 4,6-Dinitro-2-methylphenol | 8040_PHENOLIC_GC | U | 4 | ug/L | 2/20/2003 | |
| 699-25-33A | 4,6-Dinitro-2-methylphenol | 8040_PHENOLIC_GC | U | 4 | ug/L | 2/18/2004 | |
| 699-25-33A | 4,6-Dinitro-2-methylphenol | 8040_PHENOLIC_GC | U | 2.6 | ug/L | 2/17/2005 | |
| 699-25-33A | 4,6-Dinitro-2-methylphenol | 8040_PHENOLIC_GC | U | 2.2 | ug/L | 2/23/2006 | |
| 699-25-33A | 4,6-Dinitro-2-methylphenol | 8040_PHENOLIC_GC | U | 2.2 | ug/L | 2/13/2007 | |
| 699-25-33A | 4,6-Dinitro-2-methylphenol | 8040_PHENOLIC_GC | U | 2.2 | ug/L | 2/26/2008 | |
| 699-25-33A | 4,6-Dinitro-2-methylphenol | 8040_PHENOLIC_GC | UN | 2.2 | ug/L | 1/29/2009 | |
| 699-25-33A | 4-Chloro-3-methylphenol | 8040_PHENOLIC_GC | U | 4.8 | ug/L | 2/18/1997 | |
| 699-25-33A | 4-Chloro-3-methylphenol | 8040_PHENOLIC_GC | U | 2 | ug/L | 2/23/1998 | |
| 699-25-33A | 4-Chloro-3-methylphenol | 8040_PHENOLIC_GC | U | 2 | ug/L | 2/23/1998 | |
| 699-25-33A | 4-Chloro-3-methylphenol | 8040_PHENOLIC_GC | U | 1 | ug/L | 2/8/1999 | |
| 699-25-33A | 4-Chloro-3-methylphenol | 8040_PHENOLIC_GC | U | 1 | ug/L | 2/29/2000 | |
| 699-25-33A | 4-Chloro-3-methylphenol | 8040_PHENOLIC_GC | U | 1 | ug/L | 2/29/2000 | |
| 699-25-33A | 4-Chloro-3-methylphenol | 8040_PHENOLIC_GC | U | 3.3 | ug/L | 2/26/2001 | |
| 699-25-33A | 4-Chloro-3-methylphenol | 8040_PHENOLIC_GC | U | 3.3 | ug/L | 2/12/2002 | |

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|---|---|---|---|---|---|---|---|
| 699-25-33A | 4-Chloro-3-methylphenol | 8040_PHENOLIC_GC | U | 2.8 | ug/L | 2/20/2003 | |
| 699-25-33A | 4-Chloro-3-methylphenol | 8040_PHENOLIC_GC | U | 2.8 | ug/L | 2/18/2004 | |
| 699-25-33A | 4-Chloro-3-methylphenol | 8040_PHENOLIC_GC | U | 3.2 | ug/L | 2/17/2005 | |
| 699-25-33A | 4-Chloro-3-methylphenol | 8040_PHENOLIC_GC | U | 2.4 | ug/L | 2/23/2006 | |
| 699-25-33A | 4-Chloro-3-methylphenol | 8040_PHENOLIC_GC | U | 2.4 | ug/L | 2/13/2007 | |
| 699-25-33A | 4-Chloro-3-methylphenol | 8040_PHENOLIC_GC | U | 2.4 | ug/L | 2/26/2008 | |
| 699-25-33A | 4-Chloro-3-methylphenol | 8040_PHENOLIC_GC | U | 2.4 | ug/L | 1/29/2009 | |
| 699-25-33A | 4-Nitrophenol | 8040_PHENOLIC_GC | U | 4.8 | ug/L | 2/18/1997 | |
| 699-25-33A | 4-Nitrophenol | 8040_PHENOLIC_GC | U | 0.7 | ug/L | 2/23/1998 | |
| 699-25-33A | 4-Nitrophenol | 8040_PHENOLIC_GC | U | 0.7 | ug/L | 2/23/1998 | |
| 699-25-33A | 4-Nitrophenol | 8040_PHENOLIC_GC | U | 0.9 | ug/L | 2/8/1999 | |
| 699-25-33A | 4-Nitrophenol | 8040_PHENOLIC_GC | U | 0.92 | ug/L | 2/29/2000 | |
| 699-25-33A | 4-Nitrophenol | 8040_PHENOLIC_GC | U | 0.92 | ug/L | 2/29/2000 | |
| 699-25-33A | 4-Nitrophenol | 8040_PHENOLIC_GC | U | 1.9 | ug/L | 2/26/2001 | |
| 699-25-33A | 4-Nitrophenol | 8040_PHENOLIC_GC | U | 1.9 | ug/L | 2/12/2002 | |
| 699-25-33A | 4-Nitrophenol | 8040_PHENOLIC_GC | U | 2.8 | ug/L | 2/20/2003 | |
| 699-25-33A | 4-Nitrophenol | 8040_PHENOLIC_GC | U | 2.8 | ug/L | 2/18/2004 | |
| 699-25-33A | 4-Nitrophenol | 8040_PHENOLIC_GC | U | 2.3 | ug/L | 2/17/2005 | |
| 699-25-33A | 4-Nitrophenol | 8040_PHENOLIC_GC | U | 2.2 | ug/L | 2/23/2006 | |
| 699-25-33A | 4-Nitrophenol | 8040_PHENOLIC_GC | U | 2.2 | ug/L | 2/13/2007 | |
| 699-25-33A | 4-Nitrophenol | 8040_PHENOLIC_GC | U | 2.2 | ug/L | 2/26/2008 | |
| 699-25-33A | 4-Nitrophenol | 8040_PHENOLIC_GC | U | 2.2 | ug/L | 1/29/2009 | |
| 699-25-33A | Acetone | 8260_VOA_GCMS | U | 4 | ug/L | 2/29/2000 | |
| 699-25-33A | Acetone | 8260_VOA_GCMS | U | 4 | ug/L | 2/29/2000 | |
| 699-25-33A | Acetone | 8260_VOA_GCMS | U | 4 | ug/L | 10/6/2000 | |

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|---|---|---|---|---|---|---|---|
| 699-25-33A | Acetone | 8260_VOA_GCMS | U | 4 | ug/L | 2/26/2001 | |
| 699-25-33A | Acetone | 8260_VOA_GCMS | JB | 4.3 | ug/L | 8/14/2001 | /Associated with suspect field blank (FXR623) |
| 699-25-33A | Acetone | 8260_VOA_GCMS | JB | 0.6 | ug/L | 2/12/2002 | |
| 699-25-33A | Acetone | 8260_VOA_GCMS | JB | 1.2 | ug/L | 9/3/2002 | |
| 699-25-33A | Acetone | 8260_VOA_GCMS | JB | 0.94 | ug/L | 2/20/2003 | |
| 699-25-33A | Acetone | 8260_VOA_GCMS | U | 0.66 | ug/L | 8/18/2003 | |
| 699-25-33A | Acetone | 8260_VOA_GCMS | U | 0.66 | ug/L | 2/18/2004 | |
| 699-25-33A | Acetone | 8260_VOA_GCMS | JB | 1.2 | ug/L | 8/31/2004 | |
| 699-25-33A | Acetone | 8260_VOA_GCMS | U | 0.21 | ug/L | 2/17/2005 | |
| 699-25-33A | Acetone | 8260_VOA_GCMS | U | 0.21 | ug/L | 8/2/2005 | |
| 699-25-33A | Acetone | 8260_VOA_GCMS | U | 0.7 | ug/L | 2/23/2006 | |
| 699-25-33A | Acetone | 8260_VOA_GCMS | UN | 0.8 | ug/L | 9/1/2006 | |
| 699-25-33A | Acetone | 8260_VOA_GCMS | N | 2.2 | ug/L | 9/1/2006 | |
| 699-25-33A | Acetone | 8260_VOA_GCMS | UN | 0.8 | ug/L | 2/13/2007 | |
| 699-25-33A | Acetone | 8260_VOA_GCMS | U | 0.8 | ug/L | 9/24/2007 | |
| 699-25-33A | Acetone | 8260_VOA_GCMS | U | 1 | ug/L | 2/26/2008 | |
| 699-25-33A | Acetone | 8260_VOA_GCMS | U | 1 | ug/L | 8/24/2008 | |
| 699-25-33A | Acetone | 8260_VOA_GCMS | U | 0.56 | ug/L | 11/3/2008 | |
| 699-25-33A | Acetone | 8260_VOA_GCMS | U | 1 | ug/L | 1/29/2009 | |
| 699-25-33A | Acetone | 8260_VOA_GCMS | U | 1 | ug/L | 7/20/2009 | |
| 699-25-33A | Acetonitrile | 8260_VOA_GCMS | U | 4.2 | ug/L | 11/3/2008 | |
| 699-25-33A | Acrolein | 8260_VOA_GCMS | U | 0.52 | ug/L | 11/3/2008 | |
| 699-25-33A | Aldrin | 8081_PEST_GC | U | 0.004 | ug/L | 11/3/2008 | |
| 699-25-33A | Alkalinity | 2320_ALKALINITY | | 130000 | ug/L | 11/3/2008 | |
| 699-25-33A | Alkalinity | 310.1_ALKALINITY | | 123000 | ug/L | 2/18/1997 | |
| 699-25-33A | Alkalinity | 310.1_ALKALINITY | | 131000 | ug/L | 8/13/1997 | |
| 699-25-33A | Alkalinity | 310.1_ALKALINITY | | 132000 | ug/L | 2/23/1998 | |

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|---|---|---|---|---|---|---|---|
| 699-25-33A | Alkalinity | 310.1_ALKALINITY | | 129000 | ug/L | 2/23/1998 | |
| 699-25-33A | Alkalinity | 310.1_ALKALINITY | | 137000 | ug/L | 8/24/1998 | /Field blank analyzed same date is suspect |
| 699-25-33A | Alkalinity | 310.1_ALKALINITY | | 137000 | ug/L | 2/8/1999 | |
| 699-25-33A | Allyl chloride | 8260_VOA_GCMS | U | 0.2 | ug/L | 11/3/2008 | |
| 699-25-33A | Alpha-BHC | 8081_PEST_GC | U | 0.0025 | ug/L | 11/3/2008 | |
| 699-25-33A | Antimony | 6010_METALS_ICP | U | 32 | ug/L | 2/26/2008 | |
| 699-25-33A | Antimony | 6010_METALS_ICP | U | 60 | ug/L | 11/3/2008 | |
| 699-25-33A | Antimony | 6010_METALS_ICP | U | 56 | ug/L | 1/29/2009 | |
| 699-25-33A | Arsenic | 200.8_METALS_ICPMS | B | 2.2 | ug/L | 11/3/2008 | |
| 699-25-33A | Barium | 6010_METALS_ICP | | 36.9 | ug/L | 2/26/2008 | |
| 699-25-33A | Barium | 6010_METALS_ICP | | 36.2 | ug/L | 11/3/2008 | |
| 699-25-33A | Barium | 6010_METALS_ICP | | 35.4 | ug/L | 1/29/2009 | |
| 699-25-33A | Benzene | 524.2_VOA_GCMS | U | 0.3 | ug/L | 8/24/1998 | |
| 699-25-33A | Benzene | 524.2_VOA_GCMS | U | 0.3 | ug/L | 2/8/1999 | |
| 699-25-33A | Benzene | 8020_VOA_GC | U | 0.2 | ug/L | 2/18/1997 | |
| 699-25-33A | Benzene | 8020_VOA_GC | U | 0.031 | ug/L | 2/23/1998 | |
| 699-25-33A | Benzene | 8020_VOA_GC | U | 0.031 | ug/L | 2/23/1998 | |
| 699-25-33A | Benzene | 8260_VOA_GCMS | U | 0.23 | ug/L | 2/29/2000 | |
| 699-25-33A | Benzene | 8260_VOA_GCMS | U | 0.23 | ug/L | 2/29/2000 | |
| 699-25-33A | Benzene | 8260_VOA_GCMS | U | 0.23 | ug/L | 10/6/2000 | |
| 699-25-33A | Benzene | 8260_VOA_GCMS | U | 0.23 | ug/L | 2/26/2001 | |
| 699-25-33A | Benzene | 8260_VOA_GCMS | U | 0.23 | ug/L | 8/14/2001 | |
| 699-25-33A | Benzene | 8260_VOA_GCMS | U | 0.23 | ug/L | 2/12/2002 | |
| 699-25-33A | Benzene | 8260_VOA_GCMS | U | 0.23 | ug/L | 9/3/2002 | |
| 699-25-33A | Benzene | 8260_VOA_GCMS | U | 0.07 | ug/L | 2/20/2003 | |
| 699-25-33A | Benzene | 8260_VOA_GCMS | U | 0.07 | ug/L | 8/18/2003 | |
| 699-25-33A | Benzene | 8260_VOA_GCMS | U | 0.07 | ug/L | 2/18/2004 | |

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|---|---|---|---|---|---|---|---|
| 699-25-33A | Benzene | 8260_VOA_GCMS | U | 0.11 | ug/L | 8/31/2004 | |
| 699-25-33A | Benzene | 8260_VOA_GCMS | U | 0.05 | ug/L | 2/17/2005 | |
| 699-25-33A | Benzene | 8260_VOA_GCMS | U | 0.05 | ug/L | 8/2/2005 | |
| 699-25-33A | Benzene | 8260_VOA_GCMS | U | 0.17 | ug/L | 2/23/2006 | |
| 699-25-33A | Benzene | 8260_VOA_GCMS | U | 0.17 | ug/L | 9/1/2006 | |
| 699-25-33A | Benzene | 8260_VOA_GCMS | U | 0.17 | ug/L | 9/1/2006 | |
| 699-25-33A | Benzene | 8260_VOA_GCMS | U | 0.064 | ug/L | 2/13/2007 | |
| 699-25-33A | Benzene | 8260_VOA_GCMS | U | 0.1 | ug/L | 9/24/2007 | |
| 699-25-33A | Benzene | 8260_VOA_GCMS | U | 1 | ug/L | 2/26/2008 | |
| 699-25-33A | Benzene | 8260_VOA_GCMS | U | 1 | ug/L | 8/24/2008 | |
| 699-25-33A | Benzene | 8260_VOA_GCMS | U | 0.032 | ug/L | 11/3/2008 | |
| 699-25-33A | Benzene | 8260_VOA_GCMS | U | 1 | ug/L | 1/29/2009 | |
| 699-25-33A | Benzene | 8260_VOA_GCMS | U | 1 | ug/L | 7/20/2009 | |
| 699-25-33A | Benzothiazole | 8270_SVOA_GCMS | U | 1 | ug/L | 11/3/2008 | |
| 699-25-33A | Beryllium | 6010_METALS_ICP | U | 4 | ug/L | 2/26/2008 | |
| 699-25-33A | Beryllium | 6010_METALS_ICP | U | 4 | ug/L | 11/3/2008 | |
| 699-25-33A | Beryllium | 6010_METALS_ICP | U | 4 | ug/L | 1/29/2009 | |
| 699-25-33A | Bis(2-ethylhexyl) phthalate | 8270_SVOA_GCMS | U | 1 | ug/L | 11/3/2008 | |
| 699-25-33A | Bromide | 300.0_ANIONS_IC | U | 23 | ug/L | 2/18/1997 | |
| 699-25-33A | Bromodichloromethane | 8260_VOA_GCMS | U | 0.088 | ug/L | 11/3/2008 | |
| 699-25-33A | Bromoform | 8260_VOA_GCMS | U | 0.27 | ug/L | 11/3/2008 | |
| 699-25-33A | Bromomethane | 8260_VOA_GCMS | U | 0.5 | ug/L | 11/3/2008 | |
| 699-25-33A | Cadmium | 6010_METALS_ICP | U | 4 | ug/L | 2/26/2008 | |
| 699-25-33A | Cadmium | 6010_METALS_ICP | U | 4 | ug/L | 11/3/2008 | |
| 699-25-33A | Cadmium | 6010_METALS_ICP | U | 4 | ug/L | 1/29/2009 | |
| 699-25-33A | Calcium | 6010_METALS_ICP | | 39500 | ug/L | 2/26/2008 | |
| 699-25-33A | Calcium | 6010_METALS_ICP | | 45000 | ug/L | 11/3/2008 | |
| 699-25-33A | Calcium | 6010_METALS_ICP | | 38500 | ug/L | 1/29/2009 | |

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|---|---|---|---|---|---|---|---|
| 699-25-33A | Carbon disulfide | 8260_VOA_GCMS | U | 0.3 | ug/L | 2/29/2000 | |
| 699-25-33A | Carbon disulfide | 8260_VOA_GCMS | U | 0.3 | ug/L | 2/29/2000 | |
| 699-25-33A | Carbon disulfide | 8260_VOA_GCMS | U | 0.3 | ug/L | 10/6/2000 | |
| 699-25-33A | Carbon disulfide | 8260_VOA_GCMS | U | 0.3 | ug/L | 2/26/2001 | |
| 699-25-33A | Carbon disulfide | 8260_VOA_GCMS | U | 0.29 | ug/L | 8/14/2001 | |
| 699-25-33A | Carbon disulfide | 8260_VOA_GCMS | U | 0.29 | ug/L | 2/12/2002 | |
| 699-25-33A | Carbon disulfide | 8260_VOA_GCMS | U | 0.29 | ug/L | 9/3/2002 | |
| 699-25-33A | Carbon disulfide | 8260_VOA_GCMS | U | 0.43 | ug/L | 2/20/2003 | |
| 699-25-33A | Carbon disulfide | 8260_VOA_GCMS | U | 0.43 | ug/L | 8/18/2003 | |
| 699-25-33A | Carbon disulfide | 8260_VOA_GCMS | U | 0.43 | ug/L | 2/18/2004 | |
| 699-25-33A | Carbon disulfide | 8260_VOA_GCMS | U | 0.06 | ug/L | 8/31/2004 | |
| 699-25-33A | Carbon disulfide | 8260_VOA_GCMS | U | 0.25 | ug/L | 2/17/2005 | |
| 699-25-33A | Carbon disulfide | 8260_VOA_GCMS | U | 0.25 | ug/L | 8/2/2005 | |
| 699-25-33A | Carbon disulfide | 8260_VOA_GCMS | U | 0.16 | ug/L | 2/23/2006 | |
| 699-25-33A | Carbon disulfide | 8260_VOA_GCMS | U | 0.16 | ug/L | 9/1/2006 | |
| 699-25-33A | Carbon disulfide | 8260_VOA_GCMS | U | 0.16 | ug/L | 9/1/2006 | |
| 699-25-33A | Carbon disulfide | 8260_VOA_GCMS | U | 0.031 | ug/L | 2/13/2007 | |
| 699-25-33A | Carbon disulfide | 8260_VOA_GCMS | U | 0.1 | ug/L | 9/24/2007 | |
| 699-25-33A | Carbon disulfide | 8260_VOA_GCMS | U | 1 | ug/L | 2/26/2008 | |
| 699-25-33A | Carbon disulfide | 8260_VOA_GCMS | U | 1 | ug/L | 8/24/2008 | |
| 699-25-33A | Carbon disulfide | 8260_VOA_GCMS | U | 0.029 | ug/L | 11/3/2008 | |
| 699-25-33A | Carbon disulfide | 8260_VOA_GCMS | U | 1 | ug/L | 1/29/2009 | |
| 699-25-33A | Carbon disulfide | 8260_VOA_GCMS | U | 1 | ug/L | 7/20/2009 | |
| 699-25-33A | Carbon tetrachloride | 524.2_VOA_GCMS | U | 0.45 | ug/L | 8/24/1998 | |
| 699-25-33A | Carbon tetrachloride | 524.2_VOA_GCMS | U | 0.45 | ug/L | 2/8/1999 | |
| 699-25-33A | Carbon tetrachloride | 524.2_VOA_GCMS | U | 0.45 | ug/L | 8/16/1999 | |
| 699-25-33A | Carbon tetrachloride | 8010_VOA_GC | U | 0.5 | ug/L | 2/18/1997 | |
| 699-25-33A | Carbon tetrachloride | 8010_VOA_GC | U | 0.025 | ug/L | 8/13/1997 | |

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|---|---|---|---|---|---|---|---|
| 699-25-33A | Carbon tetrachloride | 8010_VOA_GC | U | 0.025 | ug/L | 2/23/1998 | |
| 699-25-33A | Carbon tetrachloride | 8010_VOA_GC | U | 0.025 | ug/L | 2/23/1998 | |
| 699-25-33A | Carbon tetrachloride | 8260_VOA_GCMS | U | 0.23 | ug/L | 2/29/2000 | |
| 699-25-33A | Carbon tetrachloride | 8260_VOA_GCMS | U | 0.23 | ug/L | 2/29/2000 | |
| 699-25-33A | Carbon tetrachloride | 8260_VOA_GCMS | J | 0.61 | ug/L | 10/6/2000 | |
| 699-25-33A | Carbon tetrachloride | 8260_VOA_GCMS | U | 0.23 | ug/L | 2/26/2001 | |
| 699-25-33A | Carbon tetrachloride | 8260_VOA_GCMS | U | 0.33 | ug/L | 8/14/2001 | |
| 699-25-33A | Carbon tetrachloride | 8260_VOA_GCMS | U | 0.33 | ug/L | 2/12/2002 | |
| 699-25-33A | Carbon tetrachloride | 8260_VOA_GCMS | U | 0.33 | ug/L | 9/3/2002 | |
| 699-25-33A | Carbon tetrachloride | 8260_VOA_GCMS | UN | 0.15 | ug/L | 2/20/2003 | |
| 699-25-33A | Carbon tetrachloride | 8260_VOA_GCMS | U | 0.15 | ug/L | 8/18/2003 | |
| 699-25-33A | Carbon tetrachloride | 8260_VOA_GCMS | U | 0.15 | ug/L | 2/18/2004 | |
| 699-25-33A | Carbon tetrachloride | 8260_VOA_GCMS | U | 0.1 | ug/L | 8/31/2004 | |
| 699-25-33A | Carbon tetrachloride | 8260_VOA_GCMS | U | 0.09 | ug/L | 2/17/2005 | |
| 699-25-33A | Carbon tetrachloride | 8260_VOA_GCMS | U | 0.09 | ug/L | 8/2/2005 | |
| 699-25-33A | Carbon tetrachloride | 8260_VOA_GCMS | U | 0.15 | ug/L | 2/23/2006 | |
| 699-25-33A | Carbon tetrachloride | 8260_VOA_GCMS | U | 0.15 | ug/L | 9/1/2006 | |
| 699-25-33A | Carbon tetrachloride | 8260_VOA_GCMS | U | 0.15 | ug/L | 9/1/2006 | |
| 699-25-33A | Carbon tetrachloride | 8260_VOA_GCMS | U | 0.039 | ug/L | 2/13/2007 | |
| 699-25-33A | Carbon tetrachloride | 8260_VOA_GCMS | U | 0.1 | ug/L | 9/24/2007 | |
| 699-25-33A | Carbon tetrachloride | 8260_VOA_GCMS | U | 1 | ug/L | 2/26/2008 | |
| 699-25-33A | Carbon tetrachloride | 8260_VOA_GCMS | U | 1 | ug/L | 8/24/2008 | |
| 699-25-33A | Carbon tetrachloride | 8260_VOA_GCMS | U | 0.042 | ug/L | 11/3/2008 | |
| 699-25-33A | Carbon tetrachloride | 8260_VOA_GCMS | U | 1 | ug/L | 1/29/2009 | |
| 699-25-33A | Carbon tetrachloride | 8260_VOA_GCMS | U | 1 | ug/L | 7/20/2009 | |
| 699-25-33A | Chlordane | 8081_PEST_GC | U | 0.18 | ug/L | 11/3/2008 | |
| 699-25-33A | Chloride | 300.0_ANIONS_IC | D | 5670 | ug/L | 2/18/1997 | |
| 699-25-33A | Chloride | 300.0_ANIONS_IC | CD | 5800 | ug/L | 8/13/1997 | |

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|---|---|---|---|---|---|---|---|
| 699-25-33A | Chloride | 300.0_ANIONS_IC | D | 6100 | ug/L | 2/23/1998 | |
| 699-25-33A | Chloride | 300.0_ANIONS_IC | D | 6210 | ug/L | 2/23/1998 | |
| 699-25-33A | Chloride | 300.0_ANIONS_IC | CD | 6050 | ug/L | 8/24/1998 | |
| 699-25-33A | Chloride | 300.0_ANIONS_IC | CD | 6020 | ug/L | 2/8/1999 | |
| 699-25-33A | Chloride | 300.0_ANIONS_IC | CD | 6190 | ug/L | 8/16/1999 | |
| 699-25-33A | Chloride | 300.0_ANIONS_IC | D | 5900 | ug/L | 2/29/2000 | /Associated with suspect field blank (FTB278/699-26-34B) |
| 699-25-33A | Chloride | 300.0_ANIONS_IC | D | 6000 | ug/L | 2/29/2000 | /Associated with suspect field blank (FTB278/699-26-34B) |
| 699-25-33A | Chloride | 300.0_ANIONS_IC | D | 5900 | ug/L | 10/6/2000 | |
| 699-25-33A | Chloride | 300.0_ANIONS_IC | D | 6300 | ug/L | 2/26/2001 | |
| 699-25-33A | Chloride | 300.0_ANIONS_IC | D | 6500 | ug/L | 8/14/2001 | |
| 699-25-33A | Chloride | 300.0_ANIONS_IC | D | 6300 | ug/L | 2/12/2002 | |
| 699-25-33A | Chloride | 300.0_ANIONS_IC | CD | 6600 | ug/L | 9/3/2002 | |
| 699-25-33A | Chloride | 300.0_ANIONS_IC | CD | 6400 | ug/L | 2/20/2003 | |
| 699-25-33A | Chloride | 300.0_ANIONS_IC | CD | 6600 | ug/L | 8/18/2003 | |
| 699-25-33A | Chloride | 300.0_ANIONS_IC | D | 7200 | ug/L | 2/18/2004 | /Associated with suspect field blank (FTB859 299-W14-18) |
| 699-25-33A | Chloride | 300.0_ANIONS_IC | CD | 6800 | ug/L | 8/31/2004 | |
| 699-25-33A | Chloride | 300.0_ANIONS_IC | D | 7300 | ug/L | 2/17/2005 | |
| 699-25-33A | Chloride | 300.0_ANIONS_IC | D | 7500 | ug/L | 8/2/2005 | |
| 699-25-33A | Chloride | 300.0_ANIONS_IC | CD | 7300 | ug/L | 2/23/2006 | /Associated with suspect field blank (FTB 699-24-34A) |
| 699-25-33A | Chloride | 300.0_ANIONS_IC | CD | 8300 | ug/L | 9/1/2006 | |
| 699-25-33A | Chloride | 300.0_ANIONS_IC | CD | 8400 | ug/L | 9/1/2006 | |
| 699-25-33A | Chloride | 300.0_ANIONS_IC | D | 6790 | ug/L | 2/13/2007 | |

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|---|---|---|---|---|---|---|---|
| 699-25-33A | Chloride | 300.0_ANIONS_IC | | 7700 | ug/L | 9/24/2007 | |
| 699-25-33A | Chloride | 300.0_ANIONS_IC | D | 7700 | ug/L | 2/26/2008 | |
| 699-25-33A | Chloride | 300.0_ANIONS_IC | D | 7380 | ug/L | 8/24/2008 | |
| 699-25-33A | Chloride | 300.0_ANIONS_IC | D | 7300 | ug/L | 11/3/2008 | |
| 699-25-33A | Chloride | 300.0_ANIONS_IC | D | 7190 | ug/L | 1/29/2009 | |
| 699-25-33A | Chloride | 300.0_ANIONS_IC | D | 7930 | ug/L | 7/20/2009 | |
| 699-25-33A | Chlorobenzene | 8260_VOA_GCMS | U | 1 | ug/L | 2/26/2008 | |
| 699-25-33A | Chlorobenzene | 8260_VOA_GCMS | U | 1 | ug/L | 8/24/2008 | |
| 699-25-33A | Chlorobenzene | 8260_VOA_GCMS | U | 0.48 | ug/L | 11/3/2008 | |
| 699-25-33A | Chlorobenzene | 8260_VOA_GCMS | U | 1 | ug/L | 1/29/2009 | |
| 699-25-33A | Chlorobenzene | 8260_VOA_GCMS | U | 1 | ug/L | 7/20/2009 | |
| 699-25-33A | Chloroethane | 8260_VOA_GCMS | U | 0.085 | ug/L | 11/3/2008 | |
| 699-25-33A | Chloroform | 524.2_VOA_GCMS | U | 0.29 | ug/L | 8/24/1998 | /Field blank collected same date is suspect |
| 699-25-33A | Chloroform | 524.2_VOA_GCMS | U | 0.29 | ug/L | 2/8/1999 | |
| 699-25-33A | Chloroform | 524.2_VOA_GCMS | U | 0.29 | ug/L | 8/16/1999 | |
| 699-25-33A | Chloroform | 8010_VOA_GC | U | 0.2 | ug/L | 2/18/1997 | |
| 699-25-33A | Chloroform | 8010_VOA_GC | U | 0.028 | ug/L | 8/13/1997 | |
| 699-25-33A | Chloroform | 8010_VOA_GC | U | 0.028 | ug/L | 2/23/1998 | |
| 699-25-33A | Chloroform | 8010_VOA_GC | U | 0.028 | ug/L | 2/23/1998 | |
| 699-25-33A | Chloroform | 8260_VOA_GCMS | U | 0.23 | ug/L | 2/29/2000 | /Associated with suspect field blank (FTB278/699-26-34B) |
| 699-25-33A | Chloroform | 8260_VOA_GCMS | U | 0.23 | ug/L | 2/29/2000 | /Associated with suspect field blank (FTB278/699-26-34B) |
| 699-25-33A | Chloroform | 8260_VOA_GCMS | U | 0.23 | ug/L | 10/6/2000 | |
| 699-25-33A | Chloroform | 8260_VOA_GCMS | U | 0.23 | ug/L | 2/26/2001 | |
| 699-25-33A | Chloroform | 8260_VOA_GCMS | U | 0.21 | ug/L | 8/14/2001 | |

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|---|---|---|---|---|---|---|---|
| 699-25-33A | Chloroform | 8260_VOA_GCMS | J | 0.46 | ug/L | 2/12/2002 | |
| 699-25-33A | Chloroform | 8260_VOA_GCMS | U | 0.21 | ug/L | 9/3/2002 | |
| 699-25-33A | Chloroform | 8260_VOA_GCMS | U | 0.07 | ug/L | 2/20/2003 | |
| 699-25-33A | Chloroform | 8260_VOA_GCMS | UN | 0.07 | ug/L | 8/18/2003 | |
| 699-25-33A | Chloroform | 8260_VOA_GCMS | U | 0.07 | ug/L | 2/18/2004 | |
| 699-25-33A | Chloroform | 8260_VOA_GCMS | U | 0.11 | ug/L | 8/31/2004 | |
| 699-25-33A | Chloroform | 8260_VOA_GCMS | U | 0.07 | ug/L | 2/17/2005 | |
| 699-25-33A | Chloroform | 8260_VOA_GCMS | U | 0.07 | ug/L | 8/2/2005 | |
| 699-25-33A | Chloroform | 8260_VOA_GCMS | U | 0.19 | ug/L | 2/23/2006 | |
| 699-25-33A | Chloroform | 8260_VOA_GCMS | U | 0.19 | ug/L | 9/1/2006 | |
| 699-25-33A | Chloroform | 8260_VOA_GCMS | U | 0.19 | ug/L | 9/1/2006 | |
| 699-25-33A | Chloroform | 8260_VOA_GCMS | U | 0.048 | ug/L | 2/13/2007 | |
| 699-25-33A | Chloroform | 8260_VOA_GCMS | U | 0.1 | ug/L | 9/24/2007 | |
| 699-25-33A | Chloroform | 8260_VOA_GCMS | U | 1 | ug/L | 2/26/2008 | |
| 699-25-33A | Chloroform | 8260_VOA_GCMS | U | 1 | ug/L | 8/24/2008 | |
| 699-25-33A | Chloroform | 8260_VOA_GCMS | U | 0.08 | ug/L | 11/3/2008 | |
| 699-25-33A | Chloroform | 8260_VOA_GCMS | U | 1 | ug/L | 1/29/2009 | |
| 699-25-33A | Chloroform | 8260_VOA_GCMS | U | 1 | ug/L | 7/20/2009 | |
| 699-25-33A | Chloromethane | 8260_VOA_GCMS | U | 0.036 | ug/L | 11/3/2008 | |
| 699-25-33A | Chloroprene | 8260_VOA_GCMS | U | 0.085 | ug/L | 11/3/2008 | |
| 699-25-33A | Chromium | 6010_METALS_ICP | C | 7.9 | ug/L | 2/26/2008 | |
| 699-25-33A | Chromium | 6010_METALS_ICP | U | 10 | ug/L | 11/3/2008 | |
| 699-25-33A | Chromium | 6010_METALS_ICP | U | 13 | ug/L | 1/29/2009 | |
| 699-25-33A | Cobalt | 6010_METALS_ICP | U | 4 | ug/L | 2/26/2008 | |
| 699-25-33A | Cobalt | 6010_METALS_ICP | U | 5 | ug/L | 11/3/2008 | |
| 699-25-33A | Cobalt | 6010_METALS_ICP | U | 5 | ug/L | 1/29/2009 | |
| 699-25-33A | Coliform Bacteria | 9131_COLIFORM | U | 0 | Col/100mL | 2/18/1997 | |
| 699-25-33A | Coliform Bacteria | 9131_COLIFORM | U | 0 | Col/100mL | 8/13/1997 | |

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|---|---|---|---|---|---|---|---|
| 699-25-33A | Coliform Bacteria | 9131_COLIFORM | U | 0 | Col/100mL | 2/23/1998 | |
| 699-25-33A | Coliform Bacteria | 9131_COLIFORM | U | 0 | Col/100mL | 2/23/1998 | |
| 699-25-33A | Coliform Bacteria | 9131_COLIFORM | U | 0 | Col/100mL | 8/24/1998 | |
| 699-25-33A | Coliform Bacteria | 9131_COLIFORM | U | 0 | Col/100mL | 2/8/1999 | |
| 699-25-33A | Coliform Bacteria | 9131_COLIFORM | U | 0 | Col/100mL | 8/16/1999 | |
| 699-25-33A | Copper | 6010_METALS_ICP | U | 4 | ug/L | 2/26/2008 | |
| 699-25-33A | Copper | 6010_METALS_ICP | U | 6 | ug/L | 11/3/2008 | |
| 699-25-33A | Copper | 6010_METALS_ICP | U | 6 | ug/L | 1/29/2009 | |
| 699-25-33A | Delta-BHC | 8081_PEST_GC | U | 0.006 | ug/L | 11/3/2008 | |
| 699-25-33A | Dibromochloromethane | 8260_VOA_GCMS | U | 0.17 | ug/L | 11/3/2008 | |
| 699-25-33A | Dibromomethane | 8260_VOA_GCMS | U | 0.14 | ug/L | 11/3/2008 | |
| 699-25-33A | Dichlorodifluoromethane | 8260_VOA_GCMS | U | 0.074 | ug/L | 11/3/2008 | |
| 699-25-33A | Dieldrin | 8081_PEST_GC | U | 0.0023 | ug/L | 11/3/2008 | |
| 699-25-33A | Dimethoate | 8270_SVOA_GCMS | U | 1.1 | ug/L | 11/3/2008 | |
| 699-25-33A | Dinoseb(2-secButyl-4,6-dinitrophenol) | 8040_PHENOLIC_GC | U | 4.8 | ug/L | 2/18/1997 | |
| 699-25-33A | Dinoseb(2-secButyl-4,6-dinitrophenol) | 8040_PHENOLIC_GC | U | 0.52 | ug/L | 2/23/1998 | |
| 699-25-33A | Dinoseb(2-secButyl-4,6-dinitrophenol) | 8040_PHENOLIC_GC | U | 0.52 | ug/L | 2/23/1998 | |
| 699-25-33A | Dinoseb(2-secButyl-4,6-dinitrophenol) | 8040_PHENOLIC_GC | U | 2 | ug/L | 2/8/1999 | |
| 699-25-33A | Dinoseb(2-secButyl-4,6-dinitrophenol) | 8040_PHENOLIC_GC | U | 2 | ug/L | 2/29/2000 | |
| 699-25-33A | Dinoseb(2-secButyl-4,6-dinitrophenol) | 8040_PHENOLIC_GC | U | 2 | ug/L | 2/29/2000 | |
| 699-25-33A | Dinoseb(2-secButyl-4,6-dinitrophenol) | 8040_PHENOLIC_GC | U | 3.2 | ug/L | 2/26/2001 | |

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|---|---|---|---|---|---|---|---|
| 699-25-33A | Dinoseb(2-secButyl-4,6-dinitrophenol) | 8040_PHENOLIC_GC | U | 3.2 | ug/L | 2/12/2002 | |
| 699-25-33A | Dinoseb(2-secButyl-4,6-dinitrophenol) | 8040_PHENOLIC_GC | U | 1.4 | ug/L | 2/20/2003 | |
| 699-25-33A | Dinoseb(2-secButyl-4,6-dinitrophenol) | 8040_PHENOLIC_GC | U | 4.2 | ug/L | 2/18/2004 | |
| 699-25-33A | Dinoseb(2-secButyl-4,6-dinitrophenol) | 8040_PHENOLIC_GC | U | 3.7 | ug/L | 2/17/2005 | |
| 699-25-33A | Dinoseb(2-secButyl-4,6-dinitrophenol) | 8040_PHENOLIC_GC | U | 2.4 | ug/L | 2/23/2006 | |
| 699-25-33A | Dinoseb(2-secButyl-4,6-dinitrophenol) | 8040_PHENOLIC_GC | U | 2.4 | ug/L | 2/13/2007 | |
| 699-25-33A | Dinoseb(2-secButyl-4,6-dinitrophenol) | 8040_PHENOLIC_GC | U | 2.4 | ug/L | 2/26/2008 | |
| 699-25-33A | Dinoseb(2-secButyl-4,6-dinitrophenol) | 8040_PHENOLIC_GC | U | 2.4 | ug/L | 1/29/2009 | |
| 699-25-33A | Dissolved oxygen | 360.1_OXYGEN_FLD | | 7410 | ug/L | 11/3/2008 | |
| 699-25-33A | Endosulfan I | 8081_PEST_GC | U | 0.0025 | ug/L | 11/3/2008 | |
| 699-25-33A | Endosulfan II | 8081_PEST_GC | U | 0.01 | ug/L | 11/3/2008 | |
| 699-25-33A | Endosulfan sulfate | 8081_PEST_GC | U | 0.017 | ug/L | 11/3/2008 | |
| 699-25-33A | Endrin | 8081_PEST_GC | U | 0.0028 | ug/L | 11/3/2008 | |
| 699-25-33A | Endrin aldehyde | 8081_PEST_GC | U | 0.0032 | ug/L | 11/3/2008 | |
| 699-25-33A | Ethyl cyanide | 8260_VOA_GCMS | U | 2.6 | ug/L | 2/29/2000 | |
| 699-25-33A | Ethyl cyanide | 8260_VOA_GCMS | U | 2.6 | ug/L | 2/29/2000 | |
| 699-25-33A | Ethyl cyanide | 8260_VOA_GCMS | U | 2.6 | ug/L | 10/6/2000 | |
| 699-25-33A | Ethyl cyanide | 8260_VOA_GCMS | U | 2.6 | ug/L | 2/26/2001 | |
| 699-25-33A | Ethyl cyanide | 8260_VOA_GCMS | U | 2 | ug/L | 8/14/2001 | |
| 699-25-33A | Ethyl cyanide | 8260_VOA_GCMS | U | 2 | ug/L | 2/12/2002 | |

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|---|---|---|---|---|---|---|---|
| 699-25-33A | Ethyl cyanide | 8260_VOA_GCMS | U | 2 | ug/L | 9/3/2002 | |
| 699-25-33A | Ethyl cyanide | 8260_VOA_GCMS | U | 1.3 | ug/L | 2/20/2003 | |
| 699-25-33A | Ethyl cyanide | 8260_VOA_GCMS | U | 1.3 | ug/L | 8/18/2003 | |
| 699-25-33A | Ethyl cyanide | 8260_VOA_GCMS | U | 1.3 | ug/L | 2/18/2004 | |
| 699-25-33A | Ethyl cyanide | 8260_VOA_GCMS | U | 1.3 | ug/L | 8/31/2004 | |
| 699-25-33A | Ethyl cyanide | 8260_VOA_GCMS | U | 0.88 | ug/L | 2/17/2005 | |
| 699-25-33A | Ethyl cyanide | 8260_VOA_GCMS | U | 0.88 | ug/L | 8/2/2005 | |
| 699-25-33A | Ethyl cyanide | 8260_VOA_GCMS | U | 1.7 | ug/L | 2/23/2006 | |
| 699-25-33A | Ethyl cyanide | 8260_VOA_GCMS | U | 1.7 | ug/L | 9/1/2006 | |
| 699-25-33A | Ethyl cyanide | 8260_VOA_GCMS | U | 1.7 | ug/L | 9/1/2006 | |
| 699-25-33A | Ethyl cyanide | 8260_VOA_GCMS | U | 1.7 | ug/L | 2/13/2007 | |
| 699-25-33A | Ethyl cyanide | 8260_VOA_GCMS | U | 1.7 | ug/L | 9/24/2007 | |
| 699-25-33A | Ethyl cyanide | 8260_VOA_GCMS | U | 2 | ug/L | 2/26/2008 | |
| 699-25-33A | Ethyl cyanide | 8260_VOA_GCMS | U | 2 | ug/L | 8/24/2008 | |
| 699-25-33A | Ethyl cyanide | 8260_VOA_GCMS | U | 4.7 | ug/L | 11/3/2008 | |
| 699-25-33A | Ethyl cyanide | 8260_VOA_GCMS | U | 2 | ug/L | 1/29/2009 | |
| 699-25-33A | Ethyl cyanide | 8260_VOA_GCMS | U | 2 | ug/L | 7/20/2009 | |
| 699-25-33A | Ethyl methacrylate | 8260_VOA_GCMS | U | 0.39 | ug/L | 11/3/2008 | |
| 699-25-33A | Ethylbenzene | 524.2_VOA_GCMS | U | 0.27 | ug/L | 8/24/1998 | |
| 699-25-33A | Ethylbenzene | 524.2_VOA_GCMS | U | 0.27 | ug/L | 2/8/1999 | |
| 699-25-33A | Ethylbenzene | 8020_VOA_GC | U | 0.2 | ug/L | 2/18/1997 | |
| 699-25-33A | Ethylbenzene | 8020_VOA_GC | U | 0.035 | ug/L | 2/23/1998 | |
| 699-25-33A | Ethylbenzene | 8020_VOA_GC | U | 0.035 | ug/L | 2/23/1998 | |
| 699-25-33A | Ethylbenzene | 8260_VOA_GCMS | UN | 0.24 | ug/L | 9/3/2002 | |
| 699-25-33A | Ethylbenzene | 8260_VOA_GCMS | U | 0.14 | ug/L | 2/20/2003 | |
| 699-25-33A | Ethylbenzene | 8260_VOA_GCMS | U | 0.14 | ug/L | 8/18/2003 | |
| 699-25-33A | Ethylbenzene | 8260_VOA_GCMS | U | 0.07 | ug/L | 2/17/2005 | |
| 699-25-33A | Ethylbenzene | 8260_VOA_GCMS | U | 0.07 | ug/L | 8/2/2005 | |

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|---|---|---|---|---|---|---|---|
| 699-25-33A | Ethylbenzene | 8260_VOA_GCMS | U | 0.22 | ug/L | 2/23/2006 | |
| 699-25-33A | Ethylbenzene | 8260_VOA_GCMS | U | 0.22 | ug/L | 9/1/2006 | |
| 699-25-33A | Ethylbenzene | 8260_VOA_GCMS | U | 0.22 | ug/L | 9/1/2006 | |
| 699-25-33A | Ethylbenzene | 8260_VOA_GCMS | U | 0.064 | ug/L | 2/13/2007 | |
| 699-25-33A | Ethylbenzene | 8260_VOA_GCMS | U | 0.064 | ug/L | 9/24/2007 | |
| 699-25-33A | Ethylbenzene | 8260_VOA_GCMS | U | 1 | ug/L | 2/26/2008 | |
| 699-25-33A | Ethylbenzene | 8260_VOA_GCMS | U | 1 | ug/L | 8/24/2008 | |
| 699-25-33A | Ethylbenzene | 8260_VOA_GCMS | U | 0.061 | ug/L | 11/3/2008 | |
| 699-25-33A | Ethylbenzene | 8260_VOA_GCMS | U | 1 | ug/L | 1/29/2009 | |
| 699-25-33A | Ethylbenzene | 8260_VOA_GCMS | U | 1 | ug/L | 7/20/2009 | |
| 699-25-33A | Fluoride | 300.0_ANIONS_IC | U | 380 | ug/L | 2/18/1997 | |
| 699-25-33A | Fluoride | 300.0_ANIONS_IC | | 374 | ug/L | 8/13/1997 | |
| 699-25-33A | Fluoride | 300.0_ANIONS_IC | | 349 | ug/L | 2/23/1998 | |
| 699-25-33A | Fluoride | 300.0_ANIONS_IC | | 352 | ug/L | 2/23/1998 | |
| 699-25-33A | Fluoride | 300.0_ANIONS_IC | | 362 | ug/L | 8/24/1998 | |
| 699-25-33A | Fluoride | 300.0_ANIONS_IC | | 371 | ug/L | 2/8/1999 | |
| 699-25-33A | Fluoride | 300.0_ANIONS_IC | | 375 | ug/L | 8/16/1999 | |
| 699-25-33A | Fluoride | 300.0_ANIONS_IC | | 360 | ug/L | 2/29/2000 | |
| 699-25-33A | Fluoride | 300.0_ANIONS_IC | | 360 | ug/L | 2/29/2000 | |
| 699-25-33A | Fluoride | 300.0_ANIONS_IC | | 410 | ug/L | 10/6/2000 | |
| 699-25-33A | Fluoride | 300.0_ANIONS_IC | | 400 | ug/L | 2/26/2001 | |
| 699-25-33A | Fluoride | 300.0_ANIONS_IC | | 390 | ug/L | 8/14/2001 | |
| 699-25-33A | Fluoride | 300.0_ANIONS_IC | | 380 | ug/L | 2/12/2002 | |
| 699-25-33A | Fluoride | 300.0_ANIONS_IC | C | 440 | ug/L | 9/3/2002 | |
| 699-25-33A | Fluoride | 300.0_ANIONS_IC | | 450 | ug/L | 2/20/2003 | |
| 699-25-33A | Fluoride | 300.0_ANIONS_IC | | 450 | ug/L | 8/18/2003 | |
| 699-25-33A | Fluoride | 300.0_ANIONS_IC | | 350 | ug/L | 2/18/2004 | |
| 699-25-33A | Fluoride | 300.0_ANIONS_IC | | 330 | ug/L | 8/31/2004 | |

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|---|---|---|---|---|---|---|---|
| 699-25-33A | Fluoride | 300.0_ANIONS_IC | | 310 | ug/L | 2/17/2005 | |
| 699-25-33A | Fluoride | 300.0_ANIONS_IC | | 290 | ug/L | 8/2/2005 | |
| 699-25-33A | Fluoride | 300.0_ANIONS_IC | | 320 | ug/L | 2/23/2006 | |
| 699-25-33A | Fluoride | 300.0_ANIONS_IC | | 370 | ug/L | 9/1/2006 | |
| 699-25-33A | Fluoride | 300.0_ANIONS_IC | | 380 | ug/L | 9/1/2006 | |
| 699-25-33A | Fluoride | 300.0_ANIONS_IC | | 315 | ug/L | 2/13/2007 | |
| 699-25-33A | Fluoride | 300.0_ANIONS_IC | | 349 | ug/L | 9/24/2007 | |
| 699-25-33A | Fluoride | 300.0_ANIONS_IC | D | 288 | ug/L | 2/26/2008 | |
| 699-25-33A | Fluoride | 300.0_ANIONS_IC | D | 280 | ug/L | 8/24/2008 | |
| 699-25-33A | Fluoride | 300.0_ANIONS_IC | BD | 136 | ug/L | 11/3/2008 | |
| 699-25-33A | Fluoride | 300.0_ANIONS_IC | BD | 306 | ug/L | 1/29/2009 | |
| 699-25-33A | Fluoride | 300.0_ANIONS_IC | BD | 273 | ug/L | 7/20/2009 | |
| 699-25-33A | Gamma-BHC (Lindane) | 8081_PEST_GC | U | 0.0025 | ug/L | 11/3/2008 | |
| 699-25-33A | Gross alpha | 9310_ALPHA BETA_GPC | U | 1.23 | pCi/L | 8/24/1998 | |
| 699-25-33A | Gross alpha | 9310_ALPHA BETA_GPC | J | 2.81 | pCi/L | 2/8/1999 | |
| 699-25-33A | Gross alpha | 9310_ALPHA BETA_GPC | | 3.32 | pCi/L | 8/16/1999 | |
| 699-25-33A | Gross alpha | ALPHA_GPC | J | 1.24 | pCi/L | 2/18/1997 | |
| 699-25-33A | Gross alpha | ALPHA_GPC | U | 0.995 | pCi/L | 8/13/1997 | |
| 699-25-33A | Gross alpha | ALPHA_GPC | J | 2.74 | pCi/L | 2/23/1998 | |
| 699-25-33A | Gross alpha | ALPHA_GPC | J | 2.09 | pCi/L | 2/23/1998 | |
| 699-25-33A | Gross alpha | ALPHA_GPC | U | 0.986 | pCi/L | 11/3/2008 | |
| 699-25-33A | Gross beta | 9310_ALPHA BETA_GPC | | 8.47 | pCi/L | 8/24/1998 | |
| 699-25-33A | Gross beta | 9310_ALPHA BETA_GPC | | 7.11 | pCi/L | 2/8/1999 | |
| 699-25-33A | Gross beta | 9310_ALPHA BETA_GPC | | 5.65 | pCi/L | 8/16/1999 | |
| 699-25-33A | Gross beta | BETA_GPC | | 7.05 | pCi/L | 2/18/1997 | |
| 699-25-33A | Gross beta | BETA_GPC | | 4.73 | pCi/L | 8/13/1997 | |

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|---|---|---|---|---|---|---|---|
| 699-25-33A | Gross beta | BETA_GPC | | 6.67 | pCi/L | 2/23/1998 | |
| 699-25-33A | Gross beta | BETA_GPC | | 5.45 | pCi/L | 2/23/1998 | |
| 699-25-33A | Gross beta | BETA_GPC | | 23.2 | pCi/L | 11/3/2008 | |
| 699-25-33A | Heptachlor | 8081_PEST_GC | UN | 0.0025 | ug/L | 11/3/2008 | |
| 699-25-33A | Heptachlor epoxide | 8081_PEST_GC | U | 0.0032 | ug/L | 11/3/2008 | |
| 699-25-33A | Hexane | 8260_VOA_GCMS | U | 0.16 | ug/L | 11/3/2008 | |
| 699-25-33A | Iodine-129 | I129_SEP_LEPS_GS | U | -1.61 | pCi/L | 11/3/2008 | |
| 699-25-33A | Iodomethane | 8260_VOA_GCMS | U | 0.33 | ug/L | 11/3/2008 | |
| 699-25-33A | Iron | 6010_METALS_ICP | C | 112 | ug/L | 2/26/2008 | |
| 699-25-33A | Iron | 6010_METALS_ICP | B | 118 | ug/L | 11/3/2008 | |
| 699-25-33A | Iron | 6010_METALS_ICP | | 143 | ug/L | 1/29/2009 | /Associated with suspect field blank (FTB 699-25-34B) |
| 699-25-33A | Isobutyl alcohol | 8260_VOA_GCMS | U | 6.1 | ug/L | 11/3/2008 | |
| 699-25-33A | Lead | 200.8_METALS_ICPMS | B | 0.152 | ug/L | 11/3/2008 | |
| 699-25-33A | Magnesium | 6010_METALS_ICP | | 10300 | ug/L | 2/26/2008 | |
| 699-25-33A | Magnesium | 6010_METALS_ICP | | 10700 | ug/L | 11/3/2008 | |
| 699-25-33A | Magnesium | 6010_METALS_ICP | | 9910 | ug/L | 1/29/2009 | |
| 699-25-33A | Manganese | 6010_METALS_ICP | U | 4 | ug/L | 2/26/2008 | |
| 699-25-33A | Manganese | 6010_METALS_ICP | U | 4 | ug/L | 11/3/2008 | |
| 699-25-33A | Manganese | 6010_METALS_ICP | U | 4 | ug/L | 1/29/2009 | |
| 699-25-33A | Methacrylonitrile | 8260_VOA_GCMS | U | 1.8 | ug/L | 11/3/2008 | |
| 699-25-33A | Methoxychlor | 8081_PEST_GC | U | 0.005 | ug/L | 11/3/2008 | |
| 699-25-33A | Methyl methacrylate | 8260_VOA_GCMS | U | 0.62 | ug/L | 11/3/2008 | |
| 699-25-33A | Methylene chloride | 524.2_VOA_GCMS | BJ | 0.8 | ug/L | 8/24/1998 | /Field blank collected same date is suspect |
| 699-25-33A | Methylene chloride | 524.2_VOA_GCMS | U | 0.28 | ug/L | 2/8/1999 | |
| 699-25-33A | Methylene chloride | 524.2_VOA_GCMS | U | 0.28 | ug/L | 8/16/1999 | |
| 699-25-33A | Methylene chloride | 8010_VOA_GC | U | 0.2 | ug/L | 2/18/1997 | |
| 699-25-33A | Methylene chloride | 8010_VOA_GC | U | 0.21 | ug/L | 8/13/1997 | |

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| 699-25-33A | Methylene chloride | 8010_VOA_GC | U | 0.207 | ug/L | 2/23/1998 | |
| 699-25-33A | Methylene chloride | 8010_VOA_GC | U | 0.207 | ug/L | 2/23/1998 | |
| 699-25-33A | Methylene chloride | 8260_VOA_GCMS | JB | 0.6 | ug/L | 2/29/2000 | |
| 699-25-33A | Methylene chloride | 8260_VOA_GCMS | U | 0.37 | ug/L | 2/29/2000 | |
| 699-25-33A | Methylene chloride | 8260_VOA_GCMS | U | 0.37 | ug/L | 10/6/2000 | /Associated with suspect field blank (FXR491) |
| 699-25-33A | Methylene chloride | 8260_VOA_GCMS | U | 0.37 | ug/L | 2/26/2001 | |
| 699-25-33A | Methylene chloride | 8260_VOA_GCMS | JB | 4.5 | ug/L | 8/14/2001 | /Associated with suspect field blank (FXR623) |
| 699-25-33A | Methylene chloride | 8260_VOA_GCMS | U | 0.24 | ug/L | 2/12/2002 | |
| 699-25-33A | Methylene chloride | 8260_VOA_GCMS | U | 0.24 | ug/L | 9/3/2002 | /Associated with suspect field blank (FXR710)/Associated with suspect field blank (FXR710) |
| 699-25-33A | Methylene chloride | 8260_VOA_GCMS | U | 0.3 | ug/L | 2/20/2003 | /Associated with suspect field blank (FXR780) |
| 699-25-33A | Methylene chloride | 8260_VOA_GCMS | U | 0.3 | ug/L | 8/18/2003 | |
| 699-25-33A | Methylene chloride | 8260_VOA_GCMS | U | 0.3 | ug/L | 2/18/2004 | |
| 699-25-33A | Methylene chloride | 8260_VOA_GCMS | U | 0.17 | ug/L | 8/31/2004 | |
| 699-25-33A | Methylene chloride | 8260_VOA_GCMS | UN | 0.12 | ug/L | 2/17/2005 | /Associated with suspect field blank (FXR980/ZP1) |
| 699-25-33A | Methylene chloride | 8260_VOA_GCMS | U | 0.12 | ug/L | 8/2/2005 | /Associated with suspect field blank (FXR1008) |
| 699-25-33A | Methylene chloride | 8260_VOA_GCMS | U | 0.1 | ug/L | 2/23/2006 | |
| 699-25-33A | Methylene chloride | 8260_VOA_GCMS | U | 0.1 | ug/L | 9/1/2006 | /Associated with suspect field blank (FXR 1144) |
| 699-25-33A | Methylene chloride | 8260_VOA_GCMS | U | 0.1 | ug/L | 9/1/2006 | /Associated with suspect field blank (FXR 1144) |

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|---|---|---|---|---|---|---|---|
| 699-25-33A | Methylene chloride | 8260_VOA_GCMS | U | 0.6 | ug/L | 2/13/2007 | |
| 699-25-33A | Methylene chloride | 8260_VOA_GCMS | U | 0.1 | ug/L | 9/24/2007 | /Associated with suspect field blank (FTB 699-25-33A) |
| 699-25-33A | Methylene chloride | 8260_VOA_GCMS | U | 1 | ug/L | 2/26/2008 | /Associated with suspect field blank (FXR 1409) |
| 699-25-33A | Methylene chloride | 8260_VOA_GCMS | U | 1 | ug/L | 8/24/2008 | |
| 699-25-33A | Methylene chloride | 8260_VOA_GCMS | U | 0.091 | ug/L | 11/3/2008 | /Associated with suspect field blank (FXR 1521) |
| 699-25-33A | Methylene chloride | 8260_VOA_GCMS | U | 1 | ug/L | 1/29/2009 | |
| 699-25-33A | Methylene chloride | 8260_VOA_GCMS | U | 1 | ug/L | 7/20/2009 | |
| 699-25-33A | Naphthalene | 8270_SVOA_GCMS | U | 1 | ug/L | 11/3/2008 | |
| 699-25-33A | Neptunium-237 | NP237_LLE_PLATE_AEA | U | 0.0283 | pCi/L | 11/3/2008 | |
| 699-25-33A | Nickel | 6010_METALS_ICP | U | 4 | ug/L | 2/26/2008 | |
| 699-25-33A | Nickel | 6010_METALS_ICP | U | 6 | ug/L | 11/3/2008 | |
| 699-25-33A | Nickel | 6010_METALS_ICP | U | 6 | ug/L | 1/29/2009 | |
| 699-25-33A | Nitrate | 300.0_ANIONS_IC | | 3940 | ug/L | 2/18/1997 | |
| 699-25-33A | Nitrate | 300.0_ANIONS_IC | | 3990 | ug/L | 8/13/1997 | |
| 699-25-33A | Nitrate | 300.0_ANIONS_IC | D | 4430 | ug/L | 2/23/1998 | |
| 699-25-33A | Nitrate | 300.0_ANIONS_IC | D | 4420 | ug/L | 2/23/1998 | |
| 699-25-33A | Nitrate | 300.0_ANIONS_IC | D | 4330 | ug/L | 8/24/1998 | |
| 699-25-33A | Nitrate | 300.0_ANIONS_IC | D | 4600 | ug/L | 2/8/1999 | /Associated with suspect field blank (FTB210/699-24-34C) |
| 699-25-33A | Nitrate | 300.0_ANIONS_IC | D | 4290 | ug/L | 8/16/1999 | |
| 699-25-33A | Nitrate | 300.0_ANIONS_IC | D | 4430 | ug/L | 2/29/2000 | |
| 699-25-33A | Nitrate | 300.0_ANIONS_IC | D | 4870 | ug/L | 2/29/2000 | |
| 699-25-33A | Nitrate | 300.0_ANIONS_IC | DN | 5310 | ug/L | 10/6/2000 | |
| 699-25-33A | Nitrate | 300.0_ANIONS_IC | D | 4870 | ug/L | 2/26/2001 | |

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|---|---|---|---|---|---|---|---|
| 699-25-33A | Nitrate | 300.0_ANIONS_IC | D | 5310 | ug/L | 8/14/2001 | |
| 699-25-33A | Nitrate | 300.0_ANIONS_IC | D | 4870 | ug/L | 2/12/2002 | |
| 699-25-33A | Nitrate | 300.0_ANIONS_IC | D | 5750 | ug/L | 9/3/2002 | |
| 699-25-33A | Nitrate | 300.0_ANIONS_IC | D | 6640 | ug/L | 2/20/2003 | |
| 699-25-33A | Nitrate | 300.0_ANIONS_IC | D | 6640 | ug/L | 8/18/2003 | |
| 699-25-33A | Nitrate | 300.0_ANIONS_IC | D | 7080 | ug/L | 2/18/2004 | |
| 699-25-33A | Nitrate | 300.0_ANIONS_IC | D | 7080 | ug/L | 8/31/2004 | |
| 699-25-33A | Nitrate | 300.0_ANIONS_IC | D | 8850 | ug/L | 2/17/2005 | |
| 699-25-33A | Nitrate | 300.0_ANIONS_IC | D | 10600 | ug/L | 8/2/2005 | |
| 699-25-33A | Nitrate | 300.0_ANIONS_IC | D | 10200 | ug/L | 2/23/2006 | |
| 699-25-33A | Nitrate | 300.0_ANIONS_IC | D | 10200 | ug/L | 9/1/2006 | |
| 699-25-33A | Nitrate | 300.0_ANIONS_IC | D | 10200 | ug/L | 9/1/2006 | |
| 699-25-33A | Nitrate | 300.0_ANIONS_IC | D | 9870 | ug/L | 2/13/2007 | |
| 699-25-33A | Nitrate | 300.0_ANIONS_IC | | 10700 | ug/L | 9/24/2007 | |
| 699-25-33A | Nitrate | 300.0_ANIONS_IC | D | 11100 | ug/L | 2/26/2008 | |
| 699-25-33A | Nitrate | 300.0_ANIONS_IC | D | 10600 | ug/L | 8/24/2008 | |
| 699-25-33A | Nitrate | 300.0_ANIONS_IC | D | 10500 | ug/L | 11/3/2008 | |
| 699-25-33A | Nitrate | 300.0_ANIONS_IC | D | 11000 | ug/L | 1/29/2009 | |
| 699-25-33A | Nitrate | 300.0_ANIONS_IC | D | 10800 | ug/L | 7/20/2009 | |
| 699-25-33A | Nitrite | 300.0_ANIONS_IC | U | 6.57 | ug/L | 2/18/1997 | |
| 699-25-33A | Nitrite | 300.0_ANIONS_IC | U | 6.57 | ug/L | 8/13/1997 | |
| 699-25-33A | Nitrite | 300.0_ANIONS_IC | U | 3.28 | ug/L | 2/23/1998 | |
| 699-25-33A | Nitrite | 300.0_ANIONS_IC | U | 3.28 | ug/L | 2/23/1998 | |
| 699-25-33A | Nitrite | 300.0_ANIONS_IC | U | 55.8 | ug/L | 8/24/1998 | |
| 699-25-33A | Nitrite | 300.0_ANIONS_IC | U | 23 | ug/L | 2/8/1999 | |
| 699-25-33A | Nitrite | 300.0_ANIONS_IC | U | 23 | ug/L | 8/16/1999 | |
| 699-25-33A | Nitrite | 300.0_ANIONS_IC | U | 24.3 | ug/L | 2/29/2000 | |
| 699-25-33A | Nitrite | 300.0_ANIONS_IC | U | 24.3 | ug/L | 2/29/2000 | |

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|---|---|---|---|---|---|---|---|
| 699-25-33A | Nitrite | 300.0_ANIONS_IC | UN | 24.3 | ug/L | 10/6/2000 | |
| 699-25-33A | Nitrite | 300.0_ANIONS_IC | U | 24.3 | ug/L | 2/26/2001 | |
| 699-25-33A | Nitrite | 300.0_ANIONS_IC | U | 6.57 | ug/L | 8/14/2001 | |
| 699-25-33A | Nitrite | 300.0_ANIONS_IC | U | 36.1 | ug/L | 2/12/2002 | |
| 699-25-33A | Nitrite | 300.0_ANIONS_IC | U | 36.1 | ug/L | 9/3/2002 | |
| 699-25-33A | Nitrite | 300.0_ANIONS_IC | U | 36.1 | ug/L | 2/20/2003 | |
| 699-25-33A | Nitrite | 300.0_ANIONS_IC | U | 24.3 | ug/L | 8/18/2003 | |
| 699-25-33A | Nitrite | 300.0_ANIONS_IC | U | 24.3 | ug/L | 2/18/2004 | |
| 699-25-33A | Nitrite | 300.0_ANIONS_IC | U | 13.1 | ug/L | 8/31/2004 | |
| 699-25-33A | Nitrite | 300.0_ANIONS_IC | U | 13.1 | ug/L | 2/17/2005 | |
| 699-25-33A | Nitrite | 300.0_ANIONS_IC | U | 20 | ug/L | 8/2/2005 | |
| 699-25-33A | Nitrite | 300.0_ANIONS_IC | UN | 20 | ug/L | 2/23/2006 | |
| 699-25-33A | Nitrite | 300.0_ANIONS_IC | UN | 13.1 | ug/L | 9/1/2006 | |
| 699-25-33A | Nitrite | 300.0_ANIONS_IC | UN | 13.1 | ug/L | 9/1/2006 | |
| 699-25-33A | Nitrite | 300.0_ANIONS_IC | U | 32.8 | ug/L | 2/13/2007 | |
| 699-25-33A | Nitrite | 300.0_ANIONS_IC | U | 32.8 | ug/L | 9/24/2007 | |
| 699-25-33A | Nitrite | 300.0_ANIONS_IC | DU | 65.7 | ug/L | 2/26/2008 | |
| 699-25-33A | Nitrite | 300.0_ANIONS_IC | DU | 84.1 | ug/L | 8/24/2008 | |
| 699-25-33A | Nitrite | 300.0_ANIONS_IC | UD | 98.5 | ug/L | 11/3/2008 | |
| 699-25-33A | Nitrite | 300.0_ANIONS_IC | UD | 85.4 | ug/L | 1/29/2009 | |
| 699-25-33A | Nitrite | 300.0_ANIONS_IC | UD | 118 | ug/L | 7/20/2009 | |
| 699-25-33A | Nitrobenzene | 8270_SVOA_GCMS | U | 1 | ug/L | 11/3/2008 | |
| 699-25-33A | Pentachlorophenol | 8040_PHENOLIC_GC | U | 4.8 | ug/L | 2/18/1997 | |
| 699-25-33A | Pentachlorophenol | 8040_PHENOLIC_GC | J | 0.97 | ug/L | 2/23/1998 | |
| 699-25-33A | Pentachlorophenol | 8040_PHENOLIC_GC | U | 2.2 | ug/L | 2/23/1998 | |
| 699-25-33A | Pentachlorophenol | 8040_PHENOLIC_GC | U | 1.5 | ug/L | 2/8/1999 | |
| 699-25-33A | Pentachlorophenol | 8040_PHENOLIC_GC | U | 1.5 | ug/L | 2/29/2000 | |
| 699-25-33A | Pentachlorophenol | 8040_PHENOLIC_GC | U | 1.5 | ug/L | 2/29/2000 | |

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|---|---|---|---|---|---|---|---|
| 699-25-33A | Pentachlorophenol | 8040_PHENOLIC_GC | U | 3.8 | ug/L | 2/26/2001 | |
| 699-25-33A | Pentachlorophenol | 8040_PHENOLIC_GC | U | 3.8 | ug/L | 2/12/2002 | |
| 699-25-33A | Pentachlorophenol | 8040_PHENOLIC_GC | U | 2.5 | ug/L | 2/20/2003 | |
| 699-25-33A | Pentachlorophenol | 8040_PHENOLIC_GC | U | 4.3 | ug/L | 2/18/2004 | |
| 699-25-33A | Pentachlorophenol | 8040_PHENOLIC_GC | U | 2.8 | ug/L | 2/17/2005 | |
| 699-25-33A | Pentachlorophenol | 8040_PHENOLIC_GC | U | 2.4 | ug/L | 2/23/2006 | |
| 699-25-33A | Pentachlorophenol | 8040_PHENOLIC_GC | U | 2.4 | ug/L | 2/13/2007 | |
| 699-25-33A | Pentachlorophenol | 8040_PHENOLIC_GC | U | 2.4 | ug/L | 2/26/2008 | |
| 699-25-33A | Pentachlorophenol | 8040_PHENOLIC_GC | U | 2.4 | ug/L | 1/29/2009 | |
| 699-25-33A | Pentachlorophenol | 8270_SVOA_GCMS | U | 2 | ug/L | 11/3/2008 | |
| 699-25-33A | Phenol | 8040_PHENOLIC_GC | U | 0.95 | ug/L | 2/18/1997 | |
| 699-25-33A | Phenol | 8040_PHENOLIC_GC | U | 0.94 | ug/L | 2/23/1998 | |
| 699-25-33A | Phenol | 8040_PHENOLIC_GC | U | 0.94 | ug/L | 2/23/1998 | |
| 699-25-33A | Phenol | 8040_PHENOLIC_GC | U | 0.54 | ug/L | 2/8/1999 | |
| 699-25-33A | Phenol | 8040_PHENOLIC_GC | U | 0.54 | ug/L | 2/29/2000 | |
| 699-25-33A | Phenol | 8040_PHENOLIC_GC | U | 0.54 | ug/L | 2/29/2000 | |
| 699-25-33A | Phenol | 8040_PHENOLIC_GC | U | 1 | ug/L | 2/26/2001 | |
| 699-25-33A | Phenol | 8040_PHENOLIC_GC | U | 1 | ug/L | 2/12/2002 | |
| 699-25-33A | Phenol | 8040_PHENOLIC_GC | U | 3 | ug/L | 2/20/2003 | |
| 699-25-33A | Phenol | 8040_PHENOLIC_GC | U | 3 | ug/L | 2/18/2004 | |
| 699-25-33A | Phenol | 8040_PHENOLIC_GC | U | 2.8 | ug/L | 2/17/2005 | |
| 699-25-33A | Phenol | 8040_PHENOLIC_GC | U | 2.3 | ug/L | 2/23/2006 | |
| 699-25-33A | Phenol | 8040_PHENOLIC_GC | U | 2.3 | ug/L | 2/13/2007 | |
| 699-25-33A | Phenol | 8040_PHENOLIC_GC | U | 2.3 | ug/L | 2/26/2008 | |
| 699-25-33A | Phenol | 8040_PHENOLIC_GC | U | 2.3 | ug/L | 1/29/2009 | |
| 699-25-33A | Phenol | 8270_SVOA_GCMS | U | 4 | ug/L | 11/3/2008 | |
| 699-25-33A | Phosphate | 300.0_ANIONS_IC | U | 36 | ug/L | 2/18/1997 | |
| 699-25-33A | Potassium | 6010_METALS_ICP | | 5760 | ug/L | 2/26/2008 | |

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|---|---|---|---|---|---|---|---|
| 699-25-33A | Potassium | 6010_METALS_ICP | | 6730 | ug/L | 11/3/2008 | |
| 699-25-33A | Potassium | 6010_METALS_ICP | | 5250 | ug/L | 1/29/2009 | |
| 699-25-33A | Protactinium-231 | PA231_IE_PLATE_AEA | U | 0 | pCi/L | 11/3/2008 | |
| 699-25-33A | Selenium-79 | SE79_SEP_IE_LSC | U | -2.03 | pCi/L | 11/3/2008 | |
| 699-25-33A | Silver | 6010_METALS_ICP | U | 5 | ug/L | 2/26/2008 | |
| 699-25-33A | Silver | 6010_METALS_ICP | UN | 5 | ug/L | 11/3/2008 | |
| 699-25-33A | Silver | 6010_METALS_ICP | U | 5 | ug/L | 1/29/2009 | /Associated with suspect field blank (FTB 699-25-34B) |
| 699-25-33A | Sodium | 6010_METALS_ICP | | 17000 | ug/L | 2/26/2008 | |
| 699-25-33A | Sodium | 6010_METALS_ICP | | 18600 | ug/L | 11/3/2008 | |
| 699-25-33A | Sodium | 6010_METALS_ICP | | 17000 | ug/L | 1/29/2009 | |
| 699-25-33A | Specific Conductance | 120.1_CONDUCT | C | 317 | uS/cm | 2/8/1999 | /Associated with suspect field blank (FTB210/699-24-34C) |
| 699-25-33A | Specific Conductance | 120.1_CONDUCT_FLD | | 351 | uS/cm | 2/23/2006 | |
| 699-25-33A | Specific Conductance | 120.1_CONDUCT_FLD | | 348 | uS/cm | 9/1/2006 | |
| 699-25-33A | Specific Conductance | 120.1_CONDUCT_FLD | | 350 | uS/cm | 2/13/2007 | |
| 699-25-33A | Specific Conductance | 9050_CONDUCT | | 327 | uS/cm | 2/18/1997 | |
| 699-25-33A | Specific Conductance | 9050_CONDUCT | | 327 | uS/cm | 2/18/1997 | |
| 699-25-33A | Specific Conductance | 9050_CONDUCT | | 327 | uS/cm | 2/18/1997 | |
| 699-25-33A | Specific Conductance | 9050_CONDUCT | | 328 | uS/cm | 2/18/1997 | |
| 699-25-33A | Specific Conductance | 9050_CONDUCT | | 327 | uS/cm | 8/13/1997 | |
| 699-25-33A | Specific Conductance | 9050_CONDUCT | | 327 | uS/cm | 8/13/1997 | |

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|---|---|---|---|---|---|---|---|
| 699-25-33A | Specific Conductance | 9050_CONDUCT | | 327 | uS/cm | 8/13/1997 | |
| 699-25-33A | Specific Conductance | 9050_CONDUCT | | 327 | uS/cm | 8/13/1997 | |
| 699-25-33A | Specific Conductance | 9050_CONDUCT | | 306 | uS/cm | 2/23/1998 | Y Review qualifier added per RDR 981105QL-R376 |
| 699-25-33A | Specific Conductance | 9050_CONDUCT | | 306 | uS/cm | 2/23/1998 | Y Review qualifier added per RDR 981105QL-R376 |
| 699-25-33A | Specific Conductance | 9050_CONDUCT | | 306 | uS/cm | 2/23/1998 | Y Review qualifier added per RDR 981105QL-R376 |
| 699-25-33A | Specific Conductance | 9050_CONDUCT | | 306 | uS/cm | 2/23/1998 | Y Review qualifier added per RDR 981105QL-R376 |
| 699-25-33A | Specific Conductance | 9050_CONDUCT | | 323 | uS/cm | 8/24/1998 | |
| 699-25-33A | Specific Conductance | 9050_CONDUCT | | 324 | uS/cm | 8/24/1998 | |
| 699-25-33A | Specific Conductance | 9050_CONDUCT | | 323 | uS/cm | 8/24/1998 | |
| 699-25-33A | Specific Conductance | 9050_CONDUCT | | 323 | uS/cm | 8/24/1998 | |
| 699-25-33A | Specific Conductance | 9050_CONDUCT | | 631 | uS/cm | 2/8/1999 | "R" Review flag added per RDR 990518QL-R522. Value is associated with possible bad standard. |

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|---|---|---|---|---|---|---|---|
| 699-25-33A | Specific Conductance | 9050_CONDUCT | | 632 | uS/cm | 2/8/1999 | "R" Review flag added per RDR 990518QL-R522. Value is associated with possible bad standard. |
| 699-25-33A | Specific Conductance | 9050_CONDUCT | | 631 | uS/cm | 2/8/1999 | "R" Review flag added per RDR 990518QL-R522. Value is associated with possible bad standard. |
| 699-25-33A | Specific Conductance | 9050_CONDUCT | | 632 | uS/cm | 2/8/1999 | "R" Review flag added per RDR 990518QL-R522. Value is associated with possible bad standard. |
| 699-25-33A | Specific Conductance | 9050_CONDUCT | | 318 | uS/cm | 8/16/1999 | |
| 699-25-33A | Specific Conductance | 9050_CONDUCT | | 316 | uS/cm | 8/16/1999 | |
| 699-25-33A | Specific Conductance | 9050_CONDUCT | | 313 | uS/cm | 8/16/1999 | |
| 699-25-33A | Specific Conductance | 9050_CONDUCT | | 316 | uS/cm | 8/16/1999 | |
| 699-25-33A | Specific Conductance | 9050_CONDUCT | | 328 | uS/cm | 2/29/2000 | |
| 699-25-33A | Specific Conductance | 9050_CONDUCT | | 327 | uS/cm | 2/29/2000 | |
| 699-25-33A | Specific Conductance | 9050_CONDUCT | | 328 | uS/cm | 2/29/2000 | |
| 699-25-33A | Specific Conductance | 9050_CONDUCT | | 327 | uS/cm | 2/29/2000 | |
| 699-25-33A | Specific Conductance | 9050_CONDUCT | | 328 | uS/cm | 10/6/2000 | |

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|---|---|---|---|---|---|---|---|
| 699-25-33A | Specific Conductance | 9050_CONDUCT | | 327 | uS/cm | 10/6/2000 | |
| 699-25-33A | Specific Conductance | 9050_CONDUCT | | 327 | uS/cm | 10/6/2000 | |
| 699-25-33A | Specific Conductance | 9050_CONDUCT | | 328 | uS/cm | 10/6/2000 | |
| 699-25-33A | Specific Conductance | 9050_CONDUCT | | 336 | uS/cm | 2/26/2001 | |
| 699-25-33A | Specific Conductance | 9050_CONDUCT | | 336 | uS/cm | 2/26/2001 | |
| 699-25-33A | Specific Conductance | 9050_CONDUCT | | 336 | uS/cm | 2/26/2001 | |
| 699-25-33A | Specific Conductance | 9050_CONDUCT | | 336 | uS/cm | 2/26/2001 | |
| 699-25-33A | Specific Conductance | 9050_CONDUCT | | 325 | uS/cm | 8/14/2001 | |
| 699-25-33A | Specific Conductance | 9050_CONDUCT | | 327 | uS/cm | 2/12/2002 | |
| 699-25-33A | Specific Conductance | 9050_CONDUCT | | 326 | uS/cm | 2/12/2002 | |
| 699-25-33A | Specific Conductance | 9050_CONDUCT | | 325 | uS/cm | 2/12/2002 | |
| 699-25-33A | Specific Conductance | 9050_CONDUCT | | 326 | uS/cm | 2/12/2002 | |
| 699-25-33A | Specific Conductance | 9050_CONDUCT | | 332 | uS/cm | 9/3/2002 | |
| 699-25-33A | Specific Conductance | 9050_CONDUCT | | 335 | uS/cm | 2/20/2003 | |
| 699-25-33A | Specific Conductance | 9050_CONDUCT | | 334 | uS/cm | 2/20/2003 | |
| 699-25-33A | Specific Conductance | 9050_CONDUCT | | 332 | uS/cm | 2/20/2003 | |
| 699-25-33A | Specific Conductance | 9050_CONDUCT | | 333 | uS/cm | 2/20/2003 | |
| 699-25-33A | Specific Conductance | 9050_CONDUCT | | 326 | uS/cm | 8/18/2003 | |
| 699-25-33A | Specific Conductance | 9050_CONDUCT | | 332 | uS/cm | 2/18/2004 | |

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|---|---|---|---|---|---|---|---|
| 699-25-33A | Specific Conductance | 9050_CONDUCT | | 333 | uS/cm | 8/31/2004 | |
| 699-25-33A | Specific Conductance | 9050_CONDUCT | | 341 | uS/cm | 2/17/2005 | |
| 699-25-33A | Specific Conductance | 9050_CONDUCT | | 354 | uS/cm | 8/2/2005 | |
| 699-25-33A | Specific Conductance | CONDUCT_FLD | | 354 | uS/cm | 9/24/2007 | |
| 699-25-33A | Specific Conductance | CONDUCT_FLD | | 355 | uS/cm | 2/26/2008 | |
| 699-25-33A | Specific Conductance | CONDUCT_FLD | | 354 | uS/cm | 2/26/2008 | |
| 699-25-33A | Specific Conductance | CONDUCT_FLD | | 355 | uS/cm | 2/26/2008 | |
| 699-25-33A | Specific Conductance | CONDUCT_FLD | | 355 | uS/cm | 2/26/2008 | |
| 699-25-33A | Specific Conductance | CONDUCT_FLD | | 358 | uS/cm | 8/24/2008 | |
| 699-25-33A | Specific Conductance | CONDUCT_FLD | | 358 | uS/cm | 8/24/2008 | |
| 699-25-33A | Specific Conductance | CONDUCT_FLD | | 358 | uS/cm | 8/24/2008 | |
| 699-25-33A | Specific Conductance | CONDUCT_FLD | | 357 | uS/cm | 8/24/2008 | |
| 699-25-33A | Specific Conductance | CONDUCT_FLD | | 348 | uS/cm | 11/3/2008 | |
| 699-25-33A | Specific Conductance | CONDUCT_FLD | | 359 | uS/cm | 1/29/2009 | |
| 699-25-33A | Specific Conductance | CONDUCT_FLD | | 348 | uS/cm | 7/20/2009 | |
| 699-25-33A | Strontium | 6010_METALS_ICP | | 206 | ug/L | 2/26/2008 | |
| 699-25-33A | Strontium | 6010_METALS_ICP | | 290 | ug/L | 11/3/2008 | |
| 699-25-33A | Strontium | 6010_METALS_ICP | | 192 | ug/L | 1/29/2009 | |
| 699-25-33A | Styrene | 8260_VOA_GCMS | U | 0.079 | ug/L | 11/3/2008 | |
| 699-25-33A | Sulfate | 300.0_ANIONS_IC | D | 21900 | ug/L | 2/18/1997 | |
| 699-25-33A | Sulfate | 300.0_ANIONS_IC | D | 21700 | ug/L | 8/13/1997 | |

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|---|---|---|---|---|---|---|---|
| 699-25-33A | Sulfate | 300.0_ANIONS_IC | D | 21400 | ug/L | 2/23/1998 | |
| 699-25-33A | Sulfate | 300.0_ANIONS_IC | D | 21300 | ug/L | 2/23/1998 | |
| 699-25-33A | Sulfate | 300.0_ANIONS_IC | D | 21200 | ug/L | 8/24/1998 | /Field blank collected same date is suspect |
| 699-25-33A | Sulfate | 300.0_ANIONS_IC | D | 22300 | ug/L | 2/8/1999 | |
| 699-25-33A | Sulfate | 300.0_ANIONS_IC | CD | 21900 | ug/L | 8/16/1999 | |
| 699-25-33A | Sulfate | 300.0_ANIONS_IC | D | 22400 | ug/L | 2/29/2000 | |
| 699-25-33A | Sulfate | 300.0_ANIONS_IC | D | 22500 | ug/L | 2/29/2000 | |
| 699-25-33A | Sulfate | 300.0_ANIONS_IC | D | 21600 | ug/L | 10/6/2000 | |
| 699-25-33A | Sulfate | 300.0_ANIONS_IC | D | 24400 | ug/L | 2/26/2001 | |
| 699-25-33A | Sulfate | 300.0_ANIONS_IC | D | 23200 | ug/L | 8/14/2001 | |
| 699-25-33A | Sulfate | 300.0_ANIONS_IC | D | 24400 | ug/L | 2/12/2002 | |
| 699-25-33A | Sulfate | 300.0_ANIONS_IC | CD | 25600 | ug/L | 9/3/2002 | |
| 699-25-33A | Sulfate | 300.0_ANIONS_IC | D | 24500 | ug/L | 2/20/2003 | |
| 699-25-33A | Sulfate | 300.0_ANIONS_IC | D | 25600 | ug/L | 8/18/2003 | |
| 699-25-33A | Sulfate | 300.0_ANIONS_IC | D | 25700 | ug/L | 2/18/2004 | |
| 699-25-33A | Sulfate | 300.0_ANIONS_IC | D | 25300 | ug/L | 8/31/2004 | |
| 699-25-33A | Sulfate | 300.0_ANIONS_IC | D | 26000 | ug/L | 2/17/2005 | |
| 699-25-33A | Sulfate | 300.0_ANIONS_IC | D | 28500 | ug/L | 8/2/2005 | |
| 699-25-33A | Sulfate | 300.0_ANIONS_IC | D | 28300 | ug/L | 2/23/2006 | |
| 699-25-33A | Sulfate | 300.0_ANIONS_IC | D | 29200 | ug/L | 9/1/2006 | |
| 699-25-33A | Sulfate | 300.0_ANIONS_IC | D | 29100 | ug/L | 9/1/2006 | |
| 699-25-33A | Sulfate | 300.0_ANIONS_IC | D | 28100 | ug/L | 2/13/2007 | |
| 699-25-33A | Sulfate | 300.0_ANIONS_IC | | 30300 | ug/L | 9/24/2007 | |
| 699-25-33A | Sulfate | 300.0_ANIONS_IC | D | 31200 | ug/L | 2/26/2008 | |
| 699-25-33A | Sulfate | 300.0_ANIONS_IC | DN | 30200 | ug/L | 8/24/2008 | |
| 699-25-33A | Sulfate | 300.0_ANIONS_IC | D | 29900 | ug/L | 11/3/2008 | |
| 699-25-33A | Sulfate | 300.0_ANIONS_IC | D | 30300 | ug/L | 1/29/2009 | |

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|---|---|---|---|---|---|---|---|
| 699-25-33A | Sulfate | 300.0_ANIONS_IC | D | 31600 | ug/L | 7/20/2009 | |
| 699-25-33A | Technetium-99 | TC99_3MDSK_LSC | | 24 | pCi/L | 11/3/2008 | |
| 699-25-33A | Temperature | 170.1_TEMP_FLD | | 19.1 | Deg C | 2/23/2006 | |
| 699-25-33A | Temperature | 170.1_TEMP_FLD | | 19.9 | Deg C | 9/1/2006 | |
| 699-25-33A | Temperature | 170.1_TEMP_FLD | | 19 | Deg C | 2/13/2007 | |
| 699-25-33A | Temperature | TEMP_FLD | | 19.5 | Deg C | 2/18/1997 | |
| 699-25-33A | Temperature | TEMP_FLD | | 19.6 | Deg C | 2/18/1997 | |
| 699-25-33A | Temperature | TEMP_FLD | | 19.5 | Deg C | 2/18/1997 | |
| 699-25-33A | Temperature | TEMP_FLD | | 19.6 | Deg C | 2/18/1997 | |
| 699-25-33A | Temperature | TEMP_FLD | | 19.8 | Deg C | 8/13/1997 | |
| 699-25-33A | Temperature | TEMP_FLD | | 19.8 | Deg C | 8/13/1997 | |
| 699-25-33A | Temperature | TEMP_FLD | | 19.8 | Deg C | 8/13/1997 | |
| 699-25-33A | Temperature | TEMP_FLD | | 19.8 | Deg C | 8/13/1997 | |
| 699-25-33A | Temperature | TEMP_FLD | | 19.4 | Deg C | 2/23/1998 | |
| 699-25-33A | Temperature | TEMP_FLD | | 19.5 | Deg C | 2/23/1998 | |
| 699-25-33A | Temperature | TEMP_FLD | | 19.5 | Deg C | 2/23/1998 | |
| 699-25-33A | Temperature | TEMP_FLD | | 19.5 | Deg C | 2/23/1998 | |
| 699-25-33A | Temperature | TEMP_FLD | | 19.6 | Deg C | 8/24/1998 | |
| 699-25-33A | Temperature | TEMP_FLD | | 19.6 | Deg C | 8/24/1998 | |
| 699-25-33A | Temperature | TEMP_FLD | | 19.6 | Deg C | 8/24/1998 | |
| 699-25-33A | Temperature | TEMP_FLD | | 19.6 | Deg C | 8/24/1998 | |
| 699-25-33A | Temperature | TEMP_FLD | | 19.3 | Deg C | 2/8/1999 | |
| 699-25-33A | Temperature | TEMP_FLD | | 19.3 | Deg C | 2/8/1999 | |
| 699-25-33A | Temperature | TEMP_FLD | | 19.3 | Deg C | 2/8/1999 | |
| 699-25-33A | Temperature | TEMP_FLD | | 19.3 | Deg C | 2/8/1999 | |
| 699-25-33A | Temperature | TEMP_FLD | | 19.9 | Deg C | 8/16/1999 | |
| 699-25-33A | Temperature | TEMP_FLD | | 19.9 | Deg C | 8/16/1999 | |
| 699-25-33A | Temperature | TEMP_FLD | | 20 | Deg C | 8/16/1999 | |
| 699-25-33A | Temperature | TEMP_FLD | | 20 | Deg C | 8/16/1999 | |
| 699-25-33A | Temperature | TEMP_FLD | | 19.6 | Deg C | 2/29/2000 | |
| 699-25-33A | Temperature | TEMP_FLD | | 19.6 | Deg C | 2/29/2000 | |
| 699-25-33A | Temperature | TEMP_FLD | | 19.6 | Deg C | 2/29/2000 | |
| 699-25-33A | Temperature | TEMP_FLD | | 19.6 | Deg C | 2/29/2000 | |
| 699-25-33A | Temperature | TEMP_FLD | | 19.5 | Deg C | 10/6/2000 | |
| 699-25-33A | Temperature | TEMP_FLD | | 19.6 | Deg C | 10/6/2000 | |
| 699-25-33A | Temperature | TEMP_FLD | | 19.5 | Deg C | 10/6/2000 | |
| 699-25-33A | Temperature | TEMP_FLD | | 19.5 | Deg C | 10/6/2000 | |
| 699-25-33A | Temperature | TEMP_FLD | | 19.1 | Deg C | 2/26/2001 | |
| 699-25-33A | Temperature | TEMP_FLD | | 19.1 | Deg C | 2/26/2001 | |
| 699-25-33A | Temperature | TEMP_FLD | | 19.1 | Deg C | 2/26/2001 | |
| 699-25-33A | Temperature | TEMP_FLD | | 19 | Deg C | 2/26/2001 | |
| 699-25-33A | Temperature | TEMP_FLD | | 19.5 | Deg C | 8/14/2001 | |
| 699-25-33A | Temperature | TEMP_FLD | | 19.7 | Deg C | 2/12/2002 | |
| 699-25-33A | Temperature | TEMP_FLD | | 19.7 | Deg C | 2/12/2002 | |
| 699-25-33A | Temperature | TEMP_FLD | | 19.6 | Deg C | 2/12/2002 | |
| 699-25-33A | Temperature | TEMP_FLD | | 19.7 | Deg C | 2/12/2002 | |
| 699-25-33A | Temperature | TEMP_FLD | | 19.7 | Deg C | 9/3/2002 | |
| 699-25-33A | Temperature | TEMP_FLD | | 19 | Deg C | 2/20/2003 | |
| 699-25-33A | Temperature | TEMP_FLD | | 19.9 | Deg C | 8/18/2003 | |
| 699-25-33A | Temperature | TEMP_FLD | | 18.9 | Deg C | 2/18/2004 | |
| 699-25-33A | Temperature | TEMP_FLD | | 20 | Deg C | 8/31/2004 | |

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|---|---|---|---|---|---|---|---|
| 699-25-33A | Temperature | TEMP_FLD | | 19.1 | Deg C | 2/17/2005 | |
| 699-25-33A | Temperature | TEMP_FLD | | 20.2 | Deg C | 8/2/2005 | |
| 699-25-33A | Temperature | TEMP_FLD | | 19.9 | Deg C | 9/24/2007 | |
| 699-25-33A | Temperature | TEMP_FLD | | 19.5 | Deg C | 2/26/2008 | |
| 699-25-33A | Temperature | TEMP_FLD | | 19.5 | Deg C | 2/26/2008 | |
| 699-25-33A | Temperature | TEMP_FLD | | 19.4 | Deg C | 2/26/2008 | |
| 699-25-33A | Temperature | TEMP_FLD | | 19.5 | Deg C | 2/26/2008 | |
| 699-25-33A | Temperature | TEMP_FLD | | 20 | Deg C | 8/24/2008 | |
| 699-25-33A | Temperature | TEMP_FLD | | 20 | Deg C | 8/24/2008 | |
| 699-25-33A | Temperature | TEMP_FLD | | 19.9 | Deg C | 8/24/2008 | |
| 699-25-33A | Temperature | TEMP_FLD | | 20 | Deg C | 8/24/2008 | |
| 699-25-33A | Temperature | TEMP_FLD | | 19.5 | Deg C | 11/3/2008 | |
| 699-25-33A | Temperature | TEMP_FLD | | 19.4 | Deg C | 1/29/2009 | |
| 699-25-33A | Temperature | TEMP_FLD | | 20.1 | Deg C | 7/20/2009 | |
| 699-25-33A | Tetrachloroethene | 524.2_VOA_GCMS | U | 0.41 | ug/L | 8/24/1998 | |
| 699-25-33A | Tetrachloroethene | 524.2_VOA_GCMS | U | 0.41 | ug/L | 2/8/1999 | |
| 699-25-33A | Tetrachloroethene | 524.2_VOA_GCMS | U | 0.41 | ug/L | 8/16/1999 | |
| 699-25-33A | Tetrachloroethene | 8010_VOA_GC | U | 0.2 | ug/L | 2/18/1997 | |
| 699-25-33A | Tetrachloroethene | 8010_VOA_GC | U | 0.031 | ug/L | 8/13/1997 | |
| 699-25-33A | Tetrachloroethene | 8010_VOA_GC | U | 0.031 | ug/L | 2/23/1998 | |
| 699-25-33A | Tetrachloroethene | 8010_VOA_GC | U | 0.031 | ug/L | 2/23/1998 | |
| 699-25-33A | Tetrachloroethene | 8260_VOA_GCMS | U | 0.57 | ug/L | 2/29/2000 | |
| 699-25-33A | Tetrachloroethene | 8260_VOA_GCMS | U | 0.57 | ug/L | 2/29/2000 | |
| 699-25-33A | Tetrachloroethene | 8260_VOA_GCMS | U | 0.57 | ug/L | 10/6/2000 | |
| 699-25-33A | Tetrachloroethene | 8260_VOA_GCMS | U | 0.57 | ug/L | 2/26/2001 | |
| 699-25-33A | Tetrachloroethene | 8260_VOA_GCMS | U | 0.36 | ug/L | 8/14/2001 | |
| 699-25-33A | Tetrachloroethene | 8260_VOA_GCMS | J | 0.94 | ug/L | 2/12/2002 | |
| 699-25-33A | Tetrachloroethene | 8260_VOA_GCMS | U | 0.36 | ug/L | 9/3/2002 | |
| 699-25-33A | Tetrachloroethene | 8260_VOA_GCMS | U | 0.17 | ug/L | 2/20/2003 | |
| 699-25-33A | Tetrachloroethene | 8260_VOA_GCMS | U | 0.17 | ug/L | 8/18/2003 | |
| 699-25-33A | Tetrachloroethene | 8260_VOA_GCMS | U | 0.17 | ug/L | 2/18/2004 | |
| 699-25-33A | Tetrachloroethene | 8260_VOA_GCMS | U | 0.08 | ug/L | 8/31/2004 | |
| 699-25-33A | Tetrachloroethene | 8260_VOA_GCMS | UN | 0.1 | ug/L | 2/17/2005 | |
| 699-25-33A | Tetrachloroethene | 8260_VOA_GCMS | U | 0.1 | ug/L | 8/2/2005 | |
| 699-25-33A | Tetrachloroethene | 8260_VOA_GCMS | U | 0.19 | ug/L | 2/23/2006 | |

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|---|---|---|---|---|---|---|---|
| 699-25-33A | Tetrachloroethene | 8260_VOA_GCMS | U | 0.19 | ug/L | 9/1/2006 | |
| 699-25-33A | Tetrachloroethene | 8260_VOA_GCMS | U | 0.19 | ug/L | 9/1/2006 | |
| 699-25-33A | Tetrachloroethene | 8260_VOA_GCMS | U | 0.17 | ug/L | 2/13/2007 | |
| 699-25-33A | Tetrachloroethene | 8260_VOA_GCMS | U | 0.17 | ug/L | 9/24/2007 | |
| 699-25-33A | Tetrachloroethene | 8260_VOA_GCMS | U | 1 | ug/L | 2/26/2008 | |
| 699-25-33A | Tetrachloroethene | 8260_VOA_GCMS | U | 1 | ug/L | 8/24/2008 | |
| 699-25-33A | Tetrachloroethene | 8260_VOA_GCMS | U | 0.14 | ug/L | 11/3/2008 | |
| 699-25-33A | Tetrachloroethene | 8260_VOA_GCMS | U | 1 | ug/L | 1/29/2009 | |
| 699-25-33A | Tetrachloroethene | 8260_VOA_GCMS | U | 1 | ug/L | 7/20/2009 | |
| 699-25-33A | Tetrahydrofuran | 8260_VOA_GCMS | U | 1.5 | ug/L | 2/29/2000 | |
| 699-25-33A | Tetrahydrofuran | 8260_VOA_GCMS | U | 1.5 | ug/L | 2/29/2000 | |
| 699-25-33A | Tetrahydrofuran | 8260_VOA_GCMS | U | 1.5 | ug/L | 10/6/2000 | |
| 699-25-33A | Tetrahydrofuran | 8260_VOA_GCMS | U | 1.5 | ug/L | 2/26/2001 | |
| 699-25-33A | Tetrahydrofuran | 8260_VOA_GCMS | U | 2.3 | ug/L | 8/14/2001 | |
| 699-25-33A | Tetrahydrofuran | 8260_VOA_GCMS | U | 2.3 | ug/L | 2/12/2002 | |
| 699-25-33A | Tetrahydrofuran | 8260_VOA_GCMS | U | 2.3 | ug/L | 9/3/2002 | |
| 699-25-33A | Tetrahydrofuran | 8260_VOA_GCMS | U | 1.7 | ug/L | 2/20/2003 | |
| 699-25-33A | Tetrahydrofuran | 8260_VOA_GCMS | U | 1.7 | ug/L | 8/18/2003 | |
| 699-25-33A | Tetrahydrofuran | 8260_VOA_GCMS | U | 1.7 | ug/L | 2/18/2004 | |
| 699-25-33A | Tetrahydrofuran | 8260_VOA_GCMS | U | 1.7 | ug/L | 8/31/2004 | |
| 699-25-33A | Tetrahydrofuran | 8260_VOA_GCMS | U | 1.2 | ug/L | 2/17/2005 | |
| 699-25-33A | Tetrahydrofuran | 8260_VOA_GCMS | U | 1.2 | ug/L | 8/2/2005 | |
| 699-25-33A | Tetrahydrofuran | 8260_VOA_GCMS | U | 2.9 | ug/L | 2/23/2006 | |
| 699-25-33A | Tetrahydrofuran | 8260_VOA_GCMS | U | 2.9 | ug/L | 9/1/2006 | |
| 699-25-33A | Tetrahydrofuran | 8260_VOA_GCMS | U | 2.9 | ug/L | 9/1/2006 | |
| 699-25-33A | Tetrahydrofuran | 8260_VOA_GCMS | U | 1.2 | ug/L | 2/13/2007 | |
| 699-25-33A | Tetrahydrofuran | 8260_VOA_GCMS | U | 1.2 | ug/L | 9/24/2007 | |
| 699-25-33A | Tetrahydrofuran | 8260_VOA_GCMS | U | 2 | ug/L | 2/26/2008 | |

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|---|---|---|---|---|---|---|---|
| 699-25-33A | Tetrahydrofuran | 8260_VOA_GCMS | U | 2 | ug/L | 8/24/2008 | |
| 699-25-33A | Tetrahydrofuran | 8260_VOA_GCMS | U | 3.2 | ug/L | 11/3/2008 | |
| 699-25-33A | Tetrahydrofuran | 8260_VOA_GCMS | U | 2 | ug/L | 1/29/2009 | |
| 699-25-33A | Tetrahydrofuran | 8260_VOA_GCMS | U | 2 | ug/L | 7/20/2009 | |
| 699-25-33A | Thallium | 200.8_METALS_ICPMS | U | 0.05 | ug/L | 11/3/2008 | |
| 699-25-33A | Toluene | 524.2_VOA_GCMS | U | 0.22 | ug/L | 8/24/1998 | |
| 699-25-33A | Toluene | 524.2_VOA_GCMS | U | 0.22 | ug/L | 2/8/1999 | |
| 699-25-33A | Toluene | 8020_VOA_GC | U | 0.2 | ug/L | 2/18/1997 | |
| 699-25-33A | Toluene | 8020_VOA_GC | U | 0.024 | ug/L | 2/23/1998 | |
| 699-25-33A | Toluene | 8020_VOA_GC | | 0.29 | ug/L | 2/23/1998 | |
| 699-25-33A | Toluene | 8260_VOA_GCMS | U | 0.33 | ug/L | 2/29/2000 | |
| 699-25-33A | Toluene | 8260_VOA_GCMS | U | 0.33 | ug/L | 2/29/2000 | |
| 699-25-33A | Toluene | 8260_VOA_GCMS | U | 0.33 | ug/L | 10/6/2000 | |
| 699-25-33A | Toluene | 8260_VOA_GCMS | U | 0.33 | ug/L | 2/26/2001 | |
| 699-25-33A | Toluene | 8260_VOA_GCMS | U | 0.23 | ug/L | 8/14/2001 | |
| 699-25-33A | Toluene | 8260_VOA_GCMS | U | 0.23 | ug/L | 2/12/2002 | |
| 699-25-33A | Toluene | 8260_VOA_GCMS | U | 0.23 | ug/L | 9/3/2002 | |
| 699-25-33A | Toluene | 8260_VOA_GCMS | U | 0.12 | ug/L | 2/20/2003 | |
| 699-25-33A | Toluene | 8260_VOA_GCMS | U | 0.12 | ug/L | 8/18/2003 | |
| 699-25-33A | Toluene | 8260_VOA_GCMS | U | 0.12 | ug/L | 2/18/2004 | |
| 699-25-33A | Toluene | 8260_VOA_GCMS | U | 0.07 | ug/L | 8/31/2004 | |
| 699-25-33A | Toluene | 8260_VOA_GCMS | U | 0.08 | ug/L | 2/17/2005 | |
| 699-25-33A | Toluene | 8260_VOA_GCMS | U | 0.08 | ug/L | 8/2/2005 | |
| 699-25-33A | Toluene | 8260_VOA_GCMS | U | 0.2 | ug/L | 2/23/2006 | |
| 699-25-33A | Toluene | 8260_VOA_GCMS | U | 0.2 | ug/L | 9/1/2006 | |
| 699-25-33A | Toluene | 8260_VOA_GCMS | U | 0.2 | ug/L | 9/1/2006 | |
| 699-25-33A | Toluene | 8260_VOA_GCMS | U | 0.025 | ug/L | 2/13/2007 | |
| 699-25-33A | Toluene | 8260_VOA_GCMS | U | 0.1 | ug/L | 9/24/2007 | |

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|---|---|---|---|---|---|---|---|
| 699-25-33A | Toluene | 8260_VOA_GCMS | U | 1 | ug/L | 2/26/2008 | |
| 699-25-33A | Toluene | 8260_VOA_GCMS | U | 1 | ug/L | 8/24/2008 | |
| 699-25-33A | Toluene | 8260_VOA_GCMS | U | 0.029 | ug/L | 11/3/2008 | |
| 699-25-33A | Toluene | 8260_VOA_GCMS | U | 1 | ug/L | 1/29/2009 | |
| 699-25-33A | Toluene | 8260_VOA_GCMS | U | 1 | ug/L | 7/20/2009 | |
| 699-25-33A | Total beta radiostrontium | SRTOT_SEP_PRECIP_GPC | U | -1.32 | pCi/L | 11/3/2008 | |
| 699-25-33A | Total carbon | 415.1_TOC | | 32000 | ug/L | 2/18/1997 | |
| 699-25-33A | Total carbon | 415.1_TOC | | 20800 | ug/L | 8/13/1997 | |
| 699-25-33A | Total carbon | 415.1_TOC | C | 28800 | ug/L | 2/23/1998 | |
| 699-25-33A | Total carbon | 415.1_TOC | C | 27200 | ug/L | 2/23/1998 | |
| 699-25-33A | Total carbon | 415.1_TOC | D | 20300 | ug/L | 8/24/1998 | |
| 699-25-33A | Total carbon | 415.1_TOC | | 17900 | ug/L | 2/8/1999 | /Associated with suspect field blank (FTB210/699-24-34C) |
| 699-25-33A | Total dissolved solids | 160.1_TDS | | 217000 | ug/L | 2/18/1997 | |
| 699-25-33A | Total dissolved solids | 160.1_TDS | | 165000 | ug/L | 8/13/1997 | |
| 699-25-33A | Total dissolved solids | 160.1_TDS | | 172000 | ug/L | 2/23/1998 | /Associated with suspect field blank analysis |
| 699-25-33A | Total dissolved solids | 160.1_TDS | | 171000 | ug/L | 2/23/1998 | /Associated with suspect field blank analysis |
| 699-25-33A | Total dissolved solids | 160.1_TDS | | 233000 | ug/L | 8/24/1998 | /Field blank collected same date is suspect |
| 699-25-33A | Total dissolved solids | 160.1_TDS | | 195000 | ug/L | 2/8/1999 | /Associated with suspect field blank (FTB210/699-24-34C) |
| 699-25-33A | Total organic carbon | 9060_TOC | U | 532 | ug/L | 2/18/1997 | |
| 699-25-33A | Total organic carbon | 9060_TOC | U | 532 | ug/L | 2/18/1997 | |
| 699-25-33A | Total organic carbon | 9060_TOC | U | 532 | ug/L | 2/18/1997 | |
| 699-25-33A | Total organic carbon | 9060_TOC | U | 532 | ug/L | 2/18/1997 | |
| 699-25-33A | Total organic carbon | 9060_TOC | B | 446 | ug/L | 8/13/1997 | |

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|---|---|---|---|---|---|---|---|
| 699-25-33A | Total organic carbon | 9060_TOC | B | 438 | ug/L | 8/13/1997 | |
| 699-25-33A | Total organic carbon | 9060_TOC | UC | 370 | ug/L | 8/13/1997 | |
| 699-25-33A | Total organic carbon | 9060_TOC | B | 808 | ug/L | 8/13/1997 | |
| 699-25-33A | Total organic carbon | 9060_TOC | BC | 576 | ug/L | 2/23/1998 | /Associated with suspect field blank analysis |
| 699-25-33A | Total organic carbon | 9060_TOC | BC | 677 | ug/L | 2/23/1998 | /Associated with suspect field blank analysis |
| 699-25-33A | Total organic carbon | 9060_TOC | BC | 736 | ug/L | 2/23/1998 | /Associated with suspect field blank analysis |
| 699-25-33A | Total organic carbon | 9060_TOC | BC | 862 | ug/L | 2/23/1998 | /Associated with suspect field blank analysis |
| 699-25-33A | Total organic carbon | 9060_TOC | BC | 876 | ug/L | 2/23/1998 | /Associated with suspect field blank analysis |
| 699-25-33A | Total organic carbon | 9060_TOC | C | 3160 | ug/L | 2/23/1998 | "Y" review flag added per RDR 980715QL-R304/Associated with suspect field blank analysis |
| 699-25-33A | Total organic carbon | 9060_TOC | BC | 931 | ug/L | 2/23/1998 | /Associated with suspect field blank analysis |
| 699-25-33A | Total organic carbon | 9060_TOC | BC | 538 | ug/L | 2/23/1998 | /Associated with suspect field blank analysis |
| 699-25-33A | Total organic carbon | 9060_TOC | B | 538 | ug/L | 8/24/1998 | |
| 699-25-33A | Total organic carbon | 9060_TOC | B | 464 | ug/L | 8/24/1998 | |
| 699-25-33A | Total organic carbon | 9060_TOC | B | 540 | ug/L | 8/24/1998 | |
| 699-25-33A | Total organic carbon | 9060_TOC | B | 468 | ug/L | 8/24/1998 | |

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|---|---|---|---|---|---|---|---|
| 699-25-33A | Total organic carbon | 9060_TOC | BC | 479 | ug/L | 2/8/1999 | /Associated with suspect field blank (FTB210/699-24-34C)/Associated with suspect field blank (FTB210/699-24-34C) |
| 699-25-33A | Total organic carbon | 9060_TOC | BC | 395 | ug/L | 2/8/1999 | /Associated with suspect field blank (FTB210/699-24-34C)/Associated with suspect field blank (FTB210/699-24-34C) |
| 699-25-33A | Total organic carbon | 9060_TOC | BC | 390 | ug/L | 2/8/1999 | /Associated with suspect field blank (FTB210/699-24-34C)/Associated with suspect field blank (FTB210/699-24-34C) |
| 699-25-33A | Total organic carbon | 9060_TOC | BC | 373 | ug/L | 2/8/1999 | /Associated with suspect field blank (FTB210/699-24-34C)/Associated with suspect field blank (FTB210/699-24-34C) |
| 699-25-33A | Total organic carbon | 9060_TOC | B | 446 | ug/L | 8/16/1999 | |
| 699-25-33A | Total organic carbon | 9060_TOC | B | 308 | ug/L | 8/16/1999 | |
| 699-25-33A | Total organic carbon | 9060_TOC | B | 365 | ug/L | 8/16/1999 | |
| 699-25-33A | Total organic carbon | 9060_TOC | B | 399 | ug/L | 8/16/1999 | |
| 699-25-33A | Total organic carbon | 9060_TOC | B | 930 | ug/L | 2/29/2000 | /Associated with suspect field blank (FTB278/699-26-34B) |

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|---|---|---|---|---|---|---|---|
| 699-25-33A | Total organic carbon | 9060_TOC | B | 940 | ug/L | 2/29/2000 | /Associated with suspect field blank (FTB278/699-26-34B) |
| 699-25-33A | Total organic carbon | 9060_TOC | B | 980 | ug/L | 2/29/2000 | /Associated with suspect field blank (FTB278/699-26-34B) |
| 699-25-33A | Total organic carbon | 9060_TOC | B | 990 | ug/L | 2/29/2000 | /Associated with suspect field blank (FTB278/699-26-34B) |
| 699-25-33A | Total organic carbon | 9060_TOC | B | 340 | ug/L | 10/6/2000 | |
| 699-25-33A | Total organic carbon | 9060_TOC | B | 270 | ug/L | 10/6/2000 | |
| 699-25-33A | Total organic carbon | 9060_TOC | B | 370 | ug/L | 10/6/2000 | |
| 699-25-33A | Total organic carbon | 9060_TOC | B | 320 | ug/L | 10/6/2000 | |
| 699-25-33A | Total organic carbon | 9060_TOC | B | 440 | ug/L | 2/26/2001 | |
| 699-25-33A | Total organic carbon | 9060_TOC | B | 470 | ug/L | 2/26/2001 | |
| 699-25-33A | Total organic carbon | 9060_TOC | B | 450 | ug/L | 2/26/2001 | |
| 699-25-33A | Total organic carbon | 9060_TOC | BC | 250 | ug/L | 8/14/2001 | |
| 699-25-33A | Total organic carbon | 9060_TOC | U | 140 | ug/L | 2/12/2002 | |
| 699-25-33A | Total organic carbon | 9060_TOC | U | 140 | ug/L | 2/12/2002 | |
| 699-25-33A | Total organic carbon | 9060_TOC | B | 170 | ug/L | 2/12/2002 | |
| 699-25-33A | Total organic carbon | 9060_TOC | U | 140 | ug/L | 2/12/2002 | |
| 699-25-33A | Total organic carbon | 9060_TOC | U | 140 | ug/L | 9/3/2002 | |
| 699-25-33A | Total organic carbon | 9060_TOC | U | 140 | ug/L | 2/20/2003 | |
| 699-25-33A | Total organic carbon | 9060_TOC | U | 140 | ug/L | 2/20/2003 | |
| 699-25-33A | Total organic carbon | 9060_TOC | U | 140 | ug/L | 2/20/2003 | |
| 699-25-33A | Total organic carbon | 9060_TOC | U | 140 | ug/L | 2/20/2003 | |
| 699-25-33A | Total organic carbon | 9060_TOC | U | 390 | ug/L | 8/18/2003 | |
| 699-25-33A | Total organic carbon | 9060_TOC | B | 470 | ug/L | 2/18/2004 | |
| 699-25-33A | Total organic carbon | 9060_TOC | U | 390 | ug/L | 8/31/2004 | |

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|---|---|---|---|---|---|---|---|
| 699-25-33A | Total organic carbon | 9060_TOC | U | 430 | ug/L | 2/17/2005 | |
| 699-25-33A | Total organic carbon | 9060_TOC | | 1000 | ug/L | 8/2/2005 | /Associated with suspect field blank (FTB1001/699-25-34B)/"G" Review flag added per RDR 060625STLSL-R3479 |
| 699-25-33A | Total organic carbon | 9060_TOC | | 1300 | ug/L | 2/23/2006 | "R" Review flag added per RDR 060625STLSL-R3482 |
| 699-25-33A | Total organic carbon | 9060_TOC | U | 470 | ug/L | 9/1/2006 | |
| 699-25-33A | Total organic carbon | 9060_TOC | U | 470 | ug/L | 9/1/2006 | |
| 699-25-33A | Total organic carbon | 9060_TOC | X | 362 | ug/L | 2/13/2007 | "R" Review flag added per RDR 070821WSCF-R4068 |
| 699-25-33A | Total organic carbon | 9060_TOC | U | 760 | ug/L | 9/24/2007 | |
| 699-25-33A | Total organic carbon | 9060_TOC | U | 300 | ug/L | 2/26/2008 | "Y" Review flag added per RDR 080814WSCF-R5077 |
| 699-25-33A | Total organic carbon | 9060_TOC | | 4610 | ug/L | 2/26/2008 | "Y" Review flag added per RDR 080709WSCF-R4977 |
| 699-25-33A | Total organic carbon | 9060_TOC | | 1950 | ug/L | 2/26/2008 | "Y" Review flag added per RDR 080709WSCF-R4977 |
| 699-25-33A | Total organic carbon | 9060_TOC | | 7290 | ug/L | 2/26/2008 | "Y" Review flag added per RDR 080709WSCF-R4977 |
| 699-25-33A | Total organic carbon | 9060_TOC | U | 200 | ug/L | 8/24/2008 | |
| 699-25-33A | Total organic carbon | 9060_TOC | U | 200 | ug/L | 8/24/2008 | |
| 699-25-33A | Total organic carbon | 9060_TOC | U | 200 | ug/L | 8/24/2008 | |
| 699-25-33A | Total organic carbon | 9060_TOC | U | 200 | ug/L | 8/24/2008 | |

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|---|---|---|---|---|---|---|---|
| 699-25-33A | Total organic carbon | 9060_TOC | U | 300 | ug/L | 1/29/2009 | |
| 699-25-33A | Total organic carbon | 9060_TOC | U | 300 | ug/L | 7/20/2009 | |
| 699-25-33A | Total organic halides | 9020_TOX | U | 2.65 | ug/L | 2/18/1997 | |
| 699-25-33A | Total organic halides | 9020_TOX | U | 2.65 | ug/L | 2/18/1997 | |
| 699-25-33A | Total organic halides | 9020_TOX | U | 2.65 | ug/L | 2/18/1997 | |
| 699-25-33A | Total organic halides | 9020_TOX | | 5.9 | ug/L | 2/18/1997 | |
| 699-25-33A | Total organic halides | 9020_TOX | | 6.55 | ug/L | 8/13/1997 | |
| 699-25-33A | Total organic halides | 9020_TOX | | 5.1 | ug/L | 8/13/1997 | |
| 699-25-33A | Total organic halides | 9020_TOX | | 13.8 | ug/L | 8/13/1997 | |
| 699-25-33A | Total organic halides | 9020_TOX | U | 4.62 | ug/L | 8/13/1997 | |
| 699-25-33A | Total organic halides | 9020_TOX | U | 4.62 | ug/L | 2/23/1998 | |
| 699-25-33A | Total organic halides | 9020_TOX | U | 4.62 | ug/L | 2/23/1998 | |
| 699-25-33A | Total organic halides | 9020_TOX | U | 4.62 | ug/L | 2/23/1998 | |
| 699-25-33A | Total organic halides | 9020_TOX | U | 4.62 | ug/L | 2/23/1998 | |
| 699-25-33A | Total organic halides | 9020_TOX | U | 4.62 | ug/L | 2/23/1998 | |
| 699-25-33A | Total organic halides | 9020_TOX | U | 4.62 | ug/L | 2/23/1998 | |
| 699-25-33A | Total organic halides | 9020_TOX | U | 4.62 | ug/L | 2/23/1998 | |
| 699-25-33A | Total organic halides | 9020_TOX | U | 4.62 | ug/L | 2/23/1998 | |
| 699-25-33A | Total organic halides | 9020_TOX | U | 2.38 | ug/L | 8/24/1998 | /Field blank collected same date is suspect |
| 699-25-33A | Total organic halides | 9020_TOX | | 5.8 | ug/L | 8/24/1998 | /Field blank collected same date is suspect |
| 699-25-33A | Total organic halides | 9020_TOX | | 6.45 | ug/L | 8/24/1998 | /Field blank collected same date is suspect |
| 699-25-33A | Total organic halides | 9020_TOX | | 5.95 | ug/L | 8/24/1998 | /Field blank collected same date is suspect |
| 699-25-33A | Total organic halides | 9020_TOX | U | 2.38 | ug/L | 2/8/1999 | /Associated with suspect field blank (FTB210/699-24-34C) |

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|---|---|---|---|---|---|---|---|
| 699-25-33A | Total organic halides | 9020_TOX | U | 2.38 | ug/L | 2/8/1999 | /Associated with suspect field blank (FTB210/699-24-34C) |
| 699-25-33A | Total organic halides | 9020_TOX | B | 2.8 | ug/L | 2/8/1999 | /Associated with suspect field blank (FTB210/699-24-34C) |
| 699-25-33A | Total organic halides | 9020_TOX | B | 2.7 | ug/L | 2/8/1999 | /Associated with suspect field blank (FTB210/699-24-34C) |
| 699-25-33A | Total organic halides | 9020_TOX | U | 4.27 | ug/L | 8/16/1999 | |
| 699-25-33A | Total organic halides | 9020_TOX | U | 4.27 | ug/L | 8/16/1999 | |
| 699-25-33A | Total organic halides | 9020_TOX | U | 4.27 | ug/L | 8/16/1999 | |
| 699-25-33A | Total organic halides | 9020_TOX | | 6.35 | ug/L | 8/16/1999 | |
| 699-25-33A | Total organic halides | 9020_TOX | | 7.4 | ug/L | 2/29/2000 | |
| 699-25-33A | Total organic halides | 9020_TOX | U | 4.3 | ug/L | 2/29/2000 | |
| 699-25-33A | Total organic halides | 9020_TOX | U | 4.3 | ug/L | 2/29/2000 | |
| 699-25-33A | Total organic halides | 9020_TOX | U | 4.3 | ug/L | 2/29/2000 | |
| 699-25-33A | Total organic halides | 9020_TOX | DN | 52.6 | ug/L | 10/6/2000 | "Y" Review flag added per RDR 010201ST-R1009 |
| 699-25-33A | Total organic halides | 9020_TOX | BDN | 8.8 | ug/L | 10/6/2000 | |
| 699-25-33A | Total organic halides | 9020_TOX | UDN | 8.5 | ug/L | 10/6/2000 | |
| 699-25-33A | Total organic halides | 9020_TOX | UDN | 8.5 | ug/L | 10/6/2000 | |
| 699-25-33A | Total organic halides | 9020_TOX | U | 4.3 | ug/L | 2/26/2001 | |
| 699-25-33A | Total organic halides | 9020_TOX | U | 4.3 | ug/L | 2/26/2001 | |
| 699-25-33A | Total organic halides | 9020_TOX | U | 4.3 | ug/L | 2/26/2001 | |
| 699-25-33A | Total organic halides | 9020_TOX | U | 4.3 | ug/L | 2/26/2001 | |
| 699-25-33A | Total organic halides | 9020_TOX | U | 3.6 | ug/L | 8/14/2001 | |
| 699-25-33A | Total organic halides | 9020_TOX | U | 4 | ug/L | 2/12/2002 | |
| 699-25-33A | Total organic halides | 9020_TOX | U | 4 | ug/L | 2/12/2002 | |

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|---|---|---|---|---|---|---|---|
| 699-25-33A | Total organic halides | 9020_TOX | U | 4 | ug/L | 2/12/2002 | |
| 699-25-33A | Total organic halides | 9020_TOX | U | 4 | ug/L | 2/12/2002 | |
| 699-25-33A | Total organic halides | 9020_TOX | U | 4 | ug/L | 9/3/2002 | |
| 699-25-33A | Total organic halides | 9020_TOX | U | 4 | ug/L | 2/20/2003 | |
| 699-25-33A | Total organic halides | 9020_TOX | U | 4 | ug/L | 2/20/2003 | |
| 699-25-33A | Total organic halides | 9020_TOX | U | 4 | ug/L | 2/20/2003 | |
| 699-25-33A | Total organic halides | 9020_TOX | U | 4 | ug/L | 2/20/2003 | |
| 699-25-33A | Total organic halides | 9020_TOX | U | 2.2 | ug/L | 8/18/2003 | |
| 699-25-33A | Total organic halides | 9020_TOX | U | 2.2 | ug/L | 2/18/2004 | |
| 699-25-33A | Total organic halides | 9020_TOX | U | 2.2 | ug/L | 8/31/2004 | |
| 699-25-33A | Total organic halides | 9020_TOX | | 7.9 | ug/L | 2/17/2005 | "Y" Review flag added per RDR 050912STLSL-R3129 |
| 699-25-33A | Total organic halides | 9020_TOX | | 13.1 | ug/L | 8/2/2005 | |
| 699-25-33A | Total organic halides | 9020_TOX | | 8.5 | ug/L | 2/23/2006 | |
| 699-25-33A | Total organic halides | 9020_TOX | U | 2.6 | ug/L | 9/1/2006 | |
| 699-25-33A | Total organic halides | 9020_TOX | U | 2.6 | ug/L | 9/1/2006 | |
| 699-25-33A | Total organic halides | 9020_TOX | X | 6.27 | ug/L | 2/13/2007 | |
| 699-25-33A | Total organic halides | 9020_TOX | | 8.7 | ug/L | 9/24/2007 | |
| 699-25-33A | Total organic halides | 9020_TOX | U | 5 | ug/L | 2/26/2008 | |
| 699-25-33A | Total organic halides | 9020_TOX | X | 5.13 | ug/L | 2/26/2008 | |
| 699-25-33A | Total organic halides | 9020_TOX | U | 5 | ug/L | 2/26/2008 | |
| 699-25-33A | Total organic halides | 9020_TOX | U | 5 | ug/L | 2/26/2008 | |
| 699-25-33A | Total organic halides | 9020_TOX | U | 3.5 | ug/L | 8/24/2008 | |
| 699-25-33A | Total organic halides | 9020_TOX | U | 3.5 | ug/L | 8/24/2008 | |
| 699-25-33A | Total organic halides | 9020_TOX | U | 3.5 | ug/L | 8/24/2008 | |
| 699-25-33A | Total organic halides | 9020_TOX | U | 3.5 | ug/L | 8/24/2008 | |
| 699-25-33A | Total organic halides | 9020_TOX | U | 3.5 | ug/L | 1/29/2009 | |
| 699-25-33A | Total organic halides | 9020_TOX | U | 5 | ug/L | 7/20/2009 | |

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|---|---|---|---|---|---|---|---|
| 699-25-33A | Toxaphene | 8081_PEST_GC | U | 0.33 | ug/L | 11/3/2008 | |
| 699-25-33A | Tributyl phosphate | 8270_SVOA_GCMS | U | 1.5 | ug/L | 11/3/2008 | |
| 699-25-33A | Trichloroethene | 524.2_VOA_GCMS | U | 0.19 | ug/L | 8/24/1998 | |
| 699-25-33A | Trichloroethene | 524.2_VOA_GCMS | U | 0.19 | ug/L | 2/8/1999 | |
| 699-25-33A | Trichloroethene | 524.2_VOA_GCMS | U | 0.19 | ug/L | 8/16/1999 | |
| 699-25-33A | Trichloroethene | 8010_VOA_GC | U | 0.2 | ug/L | 2/18/1997 | |
| 699-25-33A | Trichloroethene | 8010_VOA_GC | U | 0.028 | ug/L | 8/13/1997 | |
| 699-25-33A | Trichloroethene | 8010_VOA_GC | U | 0.028 | ug/L | 2/23/1998 | |
| 699-25-33A | Trichloroethene | 8010_VOA_GC | U | 0.028 | ug/L | 2/23/1998 | |
| 699-25-33A | Trichloroethene | 8260_VOA_GCMS | U | 0.16 | ug/L | 2/29/2000 | |
| 699-25-33A | Trichloroethene | 8260_VOA_GCMS | U | 0.16 | ug/L | 2/29/2000 | |
| 699-25-33A | Trichloroethene | 8260_VOA_GCMS | U | 0.16 | ug/L | 10/6/2000 | |
| 699-25-33A | Trichloroethene | 8260_VOA_GCMS | U | 0.16 | ug/L | 2/26/2001 | |
| 699-25-33A | Trichloroethene | 8260_VOA_GCMS | U | 0.29 | ug/L | 8/14/2001 | |
| 699-25-33A | Trichloroethene | 8260_VOA_GCMS | J | 0.65 | ug/L | 2/12/2002 | |
| 699-25-33A | Trichloroethene | 8260_VOA_GCMS | U | 0.29 | ug/L | 9/3/2002 | |
| 699-25-33A | Trichloroethene | 8260_VOA_GCMS | U | 0.16 | ug/L | 2/20/2003 | |
| 699-25-33A | Trichloroethene | 8260_VOA_GCMS | U | 0.16 | ug/L | 8/18/2003 | |
| 699-25-33A | Trichloroethene | 8260_VOA_GCMS | U | 0.16 | ug/L | 2/18/2004 | |
| 699-25-33A | Trichloroethene | 8260_VOA_GCMS | U | 0.09 | ug/L | 8/31/2004 | |
| 699-25-33A | Trichloroethene | 8260_VOA_GCMS | U | 0.13 | ug/L | 2/17/2005 | |
| 699-25-33A | Trichloroethene | 8260_VOA_GCMS | U | 0.13 | ug/L | 8/2/2005 | |
| 699-25-33A | Trichloroethene | 8260_VOA_GCMS | U | 0.2 | ug/L | 2/23/2006 | |
| 699-25-33A | Trichloroethene | 8260_VOA_GCMS | U | 0.2 | ug/L | 9/1/2006 | |
| 699-25-33A | Trichloroethene | 8260_VOA_GCMS | U | 0.2 | ug/L | 9/1/2006 | |
| 699-25-33A | Trichloroethene | 8260_VOA_GCMS | U | 0.037 | ug/L | 2/13/2007 | |
| 699-25-33A | Trichloroethene | 8260_VOA_GCMS | U | 0.1 | ug/L | 9/24/2007 | |
| 699-25-33A | Trichloroethene | 8260_VOA_GCMS | U | 1 | ug/L | 2/26/2008 | |

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|---|---|---|---|---|---|---|---|
| 699-25-33A | Trichloroethene | 8260_VOA_GCMS | U | 1 | ug/L | 8/24/2008 | |
| 699-25-33A | Trichloroethene | 8260_VOA_GCMS | U | 0.11 | ug/L | 11/3/2008 | |
| 699-25-33A | Trichloroethene | 8260_VOA_GCMS | U | 1 | ug/L | 1/29/2009 | |
| 699-25-33A | Trichloroethene | 8260_VOA_GCMS | U | 1 | ug/L | 7/20/2009 | |
| 699-25-33A | Trichloromonofluoromethane | 8260_VOA_GCMS | U | 0.1 | ug/L | 11/3/2008 | |
| 699-25-33A | Tris-2-chloroethyl phosphate | 8270_SVOA_GCMS | U | 1 | ug/L | 11/3/2008 | |
| 699-25-33A | Tritium | 906.0_H3_LSC | | 1750 | pCi/L | 2/8/1999 | |
| 699-25-33A | Tritium | 906.0_H3_LSC | | 1720 | pCi/L | 8/16/1999 | |
| 699-25-33A | Tritium | TRITIUM_DIST_LSC | | 348 | pCi/L | 2/18/1997 | |
| 699-25-33A | Tritium | TRITIUM_DIST_LSC | | 523 | pCi/L | 8/13/1997 | |
| 699-25-33A | Tritium | TRITIUM_DIST_LSC | | 1120 | pCi/L | 2/23/1998 | |
| 699-25-33A | Tritium | TRITIUM_DIST_LSC | | 1010 | pCi/L | 2/23/1998 | |
| 699-25-33A | Tritium | TRITIUM_DIST_LSC | | 1390 | pCi/L | 8/24/1998 | |
| 699-25-33A | Tritium | TRITIUM_EIE_LSC | | 8100 | pCi/L | 11/3/2008 | |
| 699-25-33A | Turbidity | 180.1_TURBIDITY_FLD | | 1.44 | NTU | 2/23/2006 | |
| 699-25-33A | Turbidity | 180.1_TURBIDITY_FLD | | 2.83 | NTU | 9/1/2006 | |
| 699-25-33A | Turbidity | 180.1_TURBIDITY_FLD | | 4.83 | NTU | 2/13/2007 | |
| 699-25-33A | Turbidity | 214A_TURBIDITY | | 2.1 | NTU | 8/13/1997 | |
| 699-25-33A | Turbidity | 214A_TURBIDITY | | 4.8 | NTU | 2/23/1998 | |
| 699-25-33A | Turbidity | 214A_TURBIDITY | | 4.82 | NTU | 2/23/1998 | |
| 699-25-33A | Turbidity | 214A_TURBIDITY | | 4.81 | NTU | 2/23/1998 | |
| 699-25-33A | Turbidity | 214A_TURBIDITY | | 4.81 | NTU | 2/23/1998 | |
| 699-25-33A | Turbidity | 214A_TURBIDITY | | 1.62 | NTU | 8/24/1998 | |
| 699-25-33A | Turbidity | 214A_TURBIDITY | | 1.43 | NTU | 8/24/1998 | |
| 699-25-33A | Turbidity | 214A_TURBIDITY | | 1.93 | NTU | 2/8/1999 | |
| 699-25-33A | Turbidity | 214A_TURBIDITY | | 1.77 | NTU | 2/8/1999 | |
| 699-25-33A | Turbidity | 214A_TURBIDITY | | 2.31 | NTU | 8/16/1999 | |

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|---|---|---|---|---|---|---|---|
| 699-25-33A | Turbidity | 214A_TURBIDITY | | 2.92 | NTU | 8/16/1999 | |
| 699-25-33A | Turbidity | 214A_TURBIDITY | | 5.53 | NTU | 8/16/1999 | |
| 699-25-33A | Turbidity | 214A_TURBIDITY | | 2.39 | NTU | 8/16/1999 | |
| 699-25-33A | Turbidity | 214A_TURBIDITY | | 1.19 | NTU | 2/29/2000 | |
| 699-25-33A | Turbidity | 214A_TURBIDITY | | 4.4 | NTU | 10/6/2000 | |
| 699-25-33A | Turbidity | 214A_TURBIDITY | | 4.43 | NTU | 10/6/2000 | |
| 699-25-33A | Turbidity | 214A_TURBIDITY | | 1.55 | NTU | 2/26/2001 | |
| 699-25-33A | Turbidity | 214A_TURBIDITY | | 1.76 | NTU | 2/26/2001 | |
| 699-25-33A | Turbidity | 214A_TURBIDITY | | 1.62 | NTU | 2/26/2001 | |
| 699-25-33A | Turbidity | 214A_TURBIDITY | | 1.5 | NTU | 2/26/2001 | |
| 699-25-33A | Turbidity | 214A_TURBIDITY | | 3.38 | NTU | 8/14/2001 | |
| 699-25-33A | Turbidity | 214A_TURBIDITY | | 3.78 | NTU | 2/12/2002 | |
| 699-25-33A | Turbidity | 214A_TURBIDITY | | 4.83 | NTU | 2/12/2002 | |
| 699-25-33A | Turbidity | 214A_TURBIDITY | | 1.24 | NTU | 9/3/2002 | |
| 699-25-33A | Turbidity | 214A_TURBIDITY | | 1.98 | NTU | 2/20/2003 | |
| 699-25-33A | Turbidity | 214A_TURBIDITY | | 2.05 | NTU | 8/18/2003 | |
| 699-25-33A | Turbidity | 214A_TURBIDITY | | 2.39 | NTU | 2/18/2004 | |
| 699-25-33A | Turbidity | 214A_TURBIDITY | | 3.61 | NTU | 8/31/2004 | |
| 699-25-33A | Turbidity | 214A_TURBIDITY | | 3.93 | NTU | 2/17/2005 | |
| 699-25-33A | Turbidity | 214A_TURBIDITY | | 2.33 | NTU | 8/2/2005 | |
| 699-25-33A | Turbidity | TURBIDITY_FLD | | 3.17 | NTU | 9/24/2007 | |
| 699-25-33A | Turbidity | TURBIDITY_FLD | | 1.57 | NTU | 2/26/2008 | |
| 699-25-33A | Turbidity | TURBIDITY_FLD | | 1.22 | NTU | 2/26/2008 | |
| 699-25-33A | Turbidity | TURBIDITY_FLD | | 1.36 | NTU | 2/26/2008 | |
| 699-25-33A | Turbidity | TURBIDITY_FLD | | 1.55 | NTU | 2/26/2008 | |
| 699-25-33A | Turbidity | TURBIDITY_FLD | | 1.43 | NTU | 8/24/2008 | |
| 699-25-33A | Turbidity | TURBIDITY_FLD | | 1.8 | NTU | 8/24/2008 | |
| 699-25-33A | Turbidity | TURBIDITY_FLD | | 1.92 | NTU | 8/24/2008 | |

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|---|---|---|---|---|---|---|---|
| 699-25-33A | Turbidity | TURBIDITY_FLD | | 1.95 | NTU | 8/24/2008 | |
| 699-25-33A | Turbidity | TURBIDITY_FLD | | 4.18 | NTU | 11/3/2008 | |
| 699-25-33A | Turbidity | TURBIDITY_FLD | | 4.82 | NTU | 1/29/2009 | |
| 699-25-33A | Turbidity | TURBIDITY_FLD | | 4.86 | NTU | 7/20/2009 | |
| 699-25-33A | Uranium | 200.8_METALS_ICPMS | | 3.44 | ug/L | 11/3/2008 | |
| 699-25-33A | Uranium-234 | UISO_PLATE_AEA | | 1.57 | pCi/L | 11/3/2008 | |
| 699-25-33A | Uranium-235 | UISO_PLATE_AEA | U | 0.0228 | pCi/L | 11/3/2008 | |
| 699-25-33A | Uranium-238 | UISO_PLATE_AEA | | 0.684 | pCi/L | 11/3/2008 | |
| 699-25-33A | Vanadium | 6010_METALS_ICP | C | 11.4 | ug/L | 2/26/2008 | |
| 699-25-33A | Vanadium | 6010_METALS_ICP | U | 10 | ug/L | 11/3/2008 | |
| 699-25-33A | Vanadium | 6010_METALS_ICP | U | 12 | ug/L | 1/29/2009 | |
| 699-25-33A | Vinyl acetate | 8260_VOA_GCMS | U | 0.22 | ug/L | 11/3/2008 | |
| 699-25-33A | Vinyl chloride | 524.2_VOA_GCMS | U | 0.5 | ug/L | 8/24/1998 | |
| 699-25-33A | Vinyl chloride | 524.2_VOA_GCMS | U | 0.5 | ug/L | 2/8/1999 | |
| 699-25-33A | Vinyl chloride | 524.2_VOA_GCMS | U | 0.5 | ug/L | 8/16/1999 | |
| 699-25-33A | Vinyl chloride | 8010_VOA_GC | U | 1 | ug/L | 2/18/1997 | |
| 699-25-33A | Vinyl chloride | 8010_VOA_GC | U | 0.29 | ug/L | 8/13/1997 | |
| 699-25-33A | Vinyl chloride | 8010_VOA_GC | U | 0.294 | ug/L | 2/23/1998 | |
| 699-25-33A | Vinyl chloride | 8010_VOA_GC | U | 0.294 | ug/L | 2/23/1998 | |
| 699-25-33A | Vinyl chloride | 8260_VOA_GCMS | U | 0.17 | ug/L | 2/29/2000 | |
| 699-25-33A | Vinyl chloride | 8260_VOA_GCMS | U | 0.17 | ug/L | 2/29/2000 | |
| 699-25-33A | Vinyl chloride | 8260_VOA_GCMS | U | 0.17 | ug/L | 10/6/2000 | |
| 699-25-33A | Vinyl chloride | 8260_VOA_GCMS | U | 0.17 | ug/L | 2/26/2001 | |
| 699-25-33A | Vinyl chloride | 8260_VOA_GCMS | U | 0.32 | ug/L | 8/14/2001 | |
| 699-25-33A | Vinyl chloride | 8260_VOA_GCMS | U | 0.32 | ug/L | 2/12/2002 | |
| 699-25-33A | Vinyl chloride | 8260_VOA_GCMS | U | 0.32 | ug/L | 9/3/2002 | |
| 699-25-33A | Vinyl chloride | 8260_VOA_GCMS | U | 0.25 | ug/L | 2/20/2003 | |
| 699-25-33A | Vinyl chloride | 8260_VOA_GCMS | U | 0.25 | ug/L | 8/18/2003 | |

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|---|---|---|---|---|---|---|---|
| 699-25-33A | Vinyl chloride | 8260_VOA_GCMS | U | 0.25 | ug/L | 2/18/2004 | |
| 699-25-33A | Vinyl chloride | 8260_VOA_GCMS | U | 0.08 | ug/L | 8/31/2004 | |
| 699-25-33A | Vinyl chloride | 8260_VOA_GCMS | U | 0.07 | ug/L | 2/17/2005 | |
| 699-25-33A | Vinyl chloride | 8260_VOA_GCMS | U | 0.07 | ug/L | 8/2/2005 | |
| 699-25-33A | Vinyl chloride | 8260_VOA_GCMS | U | 0.23 | ug/L | 2/23/2006 | |
| 699-25-33A | Vinyl chloride | 8260_VOA_GCMS | U | 0.23 | ug/L | 9/1/2006 | |
| 699-25-33A | Vinyl chloride | 8260_VOA_GCMS | U | 0.23 | ug/L | 9/1/2006 | |
| 699-25-33A | Vinyl chloride | 8260_VOA_GCMS | U | 0.044 | ug/L | 2/13/2007 | |
| 699-25-33A | Vinyl chloride | 8260_VOA_GCMS | U | 0.044 | ug/L | 9/24/2007 | |
| 699-25-33A | Vinyl chloride | 8260_VOA_GCMS | U | 1 | ug/L | 2/26/2008 | |
| 699-25-33A | Vinyl chloride | 8260_VOA_GCMS | U | 1 | ug/L | 8/24/2008 | |
| 699-25-33A | Vinyl chloride | 8260_VOA_GCMS | U | 0.13 | ug/L | 11/3/2008 | |
| 699-25-33A | Vinyl chloride | 8260_VOA_GCMS | U | 1 | ug/L | 1/29/2009 | |
| 699-25-33A | Vinyl chloride | 8260_VOA_GCMS | U | 1 | ug/L | 7/20/2009 | |
| 699-25-33A | Xylenes (total) | 524.2_VOA_GCMS | U | 0.57 | ug/L | 2/8/1999 | |
| 699-25-33A | Xylenes (total) | 8020_VOA_GC | U | 0.6 | ug/L | 2/18/1997 | |
| 699-25-33A | Xylenes (total) | 8020_VOA_GC | U | 0.1 | ug/L | 2/23/1998 | |
| 699-25-33A | Xylenes (total) | 8020_VOA_GC | U | 0.1 | ug/L | 2/23/1998 | |
| 699-25-33A | Xylenes (total) | 8260_VOA_GCMS | U | 0.61 | ug/L | 2/29/2000 | |
| 699-25-33A | Xylenes (total) | 8260_VOA_GCMS | U | 0.61 | ug/L | 2/29/2000 | |
| 699-25-33A | Xylenes (total) | 8260_VOA_GCMS | U | 0.61 | ug/L | 10/6/2000 | |
| 699-25-33A | Xylenes (total) | 8260_VOA_GCMS | U | 0.61 | ug/L | 2/26/2001 | |
| 699-25-33A | Xylenes (total) | 8260_VOA_GCMS | U | 0.66 | ug/L | 8/14/2001 | |
| 699-25-33A | Xylenes (total) | 8260_VOA_GCMS | U | 0.66 | ug/L | 2/12/2002 | |
| 699-25-33A | Xylenes (total) | 8260_VOA_GCMS | U | 0.66 | ug/L | 9/3/2002 | |
| 699-25-33A | Xylenes (total) | 8260_VOA_GCMS | U | 0.28 | ug/L | 2/20/2003 | |
| 699-25-33A | Xylenes (total) | 8260_VOA_GCMS | U | 0.28 | ug/L | 8/18/2003 | |
| 699-25-33A | Xylenes (total) | 8260_VOA_GCMS | U | 0.28 | ug/L | 2/18/2004 | |

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|---|---|---|---|---|---|---|---|
| 699-25-33A | Xylenes (total) | 8260_VOA_GCMS | U | 0.28 | ug/L | 8/31/2004 | |
| 699-25-33A | Xylenes (total) | 8260_VOA_GCMS | U | 0.13 | ug/L | 2/17/2005 | |
| 699-25-33A | Xylenes (total) | 8260_VOA_GCMS | U | 0.13 | ug/L | 8/2/2005 | |
| 699-25-33A | Xylenes (total) | 8260_VOA_GCMS | U | 0.58 | ug/L | 2/23/2006 | |
| 699-25-33A | Xylenes (total) | 8260_VOA_GCMS | U | 0.58 | ug/L | 9/1/2006 | |
| 699-25-33A | Xylenes (total) | 8260_VOA_GCMS | U | 0.58 | ug/L | 9/1/2006 | |
| 699-25-33A | Xylenes (total) | 8260_VOA_GCMS | U | 0.13 | ug/L | 2/13/2007 | |
| 699-25-33A | Xylenes (total) | 8260_VOA_GCMS | U | 0.3 | ug/L | 9/24/2007 | |
| 699-25-33A | Xylenes (total) | 8260_VOA_GCMS | U | 1 | ug/L | 2/26/2008 | |
| 699-25-33A | Xylenes (total) | 8260_VOA_GCMS | U | 1 | ug/L | 8/24/2008 | |
| 699-25-33A | Xylenes (total) | 8260_VOA_GCMS | U | 1.6 | ug/L | 11/3/2008 | |
| 699-25-33A | Xylenes (total) | 8260_VOA_GCMS | U | 1 | ug/L | 1/29/2009 | |
| 699-25-33A | Xylenes (total) | 8260_VOA_GCMS | U | 1 | ug/L | 7/20/2009 | |
| 699-25-33A | Zinc | 6010_METALS_ICP | U | 4 | ug/L | 2/26/2008 | |
| 699-25-33A | Zinc | 6010_METALS_ICP | U | 9 | ug/L | 11/3/2008 | |
| 699-25-33A | Zinc | 6010_METALS_ICP | U | 9 | ug/L | 1/29/2009 | |
| 699-25-33A | beta-1,2,3,4,5,6-Hexachlorocyclohexane (beta-BHC) | 8081_PEST_GC | U | 0.013 | ug/L | 11/3/2008 | |
| 699-25-33A | cis-1,2-Dichloroethylene | 524.2_VOA_GCMS | U | 0.37 | ug/L | 8/24/1998 | |
| 699-25-33A | cis-1,2-Dichloroethylene | 524.2_VOA_GCMS | U | 0.37 | ug/L | 2/8/1999 | |
| 699-25-33A | cis-1,2-Dichloroethylene | 524.2_VOA_GCMS | U | 0.37 | ug/L | 8/16/1999 | |
| 699-25-33A | cis-1,2-Dichloroethylene | 8010_VOA_GC | U | 0.2 | ug/L | 2/18/1997 | |
| 699-25-33A | cis-1,2-Dichloroethylene | 8010_VOA_GC | U | 0.025 | ug/L | 8/13/1997 | |
| 699-25-33A | cis-1,2-Dichloroethylene | 8010_VOA_GC | U | 0.025 | ug/L | 2/23/1998 | |

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|---|---|---|---|---|---|---|---|
| 699-25-33A | cis-1,2-Dichloroethylene | 8010_VOA_GC | U | 0.025 | ug/L | 2/23/1998 | |
| 699-25-33A | cis-1,2-Dichloroethylene | 8260_VOA_GCMS | U | 0.18 | ug/L | 2/29/2000 | |
| 699-25-33A | cis-1,2-Dichloroethylene | 8260_VOA_GCMS | U | 0.18 | ug/L | 2/29/2000 | |
| 699-25-33A | cis-1,2-Dichloroethylene | 8260_VOA_GCMS | U | 0.18 | ug/L | 10/6/2000 | |
| 699-25-33A | cis-1,2-Dichloroethylene | 8260_VOA_GCMS | U | 0.18 | ug/L | 2/26/2001 | |
| 699-25-33A | cis-1,2-Dichloroethylene | 8260_VOA_GCMS | U | 0.24 | ug/L | 8/14/2001 | |
| 699-25-33A | cis-1,2-Dichloroethylene | 8260_VOA_GCMS | U | 0.24 | ug/L | 2/12/2002 | |
| 699-25-33A | cis-1,2-Dichloroethylene | 8260_VOA_GCMS | U | 0.24 | ug/L | 9/3/2002 | |
| 699-25-33A | cis-1,2-Dichloroethylene | 8260_VOA_GCMS | U | 0.06 | ug/L | 2/20/2003 | |
| 699-25-33A | cis-1,2-Dichloroethylene | 8260_VOA_GCMS | U | 0.06 | ug/L | 8/18/2003 | |
| 699-25-33A | cis-1,2-Dichloroethylene | 8260_VOA_GCMS | U | 0.06 | ug/L | 2/18/2004 | |
| 699-25-33A | cis-1,2-Dichloroethylene | 8260_VOA_GCMS | U | 0.1 | ug/L | 8/31/2004 | |
| 699-25-33A | cis-1,2-Dichloroethylene | 8260_VOA_GCMS | U | 0.27 | ug/L | 2/17/2005 | |
| 699-25-33A | cis-1,2-Dichloroethylene | 8260_VOA_GCMS | U | 0.27 | ug/L | 8/2/2005 | |
| 699-25-33A | cis-1,2-Dichloroethylene | 8260_VOA_GCMS | U | 0.19 | ug/L | 2/23/2006 | |
| 699-25-33A | cis-1,2-Dichloroethylene | 8260_VOA_GCMS | U | 0.19 | ug/L | 9/1/2006 | |
| 699-25-33A | cis-1,2-Dichloroethylene | 8260_VOA_GCMS | U | 0.19 | ug/L | 9/1/2006 | |
| 699-25-33A | cis-1,2-Dichloroethylene | 8260_VOA_GCMS | U | 0.048 | ug/L | 2/13/2007 | |
| 699-25-33A | cis-1,2-Dichloroethylene | 8260_VOA_GCMS | U | 0.048 | ug/L | 9/24/2007 | |

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|---|---|---|---|---|---|---|---|
| 699-25-33A | cis-1,2-Dichloroethylene | 8260_VOA_GCMS | U | 1 | ug/L | 2/26/2008 | |
| 699-25-33A | cis-1,2-Dichloroethylene | 8260_VOA_GCMS | U | 1 | ug/L | 8/24/2008 | |
| 699-25-33A | cis-1,2-Dichloroethylene | 8260_VOA_GCMS | U | 0.13 | ug/L | 11/3/2008 | |
| 699-25-33A | cis-1,2-Dichloroethylene | 8260_VOA_GCMS | U | 1 | ug/L | 1/29/2009 | |
| 699-25-33A | cis-1,2-Dichloroethylene | 8260_VOA_GCMS | U | 1 | ug/L | 7/20/2009 | |
| 699-25-33A | cis-1,3-Dichloropropene | 8260_VOA_GCMS | U | 0.099 | ug/L | 11/3/2008 | |
| 699-25-33A | o-Xylene | 524.2_VOA_GCMS | U | 0.32 | ug/L | 8/24/1998 | |
| 699-25-33A | pH Measurement | 9040_PH | | 7.94 | unitless | 2/18/1997 | |
| 699-25-33A | pH Measurement | 9040_PH | | 7.93 | unitless | 2/18/1997 | |
| 699-25-33A | pH Measurement | 9040_PH | | 7.93 | unitless | 2/18/1997 | |
| 699-25-33A | pH Measurement | 9040_PH | | 7.94 | unitless | 2/18/1997 | |
| 699-25-33A | pH Measurement | 9040_PH | | 8.02 | unitless | 8/13/1997 | |
| 699-25-33A | pH Measurement | 9040_PH | | 8.02 | unitless | 8/13/1997 | |
| 699-25-33A | pH Measurement | 9040_PH | | 8.03 | unitless | 8/13/1997 | |
| 699-25-33A | pH Measurement | 9040_PH | | 8.03 | unitless | 8/13/1997 | |
| 699-25-33A | pH Measurement | 9040_PH | | 8.03 | unitless | 2/23/1998 | |
| 699-25-33A | pH Measurement | 9040_PH | | 8.03 | unitless | 2/23/1998 | |
| 699-25-33A | pH Measurement | 9040_PH | | 8.02 | unitless | 2/23/1998 | |
| 699-25-33A | pH Measurement | 9040_PH | | 8.04 | unitless | 2/23/1998 | |

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|---|---|---|---|---|---|---|---|
| 699-25-33A | pH Measurement | 9040_PH | | 8.43 | unitless | 8/24/1998 | |
| 699-25-33A | pH Measurement | 9040_PH | | 8.43 | unitless | 8/24/1998 | |
| 699-25-33A | pH Measurement | 9040_PH | | 8.43 | unitless | 8/24/1998 | |
| 699-25-33A | pH Measurement | 9040_PH | | 8.43 | unitless | 8/24/1998 | |
| 699-25-33A | pH Measurement | 9040_PH | | 8.04 | unitless | 2/8/1999 | |
| 699-25-33A | pH Measurement | 9040_PH | | 8.02 | unitless | 2/8/1999 | |
| 699-25-33A | pH Measurement | 9040_PH | | 8.01 | unitless | 2/8/1999 | |
| 699-25-33A | pH Measurement | 9040_PH | | 8.05 | unitless | 2/8/1999 | |
| 699-25-33A | pH Measurement | 9040_PH | | 8.21 | unitless | 8/16/1999 | |
| 699-25-33A | pH Measurement | 9040_PH | | 8.21 | unitless | 8/16/1999 | |
| 699-25-33A | pH Measurement | 9040_PH | | 8.21 | unitless | 8/16/1999 | |
| 699-25-33A | pH Measurement | 9040_PH | | 8.2 | unitless | 8/16/1999 | |
| 699-25-33A | pH Measurement | 9040_PH | | 7.99 | unitless | 2/29/2000 | |
| 699-25-33A | pH Measurement | 9040_PH | | 7.99 | unitless | 2/29/2000 | |
| 699-25-33A | pH Measurement | 9040_PH | | 8 | unitless | 2/29/2000 | |
| 699-25-33A | pH Measurement | 9040_PH | | 7.99 | unitless | 2/29/2000 | |
| 699-25-33A | pH Measurement | 9040_PH | | 7.91 | unitless | 10/6/2000 | |
| 699-25-33A | pH Measurement | 9040_PH | | 7.91 | unitless | 10/6/2000 | |
| 699-25-33A | pH Measurement | 9040_PH | | 7.9 | unitless | 10/6/2000 | |

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|---|---|---|---|---|---|---|---|
| 699-25-33A | pH Measurement | 9040_PH | | 7.91 | unitless | 10/6/2000 | |
| 699-25-33A | pH Measurement | 9040_PH | | 7.89 | unitless | 2/26/2001 | |
| 699-25-33A | pH Measurement | 9040_PH | | 7.91 | unitless | 2/26/2001 | |
| 699-25-33A | pH Measurement | 9040_PH | | 7.91 | unitless | 2/26/2001 | |
| 699-25-33A | pH Measurement | 9040_PH | | 7.9 | unitless | 2/26/2001 | |
| 699-25-33A | pH Measurement | 9040_PH | | 7.99 | unitless | 8/14/2001 | |
| 699-25-33A | pH Measurement | 9040_PH | | 8.05 | unitless | 2/12/2002 | |
| 699-25-33A | pH Measurement | 9040_PH | | 8.06 | unitless | 2/12/2002 | |
| 699-25-33A | pH Measurement | 9040_PH | | 8.05 | unitless | 2/12/2002 | |
| 699-25-33A | pH Measurement | 9040_PH | | 8.05 | unitless | 2/12/2002 | |
| 699-25-33A | pH Measurement | 9040_PH | | 7.99 | unitless | 9/3/2002 | |
| 699-25-33A | pH Measurement | 9040_PH | | 8.03 | unitless | 2/20/2003 | |
| 699-25-33A | pH Measurement | 9040_PH | | 8.05 | unitless | 2/20/2003 | |
| 699-25-33A | pH Measurement | 9040_PH | | 8.05 | unitless | 2/20/2003 | |
| 699-25-33A | pH Measurement | 9040_PH | | 8.05 | unitless | 2/20/2003 | |
| 699-25-33A | pH Measurement | 9040_PH | | 7.98 | unitless | 8/18/2003 | |
| 699-25-33A | pH Measurement | 9040_PH | | 7.98 | unitless | 2/18/2004 | |
| 699-25-33A | pH Measurement | 9040_PH | | 7.97 | unitless | 8/31/2004 | |
| 699-25-33A | pH Measurement | 9040_PH | | 8 | unitless | 2/17/2005 | |

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|---|---|---|---|---|---|---|---|
| 699-25-33A | pH Measurement | 9040_PH | | 7.94 | unitless | 8/2/2005 | |
| 699-25-33A | pH Measurement | PH_ELECT_FLD | | 8.04 | unitless | 2/23/2006 | |
| 699-25-33A | pH Measurement | PH_ELECT_FLD | | 7.88 | unitless | 9/1/2006 | |
| 699-25-33A | pH Measurement | PH_ELECT_FLD | | 8.03 | unitless | 2/13/2007 | |
| 699-25-33A | pH Measurement | PH_ELECT_FLD | | 7.92 | unitless | 9/24/2007 | |
| 699-25-33A | pH Measurement | PH_ELECT_FLD | | 7.83 | unitless | 2/26/2008 | |
| 699-25-33A | pH Measurement | PH_ELECT_FLD | | 7.83 | unitless | 2/26/2008 | |
| 699-25-33A | pH Measurement | PH_ELECT_FLD | | 7.84 | unitless | 2/26/2008 | |
| 699-25-33A | pH Measurement | PH_ELECT_FLD | | 7.84 | unitless | 2/26/2008 | |
| 699-25-33A | pH Measurement | PH_ELECT_FLD | | 7.97 | unitless | 8/24/2008 | |
| 699-25-33A | pH Measurement | PH_ELECT_FLD | | 7.97 | unitless | 8/24/2008 | |
| 699-25-33A | pH Measurement | PH_ELECT_FLD | | 7.97 | unitless | 8/24/2008 | |
| 699-25-33A | pH Measurement | PH_ELECT_FLD | | 7.98 | unitless | 8/24/2008 | |
| 699-25-33A | pH Measurement | PH_ELECT_FLD | | 7.24 | unitless | 11/3/2008 | |
| 699-25-33A | pH Measurement | PH_ELECT_FLD | | 7.95 | unitless | 1/29/2009 | |
| 699-25-33A | pH Measurement | PH_ELECT_FLD | | 7.98 | unitless | 7/20/2009 | |
| 699-25-33A | trans-1,2-Dichloroethylene | 524.2_VOA_GCMS | U | 0.33 | ug/L | 8/24/1998 | |
| 699-25-33A | trans-1,2-Dichloroethylene | 524.2_VOA_GCMS | U | 0.33 | ug/L | 2/8/1999 | |
| 699-25-33A | trans-1,2-Dichloroethylene | 524.2_VOA_GCMS | U | 0.33 | ug/L | 8/16/1999 | |

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|---|---|---|---|---|---|---|---|
| 699-25-33A | trans-1,2-Dichloroethylene | 8010_VOA_GC | U | 0.2 | ug/L | 2/18/1997 | |
| 699-25-33A | trans-1,2-Dichloroethylene | 8010_VOA_GC | U | 0.031 | ug/L | 8/13/1997 | |
| 699-25-33A | trans-1,2-Dichloroethylene | 8010_VOA_GC | U | 0.031 | ug/L | 2/23/1998 | |
| 699-25-33A | trans-1,2-Dichloroethylene | 8010_VOA_GC | U | 0.031 | ug/L | 2/23/1998 | |
| 699-25-33A | trans-1,2-Dichloroethylene | 8260_VOA_GCMS | U | 0.26 | ug/L | 2/29/2000 | |
| 699-25-33A | trans-1,2-Dichloroethylene | 8260_VOA_GCMS | U | 0.26 | ug/L | 2/29/2000 | |
| 699-25-33A | trans-1,2-Dichloroethylene | 8260_VOA_GCMS | U | 0.26 | ug/L | 10/6/2000 | |
| 699-25-33A | trans-1,2-Dichloroethylene | 8260_VOA_GCMS | U | 0.26 | ug/L | 2/26/2001 | |
| 699-25-33A | trans-1,2-Dichloroethylene | 8260_VOA_GCMS | U | 0.23 | ug/L | 8/14/2001 | |
| 699-25-33A | trans-1,2-Dichloroethylene | 8260_VOA_GCMS | U | 0.23 | ug/L | 2/12/2002 | |
| 699-25-33A | trans-1,2-Dichloroethylene | 8260_VOA_GCMS | U | 0.23 | ug/L | 9/3/2002 | |
| 699-25-33A | trans-1,2-Dichloroethylene | 8260_VOA_GCMS | U | 0.17 | ug/L | 2/20/2003 | |
| 699-25-33A | trans-1,2-Dichloroethylene | 8260_VOA_GCMS | U | 0.17 | ug/L | 8/18/2003 | |
| 699-25-33A | trans-1,2-Dichloroethylene | 8260_VOA_GCMS | U | 0.17 | ug/L | 2/18/2004 | |
| 699-25-33A | trans-1,2-Dichloroethylene | 8260_VOA_GCMS | U | 0.09 | ug/L | 8/31/2004 | |
| 699-25-33A | trans-1,2-Dichloroethylene | 8260_VOA_GCMS | U | 0.08 | ug/L | 2/17/2005 | |
| 699-25-33A | trans-1,2-Dichloroethylene | 8260_VOA_GCMS | U | 0.08 | ug/L | 8/2/2005 | |
| 699-25-33A | trans-1,2-Dichloroethylene | 8260_VOA_GCMS | U | 0.16 | ug/L | 2/23/2006 | |
| 699-25-33A | trans-1,2-Dichloroethylene | 8260_VOA_GCMS | U | 0.16 | ug/L | 9/1/2006 | |

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|---|---|---|---|---|---|---|---|
| 699-25-33A | trans-1,2-Dichloroethylene | 8260_VOA_GCMS | U | 0.16 | ug/L | 9/1/2006 | |
| 699-25-33A | trans-1,2-Dichloroethylene | 8260_VOA_GCMS | U | 0.016 | ug/L | 2/13/2007 | |
| 699-25-33A | trans-1,2-Dichloroethylene | 8260_VOA_GCMS | U | 0.1 | ug/L | 9/24/2007 | |
| 699-25-33A | trans-1,2-Dichloroethylene | 8260_VOA_GCMS | U | 1 | ug/L | 2/26/2008 | |
| 699-25-33A | trans-1,2-Dichloroethylene | 8260_VOA_GCMS | U | 1 | ug/L | 8/24/2008 | |
| 699-25-33A | trans-1,2-Dichloroethylene | 8260_VOA_GCMS | U | 0.089 | ug/L | 11/3/2008 | |
| 699-25-33A | trans-1,2-Dichloroethylene | 8260_VOA_GCMS | U | 1 | ug/L | 1/29/2009 | |
| 699-25-33A | trans-1,2-Dichloroethylene | 8260_VOA_GCMS | U | 1 | ug/L | 7/20/2009 | |
| 699-25-33A | trans-1,3-Dichloropropene | 8260_VOA_GCMS | U | 0.08 | ug/L | 11/3/2008 | |
| 699-25-33A | trans-1,4-Dichloro-2-butene | 8260_VOA_GCMS | U | 0.75 | ug/L | 11/3/2008 | |

| WELL_NAME | CON_LONG_NAME | METHOD_NAME |
|---|---|---|
| 699-24-35 | (m+p)-Xylene | 524.2_VOA_GCMS |
| 699-24-35 | (m+p)-Xylene | 524.2_VOA_GCMS |
| 699-24-35 | (m+p)-Xylene | 524.2_VOA_GCMS |
| 699-24-35 | (m+p)-Xylene | 8020_VOA_GC |
| 699-24-35 | (m+p)-Xylene | 8020_VOA_GC |
| 699-24-35 | (m+p)-Xylene | 8020_VOA_GC |
| 699-24-35 | (m+p)-Xylene | 8020_VOA_GC |
| 699-24-35 | (m+p)-Xylene | 8020_VOA_GC |
| 699-24-35 | (m+p)-Xylene | 8020_VOA_GC |
| 699-24-35 | (m+p)-Xylene | 8020_VOA_GC |
| 699-24-35 | (m+p)-Xylene | 8020_VOA_GC |
| 699-24-35 | (m+p)-Xylene | 8020_VOA_GC |
| 699-24-35 | (m+p)-Xylene | 8020_VOA_GC |
| 699-24-35 | (m+p)-Xylene | 8020_VOA_GC |
| 699-24-35 | (m+p)-Xylene | 8020_VOA_GC |
| 699-24-35 | (m+p)-Xylene | 8260_VOA_GCMS |
| 699-24-35 | (m+p)-Xylene | 8260_VOA_GCMS |
| 699-24-35 | (m+p)-Xylene | 8260_VOA_GCMS |
| 699-24-35 | (m+p)-Xylene | 8260_VOA_GCMS |
| 699-24-35 | (m+p)-Xylene | 8260_VOA_GCMS |
| 699-24-35 | 1,1,1-Trichloroethane | 524.2_VOA_GCMS |
| 699-24-35 | 1,1,1-Trichloroethane | 524.2_VOA_GCMS |
| 699-24-35 | 1,1,1-Trichloroethane | 524.2_VOA_GCMS |
| 699-24-35 | 1,1,1-Trichloroethane | 524.2_VOA_GCMS |
| 699-24-35 | 1,1,1-Trichloroethane | 524.2_VOA_GCMS |
| 699-24-35 | 1,1,1-Trichloroethane | 8010_VOA_GC |
| 699-24-35 | 1,1,1-Trichloroethane | 8010_VOA_GC |
| 699-24-35 | 1,1,1-Trichloroethane | 8010_VOA_GC |
| 699-24-35 | 1,1,1-Trichloroethane | 8010_VOA_GC |
| 699-24-35 | 1,1,1-Trichloroethane | 8010_VOA_GC |
| 699-24-35 | 1,1,1-Trichloroethane | 8010_VOA_GC |
| 699-24-35 | 1,1,1-Trichloroethane | 8010_VOA_GC |
| 699-24-35 | 1,1,1-Trichloroethane | 8010_VOA_GC |
| 699-24-35 | 1,1,1-Trichloroethane | 8010_VOA_GC |
| 699-24-35 | 1,1,1-Trichloroethane | 8010_VOA_GC |
| 699-24-35 | 1,1,1-Trichloroethane | 8010_VOA_GC |
| 699-24-35 | 1,1,1-Trichloroethane | 8010_VOA_GC |
| 699-24-35 | 1,1,1-Trichloroethane | 8010_VOA_GC |
| 699-24-35 | 1,1,1-Trichloroethane | 8010_VOA_GC |
| 699-24-35 | 1,1,1-Trichloroethane | 8010_VOA_GC |
| 699-24-35 | 1,1,1-Trichloroethane | 8260_VOA_GCMS |
| 699-24-35 | 1,1,1-Trichloroethane | 8260_VOA_GCMS |
| 699-24-35 | 1,1,1-Trichloroethane | 8260_VOA_GCMS |
| 699-24-35 | 1,1,1-Trichloroethane | 8260_VOA_GCMS |
| 699-24-35 | 1,1,1-Trichloroethane | 8260_VOA_GCMS |

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| 699-24-35 | 1,1,1-Trichloroethane | 8260_VOA_GCMS |
| 699-24-35 | 1,1,1-Trichloroethane | 8260_VOA_GCMS |
| 699-24-35 | 1,1,1-Trichloroethane | 8260_VOA_GCMS |
| 699-24-35 | 1,1,1-Trichloroethane | 8260_VOA_GCMS |
| 699-24-35 | 1,1,1-Trichloroethane | 8260_VOA_GCMS |
| 699-24-35 | 1,1,1-Trichloroethane | 8260_VOA_GCMS |
| 699-24-35 | 1,1,1-Trichloroethane | 8260_VOA_GCMS |
| 699-24-35 | 1,1,1-Trichloroethane | 8260_VOA_GCMS |
| 699-24-35 | 1,1,1-Trichloroethane | 8260_VOA_GCMS |
| 699-24-35 | 1,1,1-Trichloroethane | 8260_VOA_GCMS |
| 699-24-35 | 1,1,1-Trichloroethane | 8260_VOA_GCMS |
| 699-24-35 | 1,1,1-Trichloroethane | 8260_VOA_GCMS |
| 699-24-35 | 1,1,1-Trichloroethane | 8260_VOA_GCMS |
| 699-24-35 | 1,1,1-Trichloroethane | 8260_VOA_GCMS |
| 699-24-35 | 1,1,1-Trichloroethane | 8260_VOA_GCMS |
| 699-24-35 | 1,1,1-Trichloroethane | 8260_VOA_GCMS |
| 699-24-35 | 1,1,1-Trichloroethane | 8260_VOA_GCMS |
| 699-24-35 | 1,1,1-Trichloroethane | 8260_VOA_GCMS |
| 699-24-35 | 1,1,1-Trichloroethane | 8260_VOA_GCMS |
| 699-24-35 | 1,1,1-Trichloroethane | 8260_VOA_GCMS |
| 699-24-35 | 1,1,1-Trichloroethane | 8260_VOA_GCMS |
| 699-24-35 | 1,1,1-Trichloroethane | 8260_VOA_GCMS |
| 699-24-35 | 1,1,1-Trichloroethane | 8260_VOA_GCMS |
| 699-24-35 | 1,1,1-Trichloroethane | 8260_VOA_GCMS |
| 699-24-35 | 1,1,1-Trichloroethane | 8260_VOA_GCMS |
| 699-24-35 | 1,1,1-Trichloroethane | 8260_VOA_GCMS |
| 699-24-35 | 1,1,1-Trichloroethane | 8260_VOA_GCMS |
| 699-24-35 | 1,1,1-Trichloroethane | 8260_VOA_GCMS |
| 699-24-35 | 1,1,1-Trichloroethane | 8260_VOA_GCMS |
| 699-24-35 | 1,1,2-Trichloroethane | 524.2_VOA_GCMS |
| 699-24-35 | 1,1,2-Trichloroethane | 524.2_VOA_GCMS |
| 699-24-35 | 1,1,2-Trichloroethane | 524.2_VOA_GCMS |
| 699-24-35 | 1,1,2-Trichloroethane | 524.2_VOA_GCMS |
| 699-24-35 | 1,1,2-Trichloroethane | 524.2_VOA_GCMS |
| 699-24-35 | 1,1,2-Trichloroethane | 8010_VOA_GC |
| 699-24-35 | 1,1,2-Trichloroethane | 8010_VOA_GC |
| 699-24-35 | 1,1,2-Trichloroethane | 8010_VOA_GC |
| 699-24-35 | 1,1,2-Trichloroethane | 8010_VOA_GC |
| 699-24-35 | 1,1,2-Trichloroethane | 8010_VOA_GC |
| 699-24-35 | 1,1,2-Trichloroethane | 8010_VOA_GC |
| 699-24-35 | 1,1,2-Trichloroethane | 8010_VOA_GC |
| 699-24-35 | 1,1,2-Trichloroethane | 8010_VOA_GC |
| 699-24-35 | 1,1,2-Trichloroethane | 8010_VOA_GC |
| 699-24-35 | 1,1,2-Trichloroethane | 8010_VOA_GC |
| 699-24-35 | 1,1,2-Trichloroethane | 8010_VOA_GC |

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| 699-24-35 | 1,1,2-Trichloroethane | 8010_VOA_GC |
| 699-24-35 | 1,1,2-Trichloroethane | 8010_VOA_GC |
| 699-24-35 | 1,1,2-Trichloroethane | 8010_VOA_GC |
| 699-24-35 | 1,1,2-Trichloroethane | 8010_VOA_GC |
| 699-24-35 | 1,1,2-Trichloroethane | 8260_VOA_GCMS |
| 699-24-35 | 1,1,2-Trichloroethane | 8260_VOA_GCMS |
| 699-24-35 | 1,1,2-Trichloroethane | 8260_VOA_GCMS |
| 699-24-35 | 1,1,2-Trichloroethane | 8260_VOA_GCMS |
| 699-24-35 | 1,1,2-Trichloroethane | 8260_VOA_GCMS |
| 699-24-35 | 1,1,2-Trichloroethane | 8260_VOA_GCMS |
| 699-24-35 | 1,1,2-Trichloroethane | 8260_VOA_GCMS |
| 699-24-35 | 1,1,2-Trichloroethane | 8260_VOA_GCMS |
| 699-24-35 | 1,1,2-Trichloroethane | 8260_VOA_GCMS |
| 699-24-35 | 1,1,2-Trichloroethane | 8260_VOA_GCMS |
| 699-24-35 | 1,1,2-Trichloroethane | 8260_VOA_GCMS |
| 699-24-35 | 1,1,2-Trichloroethane | 8260_VOA_GCMS |
| 699-24-35 | 1,1,2-Trichloroethane | 8260_VOA_GCMS |
| 699-24-35 | 1,1,2-Trichloroethane | 8260_VOA_GCMS |
| 699-24-35 | 1,1,2-Trichloroethane | 8260_VOA_GCMS |
| 699-24-35 | 1,1,2-Trichloroethane | 8260_VOA_GCMS |
| 699-24-35 | 1,1,2-Trichloroethane | 8260_VOA_GCMS |
| 699-24-35 | 1,1,2-Trichloroethane | 8260_VOA_GCMS |
| 699-24-35 | 1,1,2-Trichloroethane | 8260_VOA_GCMS |
| 699-24-35 | 1,1,2-Trichloroethane | 8260_VOA_GCMS |
| 699-24-35 | 1,1,2-Trichloroethane | 8260_VOA_GCMS |
| 699-24-35 | 1,1,2-Trichloroethane | 8260_VOA_GCMS |
| 699-24-35 | 1,1,2-Trichloroethane | 8260_VOA_GCMS |
| 699-24-35 | 1,1,2-Trichloroethane | 8260_VOA_GCMS |
| 699-24-35 | 1,1,2-Trichloroethane | 8260_VOA_GCMS |
| 699-24-35 | 1,1,2-Trichloroethane | 8260_VOA_GCMS |
| 699-24-35 | 1,1,2-Trichloroethane | 8260_VOA_GCMS |
| 699-24-35 | 1,1,2-Trichloroethane | 8260_VOA_GCMS |
| 699-24-35 | 1,1,2-Trichloroethane | 8260_VOA_GCMS |
| 699-24-35 | 1,1,2-Trichloroethane | 8260_VOA_GCMS |
| 699-24-35 | 1,1,2-Trichloroethane | 8260_VOA_GCMS |
| 699-24-35 | 1,1,2-Trichloroethane | 8260_VOA_GCMS |
| 699-24-35 | 1,1,2-Trichloroethane | 8260_VOA_GCMS |
| 699-24-35 | 1,1,2-Trichloroethane | 8260_VOA_GCMS |
| 699-24-35 | 1,1-Dichloroethane | 524.2_VOA_GCMS |
| 699-24-35 | 1,1-Dichloroethane | 524.2_VOA_GCMS |
| 699-24-35 | 1,1-Dichloroethane | 524.2_VOA_GCMS |
| 699-24-35 | 1,1-Dichloroethane | 524.2_VOA_GCMS |
| 699-24-35 | 1,1-Dichloroethane | 524.2_VOA_GCMS |
| 699-24-35 | 1,1-Dichloroethane | 8010_VOA_GC |
| 699-24-35 | 1,1-Dichloroethane | 8010_VOA_GC |
| 699-24-35 | 1,1-Dichloroethane | 8010_VOA_GC |

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| 699-24-35 | 1,1-Dichloroethane | 8010_VOA_GC |
| 699-24-35 | 1,1-Dichloroethane | 8010_VOA_GC |
| 699-24-35 | 1,1-Dichloroethane | 8010_VOA_GC |
| 699-24-35 | 1,1-Dichloroethane | 8010_VOA_GC |
| 699-24-35 | 1,1-Dichloroethane | 8010_VOA_GC |
| 699-24-35 | 1,1-Dichloroethane | 8010_VOA_GC |
| 699-24-35 | 1,1-Dichloroethane | 8010_VOA_GC |
| 699-24-35 | 1,1-Dichloroethane | 8010_VOA_GC |
| 699-24-35 | 1,1-Dichloroethane | 8010_VOA_GC |
| 699-24-35 | 1,1-Dichloroethane | 8010_VOA_GC |
| 699-24-35 | 1,1-Dichloroethane | 8010_VOA_GC |
| 699-24-35 | 1,1-Dichloroethane | 8010_VOA_GC |
| 699-24-35 | 1,1-Dichloroethane | 8010_VOA_GC |
| 699-24-35 | 1,1-Dichloroethane | 8260_VOA_GCMS |
| 699-24-35 | 1,1-Dichloroethane | 8260_VOA_GCMS |
| 699-24-35 | 1,1-Dichloroethane | 8260_VOA_GCMS |
| 699-24-35 | 1,1-Dichloroethane | 8260_VOA_GCMS |
| 699-24-35 | 1,1-Dichloroethane | 8260_VOA_GCMS |
| 699-24-35 | 1,1-Dichloroethane | 8260_VOA_GCMS |
| 699-24-35 | 1,1-Dichloroethane | 8260_VOA_GCMS |
| 699-24-35 | 1,1-Dichloroethane | 8260_VOA_GCMS |
| 699-24-35 | 1,1-Dichloroethane | 8260_VOA_GCMS |
| 699-24-35 | 1,1-Dichloroethane | 8260_VOA_GCMS |
| 699-24-35 | 1,1-Dichloroethane | 8260_VOA_GCMS |
| 699-24-35 | 1,1-Dichloroethane | 8260_VOA_GCMS |
| 699-24-35 | 1,1-Dichloroethane | 8260_VOA_GCMS |
| 699-24-35 | 1,1-Dichloroethane | 8260_VOA_GCMS |
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| 699-24-35 | 1,1-Dichloroethane | 8260_VOA_GCMS |
| 699-24-35 | 1,1-Dichloroethane | 8260_VOA_GCMS |
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| 699-24-35 | 1,1-Dichloroethane | 8260_VOA_GCMS |
| 699-24-35 | 1,1-Dichloroethane | 8260_VOA_GCMS |
| 699-24-35 | 1,1-Dichloroethane | 8260_VOA_GCMS |
| 699-24-35 | 1,1-Dichloroethane | 8260_VOA_GCMS |
| 699-24-35 | 1,1-Dichloroethane | 8260_VOA_GCMS |
| 699-24-35 | 1,1-Dichloroethane | 8260_VOA_GCMS |
| 699-24-35 | 1,1-Dichloroethane | 8260_VOA_GCMS |
| 699-24-35 | 1,1-Dichloroethane | 8260_VOA_GCMS |
| 699-24-35 | 1,1-Dichloroethane | 8260_VOA_GCMS |
| 699-24-35 | 1,1-Dichloroethane | 8260_VOA_GCMS |
| 699-24-35 | 1,1-Dichloroethane | 8260_VOA_GCMS |
| 699-24-35 | 1,1-Dichloroethane | 8260_VOA_GCMS |
| 699-24-35 | 1,1-Dichloroethane | 8260_VOA_GCMS |
| 699-24-35 | 1,1-Dichloroethane | 8260_VOA_GCMS |

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| 699-24-35 | 1,1-Dichloroethane | 8260_VOA_GCMS |
| 699-24-35 | 1,1-Dichloroethene | 8260_VOA_GCMS |
| 699-24-35 | 1,1-Dichloroethene | 8260_VOA_GCMS |
| 699-24-35 | 1,1-Dichloroethene | 8260_VOA_GCMS |
| 699-24-35 | 1,1-Dichloroethene | 8260_VOA_GCMS |
| 699-24-35 | 1,1-Dichloroethene | 8260_VOA_GCMS |
| 699-24-35 | 1,1-Dichloroethene | 8260_VOA_GCMS |
| 699-24-35 | 1,1-Dichloroethene | 8260_VOA_GCMS |
| 699-24-35 | 1,1-Dichloroethene | 8260_VOA_GCMS |
| 699-24-35 | 1,1-Dichloroethene | 8260_VOA_GCMS |
| 699-24-35 | 1,1-Dichloroethene | 8260_VOA_GCMS |
| 699-24-35 | 1,1-Dichloroethene | 8260_VOA_GCMS |
| 699-24-35 | 1,1-Dichloroethene | 8260_VOA_GCMS |
| 699-24-35 | 1,1-Dichloroethene | 8260_VOA_GCMS |
| 699-24-35 | 1,1-Dichloroethene | 8260_VOA_GCMS |
| 699-24-35 | 1,1-Dichloroethene | 8260_VOA_GCMS |
| 699-24-35 | 1,1-Dichloroethene | 8260_VOA_GCMS |
| 699-24-35 | 1,1-Dichloroethene | 8260_VOA_GCMS |
| 699-24-35 | 1,1-Dichloroethene | 8260_VOA_GCMS |
| 699-24-35 | 1,1-Dichloroethene | 8260_VOA_GCMS |
| 699-24-35 | 1,2-Dichloroethane | 524.2_VOA_GCMS |
| 699-24-35 | 1,2-Dichloroethane | 524.2_VOA_GCMS |
| 699-24-35 | 1,2-Dichloroethane | 524.2_VOA_GCMS |
| 699-24-35 | 1,2-Dichloroethane | 524.2_VOA_GCMS |
| 699-24-35 | 1,2-Dichloroethane | 524.2_VOA_GCMS |
| 699-24-35 | 1,2-Dichloroethane | 8010_VOA_GC |
| 699-24-35 | 1,2-Dichloroethane | 8010_VOA_GC |
| 699-24-35 | 1,2-Dichloroethane | 8010_VOA_GC |
| 699-24-35 | 1,2-Dichloroethane | 8010_VOA_GC |
| 699-24-35 | 1,2-Dichloroethane | 8010_VOA_GC |
| 699-24-35 | 1,2-Dichloroethane | 8010_VOA_GC |
| 699-24-35 | 1,2-Dichloroethane | 8010_VOA_GC |
| 699-24-35 | 1,2-Dichloroethane | 8010_VOA_GC |
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| 699-24-35 | 1,2-Dichloroethane | 8010_VOA_GC |
| 699-24-35 | 1,2-Dichloroethane | 8010_VOA_GC |
| 699-24-35 | 1,2-Dichloroethane | 8010_VOA_GC |
| 699-24-35 | 1,2-Dichloroethane | 8010_VOA_GC |
| 699-24-35 | 1,2-Dichloroethane | 8010_VOA_GC |
| 699-24-35 | 1,2-Dichloroethane | 8010_VOA_GC |
| 699-24-35 | 1,2-Dichloroethane | 8010_VOA_GC |
| 699-24-35 | 1,2-Dichloroethane | 8010_VOA_GC |
| 699-24-35 | 1,2-Dichloroethane | 8010_VOA_GC |
| 699-24-35 | 1,2-Dichloroethane | 8260_VOA_GCMS |
| 699-24-35 | 1,2-Dichloroethane | 8260_VOA_GCMS |
| 699-24-35 | 1,2-Dichloroethane | 8260_VOA_GCMS |
| 699-24-35 | 1,2-Dichloroethane | 8260_VOA_GCMS |
| 699-24-35 | 1,2-Dichloroethane | 8260_VOA_GCMS |

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| 699-24-35 | 1,2-Dichloroethane | 8260_VOA_GCMS |
| 699-24-35 | 1,2-Dichloroethane | 8260_VOA_GCMS |
| 699-24-35 | 1,2-Dichloroethane | 8260_VOA_GCMS |
| 699-24-35 | 1,2-Dichloroethane | 8260_VOA_GCMS |
| 699-24-35 | 1,2-Dichloroethane | 8260_VOA_GCMS |
| 699-24-35 | 1,2-Dichloroethane | 8260_VOA_GCMS |
| 699-24-35 | 1,2-Dichloroethane | 8260_VOA_GCMS |
| 699-24-35 | 1,2-Dichloroethane | 8260_VOA_GCMS |
| 699-24-35 | 1,2-Dichloroethane | 8260_VOA_GCMS |
| 699-24-35 | 1,2-Dichloroethane | 8260_VOA_GCMS |
| 699-24-35 | 1,2-Dichloroethane | 8260_VOA_GCMS |
| 699-24-35 | 1,2-Dichloroethane | 8260_VOA_GCMS |
| 699-24-35 | 1,2-Dichloroethane | 8260_VOA_GCMS |
| 699-24-35 | 1,2-Dichloroethane | 8260_VOA_GCMS |
| 699-24-35 | 1,2-Dichloroethane | 8260_VOA_GCMS |
| 699-24-35 | 1,2-Dichloroethane | 8260_VOA_GCMS |
| 699-24-35 | 1,2-Dichloroethane | 8260_VOA_GCMS |
| 699-24-35 | 1,2-Dichloroethane | 8260_VOA_GCMS |
| 699-24-35 | 1,2-Dichloroethane | 8260_VOA_GCMS |
| 699-24-35 | 1,2-Dichloroethane | 8260_VOA_GCMS |
| 699-24-35 | 1,2-Dichloroethane | 8260_VOA_GCMS |
| 699-24-35 | 1,2-Dichloroethane | 8260_VOA_GCMS |
| 699-24-35 | 1,2-Dichloroethane | 8260_VOA_GCMS |
| 699-24-35 | 1,2-Dichloroethane | 8260_VOA_GCMS |
| 699-24-35 | 1,2-Dichloroethane | 8260_VOA_GCMS |
| 699-24-35 | 1,2-Dichloroethane | 8260_VOA_GCMS |
| 699-24-35 | 1,2-Dichloroethane | 8260_VOA_GCMS |
| 699-24-35 | 1,2-Dichloroethane | 8260_VOA_GCMS |
| 699-24-35 | 1,2-Dichloroethane | 8260_VOA_GCMS |
| 699-24-35 | 1,2-Dichloroethane | 8260_VOA_GCMS |
| 699-24-35 | 1,2-Dichloroethane | 8260_VOA_GCMS |
| 699-24-35 | 1,4-Dichlorobenzene | 524.2_VOA_GCMS |
| 699-24-35 | 1,4-Dichlorobenzene | 524.2_VOA_GCMS |
| 699-24-35 | 1,4-Dichlorobenzene | 524.2_VOA_GCMS |
| 699-24-35 | 1,4-Dichlorobenzene | 524.2_VOA_GCMS |
| 699-24-35 | 1,4-Dichlorobenzene | 524.2_VOA_GCMS |
| 699-24-35 | 1,4-Dichlorobenzene | 8010_VOA_GC |
| 699-24-35 | 1,4-Dichlorobenzene | 8010_VOA_GC |
| 699-24-35 | 1,4-Dichlorobenzene | 8010_VOA_GC |
| 699-24-35 | 1,4-Dichlorobenzene | 8010_VOA_GC |
| 699-24-35 | 1,4-Dichlorobenzene | 8010_VOA_GC |
| 699-24-35 | 1,4-Dichlorobenzene | 8010_VOA_GC |
| 699-24-35 | 1,4-Dichlorobenzene | 8010_VOA_GC |
| 699-24-35 | 1,4-Dichlorobenzene | 8010_VOA_GC |
| 699-24-35 | 1,4-Dichlorobenzene | 8010_VOA_GC |
| 699-24-35 | 1,4-Dichlorobenzene | 8010_VOA_GC |
| 699-24-35 | 1,4-Dichlorobenzene | 8010_VOA_GC |

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| 699-24-35 | 1,4-Dichlorobenzene | 8010_VOA_GC |
| 699-24-35 | 1,4-Dichlorobenzene | 8020_VOA_GC |
| 699-24-35 | 1,4-Dichlorobenzene | 8020_VOA_GC |
| 699-24-35 | 1,4-Dichlorobenzene | 8020_VOA_GC |
| 699-24-35 | 1,4-Dichlorobenzene | 8020_VOA_GC |
| 699-24-35 | 1,4-Dichlorobenzene | 8020_VOA_GC |
| 699-24-35 | 1,4-Dichlorobenzene | 8020_VOA_GC |
| 699-24-35 | 1,4-Dichlorobenzene | 8020_VOA_GC |
| 699-24-35 | 1,4-Dichlorobenzene | 8020_VOA_GC |
| 699-24-35 | 1,4-Dichlorobenzene | 8020_VOA_GC |
| 699-24-35 | 1,4-Dichlorobenzene | 8020_VOA_GC |
| 699-24-35 | 1,4-Dichlorobenzene | 8260_VOA_GCMS |
| 699-24-35 | 1,4-Dichlorobenzene | 8260_VOA_GCMS |
| 699-24-35 | 1,4-Dichlorobenzene | 8260_VOA_GCMS |
| 699-24-35 | 1,4-Dichlorobenzene | 8260_VOA_GCMS |
| 699-24-35 | 1,4-Dichlorobenzene | 8260_VOA_GCMS |
| 699-24-35 | 1,4-Dichlorobenzene | 8260_VOA_GCMS |
| 699-24-35 | 1,4-Dichlorobenzene | 8260_VOA_GCMS |
| 699-24-35 | 1,4-Dichlorobenzene | 8260_VOA_GCMS |
| 699-24-35 | 1,4-Dichlorobenzene | 8260_VOA_GCMS |
| 699-24-35 | 1,4-Dichlorobenzene | 8260_VOA_GCMS |
| 699-24-35 | 1,4-Dichlorobenzene | 8260_VOA_GCMS |
| 699-24-35 | 1,4-Dichlorobenzene | 8260_VOA_GCMS |
| 699-24-35 | 1,4-Dichlorobenzene | 8260_VOA_GCMS |
| 699-24-35 | 1,4-Dichlorobenzene | 8260_VOA_GCMS |
| 699-24-35 | 1,4-Dichlorobenzene | 8260_VOA_GCMS |
| 699-24-35 | 1,4-Dichlorobenzene | 8260_VOA_GCMS |
| 699-24-35 | 1,4-Dichlorobenzene | 8260_VOA_GCMS |
| 699-24-35 | 1,4-Dichlorobenzene | 8260_VOA_GCMS |
| 699-24-35 | 1,4-Dichlorobenzene | 8260_VOA_GCMS |
| 699-24-35 | 1,4-Dichlorobenzene | 8260_VOA_GCMS |
| 699-24-35 | 1,4-Dichlorobenzene | 8260_VOA_GCMS |
| 699-24-35 | 1,4-Dichlorobenzene | 8260_VOA_GCMS |
| 699-24-35 | 1,4-Dichlorobenzene | 8260_VOA_GCMS |
| 699-24-35 | 1,4-Dichlorobenzene | 8260_VOA_GCMS |
| 699-24-35 | 1,4-Dichlorobenzene | 8260_VOA_GCMS |
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| 699-24-35 | 1,4-Dioxane | 8260_VOA_GCMS |

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| 699-24-35 | 1,4-Dioxane | 8260_VOA_GCMS |
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| 699-24-35 | 1,4-Dioxane | 8260_VOA_GCMS |
| 699-24-35 | 1,4-Dioxane | 8260_VOA_GCMS |
| 699-24-35 | 1,4-Dioxane | 8260_VOA_GCMS |
| 699-24-35 | 1,4-Dioxane | 8260_VOA_GCMS |
| 699-24-35 | 1,4-Dioxane | 8260_VOA_GCMS |
| 699-24-35 | 1,4-Dioxane | 8270_SVOA_GCMS |
| 699-24-35 | 1,4-Dioxane | 8270_SVOA_GCMS |
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| 699-24-35 | Antimony | 6010_METALS_ICP |

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| 699-24-35 | Beryllium | 6010_METALS_ICP |
| 699-24-35 | Beryllium | 6010_METALS_ICP |
| 699-24-35 | Beryllium | 6010_METALS_ICP |
| 699-24-35 | Bromide | 300.0_ANIONS_IC |
| 699-24-35 | Bromide | 300.0_ANIONS_IC |
| 699-24-35 | Cadmium | 6010_METALS_ICP |
| 699-24-35 | Cadmium | 6010_METALS_ICP |
| 699-24-35 | Cadmium | 6010_METALS_ICP |
| 699-24-35 | Cadmium | 6010_METALS_ICP |
| 699-24-35 | Cadmium | 6010_METALS_ICP |

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| 699-24-35 | Cadmium | 6010_METALS_ICP |
| 699-24-35 | Cadmium | 6010_METALS_ICP |
| 699-24-35 | Cadmium | 6010_METALS_ICP |
| 699-24-35 | Calcium | 6010_METALS_ICP |
| 699-24-35 | Calcium | 6010_METALS_ICP |
| 699-24-35 | Calcium | 6010_METALS_ICP |
| 699-24-35 | Calcium | 6010_METALS_ICP |
| 699-24-35 | Calcium | 6010_METALS_ICP |
| 699-24-35 | Calcium | 6010_METALS_ICP |
| 699-24-35 | Calcium | 6010_METALS_ICP |
| 699-24-35 | Calcium | 6010_METALS_ICP |
| 699-24-35 | Carbon disulfide | 8260_VOA_GCMS |
| 699-24-35 | Carbon disulfide | 8260_VOA_GCMS |
| 699-24-35 | Carbon disulfide | 8260_VOA_GCMS |
| 699-24-35 | Carbon disulfide | 8260_VOA_GCMS |
| 699-24-35 | Carbon disulfide | 8260_VOA_GCMS |
| 699-24-35 | Carbon disulfide | 8260_VOA_GCMS |
| 699-24-35 | Carbon disulfide | 8260_VOA_GCMS |
| 699-24-35 | Carbon disulfide | 8260_VOA_GCMS |
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| 699-24-35 | Carbon disulfide | 8260_VOA_GCMS |
| 699-24-35 | Carbon disulfide | 8260_VOA_GCMS |
| 699-24-35 | Carbon disulfide | 8260_VOA_GCMS |
| 699-24-35 | Carbon disulfide | 8260_VOA_GCMS |
| 699-24-35 | Carbon tetrachloride | 524.2_VOA_GCMS |

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| 699-24-35 | Carbon tetrachloride | 524.2_VOA_GCMS |
| 699-24-35 | Carbon tetrachloride | 524.2_VOA_GCMS |
| 699-24-35 | Carbon tetrachloride | 524.2_VOA_GCMS |
| 699-24-35 | Carbon tetrachloride | 524.2_VOA_GCMS |
| 699-24-35 | Carbon tetrachloride | 8010_VOA_GC |
| 699-24-35 | Carbon tetrachloride | 8010_VOA_GC |
| 699-24-35 | Carbon tetrachloride | 8010_VOA_GC |
| 699-24-35 | Carbon tetrachloride | 8010_VOA_GC |
| 699-24-35 | Carbon tetrachloride | 8010_VOA_GC |
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| 699-24-35 | Carbon tetrachloride | 8010_VOA_GC |
| 699-24-35 | Carbon tetrachloride | 8010_VOA_GC |
| 699-24-35 | Carbon tetrachloride | 8260_VOA_GCMS |
| 699-24-35 | Carbon tetrachloride | 8260_VOA_GCMS |
| 699-24-35 | Carbon tetrachloride | 8260_VOA_GCMS |
| 699-24-35 | Carbon tetrachloride | 8260_VOA_GCMS |
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| 699-24-35 | Carbon tetrachloride | 8260_VOA_GCMS |

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| 699-24-35 | Carbon tetrachloride | 8260_VOA_GCMS |
| 699-24-35 | Carbon tetrachloride | 8260_VOA_GCMS |
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| 699-24-35 | Carbon tetrachloride | 8260_VOA_GCMS |
| 699-24-35 | Carbon tetrachloride | 8260_VOA_GCMS |
| 699-24-35 | Carbon tetrachloride | 8260_VOA_GCMS |
| 699-24-35 | Chemical Oxygen Demand | 410.4_COD |
| 699-24-35 | Chemical Oxygen Demand | 410.4_COD |
| 699-24-35 | Chemical Oxygen Demand | 410.4_COD |
| 699-24-35 | Chemical Oxygen Demand | 410.4_COD |
| 699-24-35 | Chemical Oxygen Demand | 410.4_COD |
| 699-24-35 | Chemical Oxygen Demand | 410.4_COD |
| 699-24-35 | Chemical Oxygen Demand | 410.4_COD |
| 699-24-35 | Chemical Oxygen Demand | 410.4_COD |
| 699-24-35 | Chemical Oxygen Demand | 410.4_COD |
| 699-24-35 | Chemical Oxygen Demand | 410.4_COD |
| 699-24-35 | Chemical Oxygen Demand | 410.4_COD |
| 699-24-35 | Chemical Oxygen Demand | 410.4_COD |
| 699-24-35 | Chemical Oxygen Demand | 410.4_COD |
| 699-24-35 | Chemical Oxygen Demand | 410.4_COD |
| 699-24-35 | Chemical Oxygen Demand | 410.4_COD |
| 699-24-35 | Chemical Oxygen Demand | 410.4_COD |
| 699-24-35 | Chemical Oxygen Demand | 410.4_COD |
| 699-24-35 | Chemical Oxygen Demand | 410.4_COD |
| 699-24-35 | Chemical Oxygen Demand | 410.4_COD |
| 699-24-35 | Chemical Oxygen Demand | 410.4_COD |
| 699-24-35 | Chemical Oxygen Demand | 410.4_COD |
| 699-24-35 | Chemical Oxygen Demand | 410.4_COD |
| 699-24-35 | Chemical Oxygen Demand | 410.4_COD |
| 699-24-35 | Chemical Oxygen Demand | 410.4_COD |
| 699-24-35 | Chemical Oxygen Demand | 410.4_COD |
| 699-24-35 | Chemical Oxygen Demand | 410.4_COD |
| 699-24-35 | Chemical Oxygen Demand | 410.4_COD |
| 699-24-35 | Chemical Oxygen Demand | 410.4_COD |
| 699-24-35 | Chemical Oxygen Demand | 410.4_COD |
| 699-24-35 | Chemical Oxygen Demand | 410.4_COD |
| 699-24-35 | Chemical Oxygen Demand | 410.4_COD |
| 699-24-35 | Chemical Oxygen Demand | 410.4_COD |
| 699-24-35 | Chemical Oxygen Demand | 410.4_COD |
| 699-24-35 | Chemical Oxygen Demand | 410.4_COD |
| 699-24-35 | Chemical Oxygen Demand | 410.4_COD |
| 699-24-35 | Chemical Oxygen Demand | 410.4_COD |
| 699-24-35 | Chemical Oxygen Demand | 410.4_COD |
| 699-24-35 | Chemical Oxygen Demand | 410.4_COD |
| 699-24-35 | Chemical Oxygen Demand | 410.4_COD |

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| 699-24-35 | Chemical Oxygen Demand | 410.4_COD |
| 699-24-35 | Chemical Oxygen Demand | 410.4_COD |
| 699-24-35 | Chemical Oxygen Demand | 410.4_COD |
| 699-24-35 | Chemical Oxygen Demand | 410.4_COD |
| 699-24-35 | Chemical Oxygen Demand | 410.4_COD |
| 699-24-35 | Chemical Oxygen Demand | 410.4_COD |
| 699-24-35 | Chemical Oxygen Demand | 410.4_COD |
| 699-24-35 | Chemical Oxygen Demand | 410.4_COD |
| 699-24-35 | Chemical Oxygen Demand | 410.4_COD |
| 699-24-35 | Chemical Oxygen Demand | 410.4_COD |
| 699-24-35 | Chemical Oxygen Demand | 410.4_COD |
| 699-24-35 | Chemical Oxygen Demand | 410.4_COD |
| 699-24-35 | Chemical Oxygen Demand | 410.4_COD |
| 699-24-35 | Chemical Oxygen Demand | 410.4_COD |
| 699-24-35 | Chloride | 300.0_ANIONS_IC |
| 699-24-35 | Chloride | 300.0_ANIONS_IC |
| 699-24-35 | Chloride | 300.0_ANIONS_IC |
| 699-24-35 | Chloride | 300.0_ANIONS_IC |
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| 699-24-35 | Chloride | 300.0_ANIONS_IC |
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| 699-24-35 | Chloride | 300.0_ANIONS_IC |
| 699-24-35 | Chloride | 300.0_ANIONS_IC |
| 699-24-35 | Chloride | 300.0_ANIONS_IC |
| 699-24-35 | Chloride | 300.0_ANIONS_IC |
| 699-24-35 | Chlorobenzene | 8260_VOA_GCMS |
| 699-24-35 | Chlorobenzene | 8260_VOA_GCMS |
| 699-24-35 | Chlorobenzene | 8260_VOA_GCMS |
| 699-24-35 | Chlorobenzene | 8260_VOA_GCMS |
| 699-24-35 | Chlorobenzene | 8260_VOA_GCMS |
| 699-24-35 | Chlorobenzene | 8260_VOA_GCMS |
| 699-24-35 | Chlorobenzene | 8260_VOA_GCMS |
| 699-24-35 | Chloroform | 524.2_VOA_GCMS |
| 699-24-35 | Chloroform | 524.2_VOA_GCMS |
| 699-24-35 | Chloroform | 524.2_VOA_GCMS |
| 699-24-35 | Chloroform | 524.2_VOA_GCMS |
| 699-24-35 | Chloroform | 524.2_VOA_GCMS |
| 699-24-35 | Chloroform | 8010_VOA_GC |
| 699-24-35 | Chloroform | 8010_VOA_GC |
| 699-24-35 | Chloroform | 8010_VOA_GC |
| 699-24-35 | Chloroform | 8010_VOA_GC |
| 699-24-35 | Chloroform | 8010_VOA_GC |
| 699-24-35 | Chloroform | 8010_VOA_GC |
| 699-24-35 | Chloroform | 8010_VOA_GC |
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| 699-24-35 | Chloroform | 8010_VOA_GC |
| 699-24-35 | Chloroform | 8010_VOA_GC |
| 699-24-35 | Chloroform | 8010_VOA_GC |
| 699-24-35 | Chloroform | 8010_VOA_GC |
| 699-24-35 | Chloroform | 8010_VOA_GC |
| 699-24-35 | Chloroform | 8010_VOA_GC |

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| 699-24-35 | Chloroform | 8010_VOA_GC |
| 699-24-35 | Chloroform | 8010_VOA_GC |
| 699-24-35 | Chloroform | 8260_VOA_GCMS |
| 699-24-35 | Chloroform | 8260_VOA_GCMS |
| 699-24-35 | Chloroform | 8260_VOA_GCMS |
| 699-24-35 | Chloroform | 8260_VOA_GCMS |
| 699-24-35 | Chloroform | 8260_VOA_GCMS |
| 699-24-35 | Chloroform | 8260_VOA_GCMS |
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| 699-24-35 | Chloroform | 8260_VOA_GCMS |
| 699-24-35 | Chloroform | 8260_VOA_GCMS |
| 699-24-35 | Chloroform | 8260_VOA_GCMS |
| 699-24-35 | Chloroform | 8260_VOA_GCMS |
| 699-24-35 | Chromium | 6010_METALS_ICP |
| 699-24-35 | Chromium | 6010_METALS_ICP |
| 699-24-35 | Chromium | 6010_METALS_ICP |
| 699-24-35 | Chromium | 6010_METALS_ICP |
| 699-24-35 | Chromium | 6010_METALS_ICP |
| 699-24-35 | Chromium | 6010_METALS_ICP |
| 699-24-35 | Chromium | 6010_METALS_ICP |
| 699-24-35 | Chromium | 6010_METALS_ICP |
| 699-24-35 | Cobalt | 6010_METALS_ICP |
| 699-24-35 | Cobalt | 6010_METALS_ICP |

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| 699-24-35 | Cobalt | 6010_METALS_ICP |
| 699-24-35 | Cobalt | 6010_METALS_ICP |
| 699-24-35 | Cobalt | 6010_METALS_ICP |
| 699-24-35 | Cobalt | 6010_METALS_ICP |
| 699-24-35 | Cobalt | 6010_METALS_ICP |
| 699-24-35 | Cobalt | 6010_METALS_ICP |
| 699-24-35 | Coliform Bacteria | 9131_COLIFORM |
| 699-24-35 | Coliform Bacteria | 9131_COLIFORM |
| 699-24-35 | Coliform Bacteria | 9131_COLIFORM |
| 699-24-35 | Coliform Bacteria | 9131_COLIFORM |
| 699-24-35 | Coliform Bacteria | 9131_COLIFORM |
| 699-24-35 | Coliform Bacteria | 9131_COLIFORM |
| 699-24-35 | Coliform Bacteria | 9131_COLIFORM |
| 699-24-35 | Coliform Bacteria | 9131_COLIFORM |
| 699-24-35 | Coliform Bacteria | 9131_COLIFORM |
| 699-24-35 | Coliform Bacteria | 9131_COLIFORM |
| 699-24-35 | Coliform Bacteria | 9131_COLIFORM |
| 699-24-35 | Coliform Bacteria | 9131_COLIFORM |
| 699-24-35 | Coliform Bacteria | 9131_COLIFORM |
| 699-24-35 | Coliform Bacteria | 9131_COLIFORM |
| 699-24-35 | Coliform Bacteria | 9131_COLIFORM |
| 699-24-35 | Coliform Bacteria | 9131_COLIFORM |
| 699-24-35 | Coliform Bacteria | 9131_COLIFORM |
| 699-24-35 | Coliform Bacteria | 9131_COLIFORM |
| 699-24-35 | Coliform Bacteria | 9223_COLIFORM |
| 699-24-35 | Coliform Bacteria | 9223_COLIFORM |
| 699-24-35 | Coliform Bacteria | 9223_COLIFORM |
| 699-24-35 | Coliform Bacteria | 9223_COLIFORM |
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| 699-24-35 | Coliform Bacteria | 9223_COLIFORM |
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| 699-24-35 | Coliform Bacteria | 9223_COLIFORM |
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| 699-24-35 | Coliform Bacteria | 9223_COLIFORM |
| 699-24-35 | Coliform Bacteria | 9223_COLIFORM |
| 699-24-35 | Coliform Bacteria | 9223_COLIFORM |

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| 699-24-35 | Coliform Bacteria | 9223_COLIFORM |
| 699-24-35 | Coliform Bacteria | 9223_COLIFORM |
| 699-24-35 | Coliform Bacteria | 9223_COLIFORM |
| 699-24-35 | Coliform Bacteria | 9223_COLIFORM |
| 699-24-35 | Coliform Bacteria | 9223_COLIFORM |
| 699-24-35 | Coliform Bacteria | 9223_COLIFORM |
| 699-24-35 | Coliform Bacteria | 9223_COLIFORM |
| 699-24-35 | Copper | 6010_METALS_ICP |
| 699-24-35 | Copper | 6010_METALS_ICP |
| 699-24-35 | Copper | 6010_METALS_ICP |
| 699-24-35 | Copper | 6010_METALS_ICP |
| 699-24-35 | Copper | 6010_METALS_ICP |
| 699-24-35 | Copper | 6010_METALS_ICP |
| 699-24-35 | Copper | 6010_METALS_ICP |
| 699-24-35 | Copper | 6010_METALS_ICP |
| 699-24-35 | Ethyl cyanide | 8260_VOA_GCMS |
| 699-24-35 | Ethyl cyanide | 8260_VOA_GCMS |
| 699-24-35 | Ethyl cyanide | 8260_VOA_GCMS |
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| 699-24-35 | Ethyl cyanide | 8260_VOA_GCMS |
| 699-24-35 | Ethyl cyanide | 8260_VOA_GCMS |
| 699-24-35 | Ethylbenzene | 524.2_VOA_GCMS |
| 699-24-35 | Ethylbenzene | 524.2_VOA_GCMS |
| 699-24-35 | Ethylbenzene | 524.2_VOA_GCMS |
| 699-24-35 | Ethylbenzene | 524.2_VOA_GCMS |
| 699-24-35 | Ethylbenzene | 8020_VOA_GC |
| 699-24-35 | Ethylbenzene | 8020_VOA_GC |
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| 699-24-35 | Ethylbenzene | 8020_VOA_GC |
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| 699-24-35 | Ethylbenzene | 8020_VOA_GC |
| 699-24-35 | Ethylbenzene | 8260_VOA_GCMS |
| 699-24-35 | Ethylbenzene | 8260_VOA_GCMS |
| 699-24-35 | Ethylbenzene | 8260_VOA_GCMS |
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| 699-24-35 | Ethylbenzene | 8260_VOA_GCMS |
| 699-24-35 | Ethylbenzene | 8260_VOA_GCMS |
| 699-24-35 | Fluoride | 300.0_ANIONS_IC |
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| 699-24-35 | Fluoride | 300.0_ANIONS_IC |
| 699-24-35 | Gross alpha | 9310_ALPHABETA_GPC |
| 699-24-35 | Gross alpha | 9310_ALPHABETA_GPC |
| 699-24-35 | Gross alpha | 9310_ALPHABETA_GPC |
| 699-24-35 | Gross alpha | 9310_ALPHABETA_GPC |
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| 699-24-35 | Gross alpha | 9310_ALPHABETA_GPC |
| 699-24-35 | Gross alpha | 9310_ALPHABETA_GPC |
| 699-24-35 | Gross alpha | 9310_ALPHABETA_GPC |
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| 699-24-35 | Gross alpha | 9310_ALPHABETA_GPC |
| 699-24-35 | Gross alpha | 9310_ALPHABETA_GPC |
| 699-24-35 | Gross alpha | 9310_ALPHABETA_GPC |
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| 699-24-35 | Gross alpha | ALPHA_GPC |
| 699-24-35 | Gross alpha | ALPHA_GPC |
| 699-24-35 | Gross alpha | ALPHA_GPC |
| 699-24-35 | Gross beta | 9310_ALPHABETA_GPC |
| 699-24-35 | Gross beta | 9310_ALPHABETA_GPC |
| 699-24-35 | Gross beta | 9310_ALPHABETA_GPC |
| 699-24-35 | Gross beta | 9310_ALPHABETA_GPC |
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| 699-24-35 | Gross beta | 9310_ALPHABETA_GPC |
| 699-24-35 | Gross beta | 9310_ALPHABETA_GPC |

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| 699-24-35 | Gross beta | BETA_GPC |
| 699-24-35 | Gross beta | BETA_GPC |
| 699-24-35 | Gross beta | BETA_GPC |
| 699-24-35 | Gross beta | BETA_GPC |
| 699-24-35 | Gross beta | BETA_GPC |
| 699-24-35 | Gross beta | BETA_GPC |
| 699-24-35 | Iron | 6010_METALS_ICP |
| 699-24-35 | Iron | 6010_METALS_ICP |
| 699-24-35 | Iron | 6010_METALS_ICP |
| 699-24-35 | Iron | 6010_METALS_ICP |
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| 699-24-35 | Iron | 6010_METALS_ICP |
| 699-24-35 | Iron | 6010_METALS_ICP |
| 699-24-35 | Iron | 6010_METALS_ICP |
| 699-24-35 | Magnesium | 6010_METALS_ICP |
| 699-24-35 | Magnesium | 6010_METALS_ICP |
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| 699-24-35 | Magnesium | 6010_METALS_ICP |
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| 699-24-35 | Magnesium | 6010_METALS_ICP |
| 699-24-35 | Magnesium | 6010_METALS_ICP |
| 699-24-35 | Magnesium | 6010_METALS_ICP |
| 699-24-35 | Manganese | 6010_METALS_ICP |
| 699-24-35 | Manganese | 6010_METALS_ICP |
| 699-24-35 | Manganese | 6010_METALS_ICP |
| 699-24-35 | Manganese | 6010_METALS_ICP |
| 699-24-35 | Manganese | 6010_METALS_ICP |
| 699-24-35 | Manganese | 6010_METALS_ICP |
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| 699-24-35 | Manganese | 6010_METALS_ICP |
| 699-24-35 | Methylene chloride | 524.2_VOA_GCMS |
| 699-24-35 | Methylene chloride | 524.2_VOA_GCMS |
| 699-24-35 | Methylene chloride | 524.2_VOA_GCMS |
| 699-24-35 | Methylene chloride | 524.2_VOA_GCMS |
| 699-24-35 | Methylene chloride | 524.2_VOA_GCMS |
| 699-24-35 | Methylene chloride | 8010_VOA_GC |
| 699-24-35 | Methylene chloride | 8010_VOA_GC |
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| 699-24-35 | Methylene chloride | 8010_VOA_GC |
| 699-24-35 | Methylene chloride | 8010_VOA_GC |
| 699-24-35 | Methylene chloride | 8260_VOA_GCMS |
| 699-24-35 | Methylene chloride | 8260_VOA_GCMS |
| 699-24-35 | Methylene chloride | 8260_VOA_GCMS |
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| 699-24-35 | Nitrate | 300.0_ANIONS_IC |

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| 699-24-35 | Tetrachloroethene | 8260_VOA_GCMS |
| 699-24-35 | Tetrahydrofuran | 8260_VOA_GCMS |
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| 699-24-35 | Tetrahydrofuran | 8260_VOA_GCMS |
| 699-24-35 | Toluene | 524.2_VOA_GCMS |
| 699-24-35 | Toluene | 524.2_VOA_GCMS |
| 699-24-35 | Toluene | 524.2_VOA_GCMS |
| 699-24-35 | Toluene | 524.2_VOA_GCMS |
| 699-24-35 | Toluene | 8020_VOA_GC |
| 699-24-35 | Toluene | 8020_VOA_GC |
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| 699-24-35 | Toluene | 8020_VOA_GC |
| 699-24-35 | Toluene | 8260_VOA_GCMS |
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| 699-24-35 | Toluene | 8260_VOA_GCMS |
| 699-24-35 | Total carbon | 415.1_TOC |
| 699-24-35 | Total carbon | 415.1_TOC |
| 699-24-35 | Total carbon | 415.1_TOC |
| 699-24-35 | Total carbon | 415.1_TOC |
| 699-24-35 | Total carbon | 415.1_TOC |
| 699-24-35 | Total carbon | 415.1_TOC |
| 699-24-35 | Total carbon | 415.1_TOC |
| 699-24-35 | Total carbon | 415.1_TOC |
| 699-24-35 | Total carbon | 415.1_TOC |
| 699-24-35 | Total carbon | 415.1_TOC |
| 699-24-35 | Total carbon | 415.1_TOC |
| 699-24-35 | Total dissolved solids | 160.1_TDS |
| 699-24-35 | Total dissolved solids | 160.1_TDS |
| 699-24-35 | Total dissolved solids | 160.1_TDS |
| 699-24-35 | Total dissolved solids | 160.1_TDS |
| 699-24-35 | Total dissolved solids | 160.1_TDS |
| 699-24-35 | Total dissolved solids | 160.1_TDS |
| 699-24-35 | Total dissolved solids | 160.1_TDS |
| 699-24-35 | Total dissolved solids | 160.1_TDS |
| 699-24-35 | Total dissolved solids | 160.1_TDS |
| 699-24-35 | Total dissolved solids | 160.1_TDS |
| 699-24-35 | Total organic carbon | 9060_TOC |
| 699-24-35 | Total organic carbon | 9060_TOC |
| 699-24-35 | Total organic carbon | 9060_TOC |
| 699-24-35 | Total organic carbon | 9060_TOC |
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| 699-24-35 | Total organic carbon | 9060_TOC |
| 699-24-35 | Total organic carbon | 9060_TOC |
| 699-24-35 | Total organic halides | 9020_TOX |
| 699-24-35 | Total organic halides | 9020_TOX |
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| 699-24-35 | Total organic halides | 9020_TOX |
| 699-24-35 | Total organic halides | 9020_TOX |
| 699-24-35 | Trichloroethene | 524.2_VOA_GCMS |
| 699-24-35 | Trichloroethene | 524.2_VOA_GCMS |
| 699-24-35 | Trichloroethene | 524.2_VOA_GCMS |
| 699-24-35 | Trichloroethene | 524.2_VOA_GCMS |
| 699-24-35 | Trichloroethene | 524.2_VOA_GCMS |

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| 699-24-35 | Trichloroethene | 8010_VOA_GC |
| 699-24-35 | Trichloroethene | 8010_VOA_GC |
| 699-24-35 | Trichloroethene | 8010_VOA_GC |
| 699-24-35 | Trichloroethene | 8010_VOA_GC |
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| 699-24-35 | Trichloroethene | 8010_VOA_GC |
| 699-24-35 | Trichloroethene | 8010_VOA_GC |
| 699-24-35 | Trichloroethene | 8260_VOA_GCMS |
| 699-24-35 | Trichloroethene | 8260_VOA_GCMS |
| 699-24-35 | Trichloroethene | 8260_VOA_GCMS |
| 699-24-35 | Trichloroethene | 8260_VOA_GCMS |
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| 699-24-35 | Trichloroethene | 8260_VOA_GCMS |
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| 699-24-35 | Trichloroethene | 8260_VOA_GCMS |
| 699-24-35 | Trichloroethene | 8260_VOA_GCMS |
| 699-24-35 | Tritium | 906.0_H3_LSC |
| 699-24-35 | Tritium | 906.0_H3_LSC |
| 699-24-35 | Tritium | 906.0_H3_LSC |
| 699-24-35 | Tritium | 906.0_H3_LSC |
| 699-24-35 | Tritium | 906.0_H3_LSC |
| 699-24-35 | Tritium | 906.0_H3_LSC |
| 699-24-35 | Tritium | 906.0_H3_LSC |
| 699-24-35 | Tritium | 906.0_H3_LSC |
| 699-24-35 | Tritium | 906.0_H3_LSC |
| 699-24-35 | Tritium | TRITIUM_DIST_LSC |
| 699-24-35 | Tritium | TRITIUM_DIST_LSC |
| 699-24-35 | Tritium | TRITIUM_DIST_LSC |
| 699-24-35 | Tritium | TRITIUM_DIST_LSC |
| 699-24-35 | Tritium | TRITIUM_DIST_LSC |
| 699-24-35 | Tritium | TRITIUM_DIST_LSC |
| 699-24-35 | Tritium | TRITIUM_DIST_LSC |
| 699-24-35 | Tritium | TRITIUM_DIST_LSC |
| 699-24-35 | Turbidity | 180.1_TURBIDITY_FLD |
| 699-24-35 | Turbidity | 180.1_TURBIDITY_FLD |
| 699-24-35 | Turbidity | 180.1_TURBIDITY_FLD |
| 699-24-35 | Turbidity | 180.1_TURBIDITY_FLD |
| 699-24-35 | Turbidity | 180.1_TURBIDITY_FLD |
| 699-24-35 | Turbidity | 214A_TURBIDITY |
| 699-24-35 | Turbidity | 214A_TURBIDITY |
| 699-24-35 | Turbidity | 214A_TURBIDITY |
| 699-24-35 | Turbidity | 214A_TURBIDITY |
| 699-24-35 | Turbidity | 214A_TURBIDITY |
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| 699-24-35 | Turbidity | 214A_TURBIDITY |
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| 699-24-35 | Turbidity | 214A_TURBIDITY |
| 699-24-35 | Turbidity | 214A_TURBIDITY |
| 699-24-35 | Turbidity | 214A_TURBIDITY |

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| 699-24-35 | Turbidity | 214A_TURBIDITY |
| 699-24-35 | Turbidity | 214A_TURBIDITY |
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| 699-24-35 | Turbidity | 214A_TURBIDITY |
| 699-24-35 | Turbidity | 214A_TURBIDITY |
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| 699-24-35 | Turbidity | 214A_TURBIDITY |
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| 699-24-35 | Turbidity | 214A_TURBIDITY |
| 699-24-35 | Turbidity | 214A_TURBIDITY |
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| 699-24-35 | Turbidity | 214A_TURBIDITY |
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| 699-24-35 | Turbidity | 214A_TURBIDITY |
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| 699-24-35 | Turbidity | 214A_TURBIDITY |
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| 699-24-35 | Turbidity | 214A_TURBIDITY |
| 699-24-35 | Turbidity | 214A_TURBIDITY |
| 699-24-35 | Turbidity | 214A_TURBIDITY |
| 699-24-35 | Turbidity | TURBIDITY_FLD |
| 699-24-35 | Turbidity | TURBIDITY_FLD |
| 699-24-35 | Turbidity | TURBIDITY_FLD |
| 699-24-35 | Turbidity | TURBIDITY_FLD |
| 699-24-35 | Turbidity | TURBIDITY_FLD |
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| 699-24-35 | Turbidity | TURBIDITY_FLD |
| 699-24-35 | Turbidity | TURBIDITY_FLD |
| 699-24-35 | Turbidity | TURBIDITY_FLD |
| 699-24-35 | Turbidity | TURBIDITY_FLD |
| 699-24-35 | Vanadium | 6010_METALS_ICP |
| 699-24-35 | Vanadium | 6010_METALS_ICP |
| 699-24-35 | Vanadium | 6010_METALS_ICP |
| 699-24-35 | Vanadium | 6010_METALS_ICP |
| 699-24-35 | Vanadium | 6010_METALS_ICP |
| 699-24-35 | Vanadium | 6010_METALS_ICP |

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| 699-24-35 | Vanadium | 6010_METALS_ICP |
| 699-24-35 | Vanadium | 6010_METALS_ICP |
| 699-24-35 | Vinyl chloride | 524.2_VOA_GCMS |
| 699-24-35 | Vinyl chloride | 524.2_VOA_GCMS |
| 699-24-35 | Vinyl chloride | 524.2_VOA_GCMS |
| 699-24-35 | Vinyl chloride | 524.2_VOA_GCMS |
| 699-24-35 | Vinyl chloride | 524.2_VOA_GCMS |
| 699-24-35 | Vinyl chloride | 8010_VOA_GC |
| 699-24-35 | Vinyl chloride | 8010_VOA_GC |
| 699-24-35 | Vinyl chloride | 8010_VOA_GC |
| 699-24-35 | Vinyl chloride | 8010_VOA_GC |
| 699-24-35 | Vinyl chloride | 8010_VOA_GC |
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| 699-24-35 | Vinyl chloride | 8010_VOA_GC |
| 699-24-35 | Vinyl chloride | 8010_VOA_GC |
| 699-24-35 | Vinyl chloride | 8010_VOA_GC |
| 699-24-35 | Vinyl chloride | 8260_VOA_GCMS |
| 699-24-35 | Vinyl chloride | 8260_VOA_GCMS |
| 699-24-35 | Vinyl chloride | 8260_VOA_GCMS |
| 699-24-35 | Vinyl chloride | 8260_VOA_GCMS |
| 699-24-35 | Vinyl chloride | 8260_VOA_GCMS |
| 699-24-35 | Vinyl chloride | 8260_VOA_GCMS |
| 699-24-35 | Vinyl chloride | 8260_VOA_GCMS |
| 699-24-35 | Vinyl chloride | 8260_VOA_GCMS |
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| 699-24-35 | Vinyl chloride | 8260_VOA_GCMS |
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| 699-24-35 | Vinyl chloride | 8260_VOA_GCMS |
| 699-24-35 | Vinyl chloride | 8260_VOA_GCMS |
| 699-24-35 | Vinyl chloride | 8260_VOA_GCMS |
| 699-24-35 | Vinyl chloride | 8260_VOA_GCMS |
| 699-24-35 | Vinyl chloride | 8260_VOA_GCMS |
| 699-24-35 | Vinyl chloride | 8260_VOA_GCMS |
| 699-24-35 | Vinyl chloride | 8260_VOA_GCMS |
| 699-24-35 | Vinyl chloride | 8260_VOA_GCMS |
| 699-24-35 | Vinyl chloride | 8260_VOA_GCMS |
| 699-24-35 | Vinyl chloride | 8260_VOA_GCMS |
| 699-24-35 | Vinyl chloride | 8260_VOA_GCMS |

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| 699-24-35 | Vinyl chloride | 8260_VOA_GCMS |
| 699-24-35 | Vinyl chloride | 8260_VOA_GCMS |
| 699-24-35 | Vinyl chloride | 8260_VOA_GCMS |
| 699-24-35 | Vinyl chloride | 8260_VOA_GCMS |
| 699-24-35 | Vinyl chloride | 8260_VOA_GCMS |
| 699-24-35 | Vinyl chloride | 8260_VOA_GCMS |
| 699-24-35 | Vinyl chloride | 8260_VOA_GCMS |
| 699-24-35 | Vinyl chloride | 8260_VOA_GCMS |
| 699-24-35 | Vinyl chloride | 8260_VOA_GCMS |
| 699-24-35 | Vinyl chloride | 8260_VOA_GCMS |
| 699-24-35 | Vinyl chloride | 8260_VOA_GCMS |
| 699-24-35 | Xylenes (total) | 524.2_VOA_GCMS |
| 699-24-35 | Xylenes (total) | 8020_VOA_GC |
| 699-24-35 | Xylenes (total) | 8020_VOA_GC |
| 699-24-35 | Xylenes (total) | 8020_VOA_GC |
| 699-24-35 | Xylenes (total) | 8020_VOA_GC |
| 699-24-35 | Xylenes (total) | 8020_VOA_GC |
| 699-24-35 | Xylenes (total) | 8020_VOA_GC |
| 699-24-35 | Xylenes (total) | 8020_VOA_GC |
| 699-24-35 | Xylenes (total) | 8020_VOA_GC |
| 699-24-35 | Xylenes (total) | 8260_VOA_GCMS |
| 699-24-35 | Xylenes (total) | 8260_VOA_GCMS |
| 699-24-35 | Xylenes (total) | 8260_VOA_GCMS |
| 699-24-35 | Xylenes (total) | 8260_VOA_GCMS |
| 699-24-35 | Xylenes (total) | 8260_VOA_GCMS |
| 699-24-35 | Xylenes (total) | 8260_VOA_GCMS |
| 699-24-35 | Xylenes (total) | 8260_VOA_GCMS |
| 699-24-35 | Xylenes (total) | 8260_VOA_GCMS |
| 699-24-35 | Xylenes (total) | 8260_VOA_GCMS |
| 699-24-35 | Xylenes (total) | 8260_VOA_GCMS |
| 699-24-35 | Xylenes (total) | 8260_VOA_GCMS |
| 699-24-35 | Xylenes (total) | 8260_VOA_GCMS |
| 699-24-35 | Xylenes (total) | 8260_VOA_GCMS |
| 699-24-35 | Xylenes (total) | 8260_VOA_GCMS |
| 699-24-35 | Xylenes (total) | 8260_VOA_GCMS |
| 699-24-35 | Xylenes (total) | 8260_VOA_GCMS |
| 699-24-35 | Xylenes (total) | 8260_VOA_GCMS |
| 699-24-35 | Xylenes (total) | 8260_VOA_GCMS |
| 699-24-35 | Xylenes (total) | 8260_VOA_GCMS |
| 699-24-35 | Xylenes (total) | 8260_VOA_GCMS |
| 699-24-35 | Xylenes (total) | 8260_VOA_GCMS |
| 699-24-35 | Xylenes (total) | 8260_VOA_GCMS |
| 699-24-35 | Xylenes (total) | 8260_VOA_GCMS |
| 699-24-35 | Xylenes (total) | 8260_VOA_GCMS |
| 699-24-35 | Xylenes (total) | 8260_VOA_GCMS |
| 699-24-35 | Xylenes (total) | 8260_VOA_GCMS |
| 699-24-35 | Xylenes (total) | 8260_VOA_GCMS |

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| 699-24-35 | Xylenes (total) | 8260_VOA_GCMS |
| 699-24-35 | Xylenes (total) | 8260_VOA_GCMS |
| 699-24-35 | Xylenes (total) | 8260_VOA_GCMS |
| 699-24-35 | Xylenes (total) | 8260_VOA_GCMS |
| 699-24-35 | Xylenes (total) | 8260_VOA_GCMS |
| 699-24-35 | Xylenes (total) | 8260_VOA_GCMS |
| 699-24-35 | Xylenes (total) | 8260_VOA_GCMS |
| 699-24-35 | Xylenes (total) | 8260_VOA_GCMS |
| 699-24-35 | Zinc | 6010_METALS_ICP |
| 699-24-35 | Zinc | 6010_METALS_ICP |
| 699-24-35 | Zinc | 6010_METALS_ICP |
| 699-24-35 | Zinc | 6010_METALS_ICP |
| 699-24-35 | Zinc | 6010_METALS_ICP |
| 699-24-35 | Zinc | 6010_METALS_ICP |
| 699-24-35 | Zinc | 6010_METALS_ICP |
| 699-24-35 | Zinc | 6010_METALS_ICP |
| 699-24-35 | cis-1,2-Dichloroethylene | 524.2_VOA_GCMS |
| 699-24-35 | cis-1,2-Dichloroethylene | 524.2_VOA_GCMS |
| 699-24-35 | cis-1,2-Dichloroethylene | 524.2_VOA_GCMS |
| 699-24-35 | cis-1,2-Dichloroethylene | 524.2_VOA_GCMS |
| 699-24-35 | cis-1,2-Dichloroethylene | 524.2_VOA_GCMS |
| 699-24-35 | cis-1,2-Dichloroethylene | 8010_VOA_GC |
| 699-24-35 | cis-1,2-Dichloroethylene | 8010_VOA_GC |
| 699-24-35 | cis-1,2-Dichloroethylene | 8010_VOA_GC |
| 699-24-35 | cis-1,2-Dichloroethylene | 8010_VOA_GC |
| 699-24-35 | cis-1,2-Dichloroethylene | 8010_VOA_GC |
| 699-24-35 | cis-1,2-Dichloroethylene | 8010_VOA_GC |
| 699-24-35 | cis-1,2-Dichloroethylene | 8010_VOA_GC |
| 699-24-35 | cis-1,2-Dichloroethylene | 8010_VOA_GC |
| 699-24-35 | cis-1,2-Dichloroethylene | 8010_VOA_GC |
| 699-24-35 | cis-1,2-Dichloroethylene | 8010_VOA_GC |
| 699-24-35 | cis-1,2-Dichloroethylene | 8010_VOA_GC |
| 699-24-35 | cis-1,2-Dichloroethylene | 8010_VOA_GC |
| 699-24-35 | cis-1,2-Dichloroethylene | 8010_VOA_GC |
| 699-24-35 | cis-1,2-Dichloroethylene | 8010_VOA_GC |
| 699-24-35 | cis-1,2-Dichloroethylene | 8010_VOA_GC |
| 699-24-35 | cis-1,2-Dichloroethylene | 8010_VOA_GC |
| 699-24-35 | cis-1,2-Dichloroethylene | 8010_VOA_GC |
| 699-24-35 | cis-1,2-Dichloroethylene | 8010_VOA_GC |
| 699-24-35 | cis-1,2-Dichloroethylene | 8260_VOA_GCMS |
| 699-24-35 | cis-1,2-Dichloroethylene | 8260_VOA_GCMS |
| 699-24-35 | cis-1,2-Dichloroethylene | 8260_VOA_GCMS |
| 699-24-35 | cis-1,2-Dichloroethylene | 8260_VOA_GCMS |
| 699-24-35 | cis-1,2-Dichloroethylene | 8260_VOA_GCMS |
| 699-24-35 | cis-1,2-Dichloroethylene | 8260_VOA_GCMS |
| 699-24-35 | cis-1,2-Dichloroethylene | 8260_VOA_GCMS |
| 699-24-35 | cis-1,2-Dichloroethylene | 8260_VOA_GCMS |
| 699-24-35 | cis-1,2-Dichloroethylene | 8260_VOA_GCMS |
| 699-24-35 | cis-1,2-Dichloroethylene | 8260_VOA_GCMS |

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| 699-24-35 | cis-1,2-Dichloroethylene | 8260_VOA_GCMS |
| 699-24-35 | cis-1,2-Dichloroethylene | 8260_VOA_GCMS |
| 699-24-35 | cis-1,2-Dichloroethylene | 8260_VOA_GCMS |
| 699-24-35 | cis-1,2-Dichloroethylene | 8260_VOA_GCMS |
| 699-24-35 | cis-1,2-Dichloroethylene | 8260_VOA_GCMS |
| 699-24-35 | cis-1,2-Dichloroethylene | 8260_VOA_GCMS |
| 699-24-35 | cis-1,2-Dichloroethylene | 8260_VOA_GCMS |
| 699-24-35 | cis-1,2-Dichloroethylene | 8260_VOA_GCMS |
| 699-24-35 | cis-1,2-Dichloroethylene | 8260_VOA_GCMS |
| 699-24-35 | cis-1,2-Dichloroethylene | 8260_VOA_GCMS |
| 699-24-35 | cis-1,2-Dichloroethylene | 8260_VOA_GCMS |
| 699-24-35 | cis-1,2-Dichloroethylene | 8260_VOA_GCMS |
| 699-24-35 | cis-1,2-Dichloroethylene | 8260_VOA_GCMS |
| 699-24-35 | cis-1,2-Dichloroethylene | 8260_VOA_GCMS |
| 699-24-35 | cis-1,2-Dichloroethylene | 8260_VOA_GCMS |
| 699-24-35 | cis-1,2-Dichloroethylene | 8260_VOA_GCMS |
| 699-24-35 | cis-1,2-Dichloroethylene | 8260_VOA_GCMS |
| 699-24-35 | cis-1,2-Dichloroethylene | 8260_VOA_GCMS |
| 699-24-35 | cis-1,2-Dichloroethylene | 8260_VOA_GCMS |
| 699-24-35 | cis-1,2-Dichloroethylene | 8260_VOA_GCMS |
| 699-24-35 | cis-1,2-Dichloroethylene | 8260_VOA_GCMS |
| 699-24-35 | cis-1,2-Dichloroethylene | 8260_VOA_GCMS |
| 699-24-35 | cis-1,2-Dichloroethylene | 8260_VOA_GCMS |
| 699-24-35 | cis-1,2-Dichloroethylene | 8260_VOA_GCMS |
| 699-24-35 | o-Xylene | 524.2_VOA_GCMS |
| 699-24-35 | o-Xylene | 524.2_VOA_GCMS |
| 699-24-35 | o-Xylene | 524.2_VOA_GCMS |
| 699-24-35 | o-Xylene | 8020_VOA_GC |
| 699-24-35 | o-Xylene | 8020_VOA_GC |
| 699-24-35 | o-Xylene | 8020_VOA_GC |
| 699-24-35 | o-Xylene | 8020_VOA_GC |
| 699-24-35 | o-Xylene | 8020_VOA_GC |
| 699-24-35 | o-Xylene | 8020_VOA_GC |
| 699-24-35 | o-Xylene | 8020_VOA_GC |
| 699-24-35 | o-Xylene | 8020_VOA_GC |
| 699-24-35 | o-Xylene | 8020_VOA_GC |
| 699-24-35 | o-Xylene | 8020_VOA_GC |
| 699-24-35 | o-Xylene | 8020_VOA_GC |
| 699-24-35 | o-Xylene | 8020_VOA_GC |
| 699-24-35 | o-Xylene | 8260_VOA_GCMS |
| 699-24-35 | o-Xylene | 8260_VOA_GCMS |
| 699-24-35 | o-Xylene | 8260_VOA_GCMS |
| 699-24-35 | o-Xylene | 8260_VOA_GCMS |
| 699-24-35 | o-Xylene | 8260_VOA_GCMS |
| 699-24-35 | pH Measurement | 9040_PH |
| 699-24-35 | pH Measurement | 9040_PH |

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| 699-24-35 | pH Measurement | 9040_PH |
| 699-24-35 | pH Measurement | 9040_PH |
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| 699-24-35 | pH Measurement | 9040_PH |
| 699-24-35 | pH Measurement | 9040_PH |
| 699-24-35 | pH Measurement | 9040_PH |
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| 699-24-35 | pH Measurement | 9040_PH |
| 699-24-35 | pH Measurement | 9040_PH |
| 699-24-35 | pH Measurement | 9040_PH |

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| 699-24-35 | pH Measurement | 9040_PH |
| 699-24-35 | pH Measurement | 9040_PH |
| 699-24-35 | pH Measurement | 9040_PH |
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| 699-24-35 | pH Measurement | 9040_PH |
| 699-24-35 | pH Measurement | 9040_PH |
| 699-24-35 | pH Measurement | 9040_PH |
| 699-24-35 | pH Measurement | 9040_PH |
| 699-24-35 | pH Measurement | PH_ELECT_FLD |
| 699-24-35 | pH Measurement | PH_ELECT_FLD |
| 699-24-35 | pH Measurement | PH_ELECT_FLD |
| 699-24-35 | pH Measurement | PH_ELECT_FLD |
| 699-24-35 | pH Measurement | PH_ELECT_FLD |
| 699-24-35 | pH Measurement | PH_ELECT_FLD |
| 699-24-35 | pH Measurement | PH_ELECT_FLD |
| 699-24-35 | pH Measurement | PH_ELECT_FLD |
| 699-24-35 | pH Measurement | PH_ELECT_FLD |
| 699-24-35 | pH Measurement | PH_ELECT_FLD |
| 699-24-35 | pH Measurement | PH_ELECT_FLD |
| 699-24-35 | pH Measurement | PH_ELECT_FLD |
| 699-24-35 | pH Measurement | PH_ELECT_FLD |
| 699-24-35 | pH Measurement | PH_ELECT_FLD |
| 699-24-35 | trans-1,2-Dichloroethylene | 524.2_VOA_GCMS |
| 699-24-35 | trans-1,2-Dichloroethylene | 524.2_VOA_GCMS |
| 699-24-35 | trans-1,2-Dichloroethylene | 524.2_VOA_GCMS |
| 699-24-35 | trans-1,2-Dichloroethylene | 524.2_VOA_GCMS |
| 699-24-35 | trans-1,2-Dichloroethylene | 524.2_VOA_GCMS |
| 699-24-35 | trans-1,2-Dichloroethylene | 8010_VOA_GC |
| 699-24-35 | trans-1,2-Dichloroethylene | 8010_VOA_GC |
| 699-24-35 | trans-1,2-Dichloroethylene | 8010_VOA_GC |
| 699-24-35 | trans-1,2-Dichloroethylene | 8010_VOA_GC |

| | | |
|---|---|---|
| 699-24-35 | trans-1,2-Dichloroethylene | 8010_VOA_GC |
| 699-24-35 | trans-1,2-Dichloroethylene | 8010_VOA_GC |
| 699-24-35 | trans-1,2-Dichloroethylene | 8010_VOA_GC |
| 699-24-35 | trans-1,2-Dichloroethylene | 8010_VOA_GC |
| 699-24-35 | trans-1,2-Dichloroethylene | 8010_VOA_GC |
| 699-24-35 | trans-1,2-Dichloroethylene | 8010_VOA_GC |
| 699-24-35 | trans-1,2-Dichloroethylene | 8010_VOA_GC |
| 699-24-35 | trans-1,2-Dichloroethylene | 8010_VOA_GC |
| 699-24-35 | trans-1,2-Dichloroethylene | 8010_VOA_GC |
| 699-24-35 | trans-1,2-Dichloroethylene | 8010_VOA_GC |
| 699-24-35 | trans-1,2-Dichloroethylene | 8010_VOA_GC |
| 699-24-35 | trans-1,2-Dichloroethylene | 8260_VOA_GCMS |
| 699-24-35 | trans-1,2-Dichloroethylene | 8260_VOA_GCMS |
| 699-24-35 | trans-1,2-Dichloroethylene | 8260_VOA_GCMS |
| 699-24-35 | trans-1,2-Dichloroethylene | 8260_VOA_GCMS |
| 699-24-35 | trans-1,2-Dichloroethylene | 8260_VOA_GCMS |
| 699-24-35 | trans-1,2-Dichloroethylene | 8260_VOA_GCMS |
| 699-24-35 | trans-1,2-Dichloroethylene | 8260_VOA_GCMS |
| 699-24-35 | trans-1,2-Dichloroethylene | 8260_VOA_GCMS |
| 699-24-35 | trans-1,2-Dichloroethylene | 8260_VOA_GCMS |
| 699-24-35 | trans-1,2-Dichloroethylene | 8260_VOA_GCMS |
| 699-24-35 | trans-1,2-Dichloroethylene | 8260_VOA_GCMS |
| 699-24-35 | trans-1,2-Dichloroethylene | 8260_VOA_GCMS |
| 699-24-35 | trans-1,2-Dichloroethylene | 8260_VOA_GCMS |
| 699-24-35 | trans-1,2-Dichloroethylene | 8260_VOA_GCMS |
| 699-24-35 | trans-1,2-Dichloroethylene | 8260_VOA_GCMS |
| 699-24-35 | trans-1,2-Dichloroethylene | 8260_VOA_GCMS |
| 699-24-35 | trans-1,2-Dichloroethylene | 8260_VOA_GCMS |
| 699-24-35 | trans-1,2-Dichloroethylene | 8260_VOA_GCMS |
| 699-24-35 | trans-1,2-Dichloroethylene | 8260_VOA_GCMS |
| 699-24-35 | trans-1,2-Dichloroethylene | 8260_VOA_GCMS |
| 699-24-35 | trans-1,2-Dichloroethylene | 8260_VOA_GCMS |
| 699-24-35 | trans-1,2-Dichloroethylene | 8260_VOA_GCMS |
| 699-24-35 | trans-1,2-Dichloroethylene | 8260_VOA_GCMS |
| 699-24-35 | trans-1,2-Dichloroethylene | 8260_VOA_GCMS |
| 699-24-35 | trans-1,2-Dichloroethylene | 8260_VOA_GCMS |
| 699-24-35 | trans-1,2-Dichloroethylene | 8260_VOA_GCMS |
| 699-24-35 | trans-1,2-Dichloroethylene | 8260_VOA_GCMS |
| 699-24-35 | trans-1,2-Dichloroethylene | 8260_VOA_GCMS |
| 699-24-35 | trans-1,2-Dichloroethylene | 8260_VOA_GCMS |
| 699-24-35 | trans-1,2-Dichloroethylene | 8260_VOA_GCMS |
| 699-24-35 | trans-1,2-Dichloroethylene | 8260_VOA_GCMS |
| 699-24-35 | trans-1,2-Dichloroethylene | 8260_VOA_GCMS |
| 699-24-35 | trans-1,2-Dichloroethylene | 8260_VOA_GCMS |
| 699-24-35 | trans-1,2-Dichloroethylene | 8260_VOA_GCMS |

| LAB_QUALIFIER | STD_VALUE_RPTD | STD_ANAL_UNITS_RPTD | SAMP_DATE_TIME |
|---|---|---|---|
| U | 0.252 | ug/L | 5/21/1998 |
| U | 0.25 | ug/L | 8/20/1998 |
| U | 0.25 | ug/L | 12/1/1998 |
| U | 0.06 | ug/L | 5/18/1999 |
| U | 0.22 | ug/L | 12/16/1999 |
| U | 0.22 | ug/L | 2/29/2000 |
| U | 0.22 | ug/L | 5/10/2000 |
| U | 0.22 | ug/L | 10/3/2000 |
| U | 0.22 | ug/L | 10/3/2000 |
| U | 0.22 | ug/L | 2/27/2001 |
| U | 0.1 | ug/L | 2/13/2002 |
| U | 0.1 | ug/L | 5/16/2002 |
| U | 0.1 | ug/L | 8/26/2002 |
| U | 0.1 | ug/L | 11/19/2002 |
| U | 0.1 | ug/L | 2/18/2003 |
| U | 0.27 | ug/L | 5/8/2001 |
| U | 0.47 | ug/L | 8/22/2001 |
| U | 0.47 | ug/L | 8/22/2001 |
| U | 0.47 | ug/L | 11/16/2001 |
| U | 0.2 | ug/L | 5/16/2003 |
| | 4 | ug/L | 5/21/1998 |
| | 2 | ug/L | 8/20/1998 |
| | 6 | ug/L | 12/1/1998 |
| | 2 | ug/L | 2/10/1999 |
| | 2 | ug/L | 8/18/1999 |
| | 4.2 | ug/L | 2/13/1997 |
| | 3.1 | ug/L | 5/15/1997 |
| | 4 | ug/L | 8/14/1997 |
| | 2.5 | ug/L | 12/8/1997 |
| | 3.2 | ug/L | 12/8/1997 |
| | 3.5 | ug/L | 2/23/1998 |
| | 2 | ug/L | 5/18/1999 |
| | 2.6 | ug/L | 12/16/1999 |
| | 1.9 | ug/L | 2/29/2000 |
| | 2.4 | ug/L | 5/10/2000 |
| | 3 | ug/L | 10/3/2000 |
| | 3.1 | ug/L | 10/3/2000 |
| | 3 | ug/L | 2/27/2001 |
| | 1.9 | ug/L | 2/13/2002 |
| | 1.8 | ug/L | 5/16/2002 |
| | 1.5 | ug/L | 11/19/2002 |
| J | 1.8 | ug/L | 5/8/2001 |
| J | 3 | ug/L | 8/22/2001 |
| J | 2.9 | ug/L | 8/22/2001 |
| J | 2.1 | ug/L | 11/16/2001 |
| J | 2.2 | ug/L | 2/13/2002 |

| | | | |
|---|---|---|---|
| | 2.3 | ug/L | 5/16/2002 |
| | 2 | ug/L | 8/26/2002 |
| | 1.7 | ug/L | 11/19/2002 |
| | 1.8 | ug/L | 2/18/2003 |
| | 1.7 | ug/L | 5/16/2003 |
| | 1.2 | ug/L | 8/13/2003 |
| J | 1.4 | ug/L | 11/18/2003 |
| J | 1.4 | ug/L | 11/18/2003 |
| | 1.6 | ug/L | 3/30/2004 |
| | 1.5 | ug/L | 5/17/2004 |
| N | 1.2 | ug/L | 8/26/2004 |
| | 1.4 | ug/L | 10/25/2004 |
| | 1 | ug/L | 2/16/2005 |
| J | 0.61 | ug/L | 5/17/2005 |
| N | 1.3 | ug/L | 8/18/2005 |
| J | 0.8 | ug/L | 11/29/2005 |
| J | 0.96 | ug/L | 2/23/2006 |
| | 1 | ug/L | 5/31/2006 |
| | 1 | ug/L | 1/23/2007 |
| | 1 | ug/L | 2/5/2007 |
| J | 0.85 | ug/L | 5/1/2007 |
| | 1 | ug/L | 9/13/2007 |
| U | 1 | ug/L | 12/3/2007 |
| J | 0.8 | ug/L | 2/26/2008 |
| U | 1 | ug/L | 6/5/2008 |
| U | 1 | ug/L | 8/14/2008 |
| U | 1 | ug/L | 10/13/2008 |
| U | 1 | ug/L | 1/19/2009 |
| U | 1 | ug/L | 4/8/2009 |
| U | 1 | ug/L | 7/20/2009 |
| U | 0.05 | ug/L | 5/21/1998 |
| U | 0.27 | ug/L | 8/20/1998 |
| U | 0.27 | ug/L | 12/1/1998 |
| U | 0.27 | ug/L | 2/10/1999 |
| U | 0.27 | ug/L | 8/18/1999 |
| U | 0.2 | ug/L | 2/13/1997 |
| U | 0.036 | ug/L | 5/15/1997 |
| | 0.28 | ug/L | 8/14/1997 |
| U | 0.036 | ug/L | 12/8/1997 |
| U | 0.036 | ug/L | 12/8/1997 |
| U | 0.036 | ug/L | 2/23/1998 |
| U | 0.04 | ug/L | 5/18/1999 |
| U | 0.19 | ug/L | 12/16/1999 |
| U | 0.19 | ug/L | 2/29/2000 |
| U | 0.19 | ug/L | 5/10/2000 |
| U | 0.19 | ug/L | 10/3/2000 |
| U | 0.19 | ug/L | 10/3/2000 |

| | | | |
|---|---|---|---|
| U | 0.19 | ug/L | 2/27/2001 |
| U | 0.2 | ug/L | 2/13/2002 |
| U | 0.2 | ug/L | 5/16/2002 |
| U | 0.2 | ug/L | 11/19/2002 |
| U | 0.31 | ug/L | 5/8/2001 |
| U | 0.27 | ug/L | 8/22/2001 |
| U | 0.27 | ug/L | 8/22/2001 |
| U | 0.27 | ug/L | 11/16/2001 |
| U | 0.27 | ug/L | 2/13/2002 |
| U | 0.27 | ug/L | 5/16/2002 |
| U | 0.27 | ug/L | 8/26/2002 |
| U | 0.05 | ug/L | 11/19/2002 |
| U | 0.05 | ug/L | 2/18/2003 |
| U | 0.05 | ug/L | 5/16/2003 |
| U | 0.05 | ug/L | 8/13/2003 |
| U | 0.05 | ug/L | 11/18/2003 |
| U | 0.05 | ug/L | 11/18/2003 |
| U | 0.05 | ug/L | 3/30/2004 |
| U | 0.05 | ug/L | 5/17/2004 |
| U | 0.21 | ug/L | 8/26/2004 |
| U | 0.21 | ug/L | 10/25/2004 |
| U | 0.07 | ug/L | 2/16/2005 |
| U | 0.07 | ug/L | 5/17/2005 |
| U | 0.07 | ug/L | 8/18/2005 |
| U | 0.07 | ug/L | 11/29/2005 |
| U | 0.23 | ug/L | 2/23/2006 |
| U | 0.23 | ug/L | 5/31/2006 |
| U | 0.092 | ug/L | 1/23/2007 |
| U | 0.092 | ug/L | 2/5/2007 |
| U | 0.092 | ug/L | 5/1/2007 |
| U | 0.092 | ug/L | 9/13/2007 |
| U | 1 | ug/L | 12/3/2007 |
| U | 0.092 | ug/L | 2/26/2008 |
| U | 1 | ug/L | 6/5/2008 |
| U | 1 | ug/L | 8/14/2008 |
| U | 1 | ug/L | 10/13/2008 |
| U | 1 | ug/L | 1/19/2009 |
| U | 1 | ug/L | 4/8/2009 |
| U | 1 | ug/L | 7/20/2009 |
| J | 0.4 | ug/L | 5/21/1998 |
| J | 0.4 | ug/L | 8/20/1998 |
| | 0.8 | ug/L | 12/1/1998 |
| J | 0.4 | ug/L | 2/10/1999 |
| J | 0.5 | ug/L | 8/18/1999 |
| | 0.5 | ug/L | 2/13/1997 |
| | 0.26 | ug/L | 5/15/1997 |
| | 0.92 | ug/L | 8/14/1997 |

| | | | |
|---|---|---|---|
| | 0.25 | ug/L | 12/8/1997 |
| | 0.33 | ug/L | 12/8/1997 |
| | 0.32 | ug/L | 2/23/1998 |
| U | 1 | ug/L | 5/18/1999 |
| | 1.4 | ug/L | 12/16/1999 |
| U | 0.36 | ug/L | 2/29/2000 |
| U | 0.36 | ug/L | 5/10/2000 |
| U | 0.36 | ug/L | 10/3/2000 |
| U | 0.36 | ug/L | 10/3/2000 |
| U | 0.36 | ug/L | 2/27/2001 |
| U | 0.23 | ug/L | 2/13/2002 |
| U | 0.23 | ug/L | 5/16/2002 |
| U | 0.23 | ug/L | 11/19/2002 |
| J | 0.32 | ug/L | 5/8/2001 |
| J | 0.53 | ug/L | 8/22/2001 |
| J | 0.51 | ug/L | 8/22/2001 |
| J | 0.36 | ug/L | 11/16/2001 |
| J | 0.4 | ug/L | 2/13/2002 |
| J | 0.47 | ug/L | 5/16/2002 |
| J | 0.38 | ug/L | 8/26/2002 |
| J | 0.3 | ug/L | 11/19/2002 |
| J | 0.29 | ug/L | 2/18/2003 |
| J | 0.28 | ug/L | 5/16/2003 |
| J | 0.23 | ug/L | 8/13/2003 |
| J | 0.25 | ug/L | 11/18/2003 |
| J | 0.25 | ug/L | 11/18/2003 |
| J | 0.29 | ug/L | 3/30/2004 |
| U | 0.1 | ug/L | 5/17/2004 |
| UN | 0.12 | ug/L | 8/26/2004 |
| J | 0.26 | ug/L | 10/25/2004 |
| J | 0.23 | ug/L | 2/16/2005 |
| U | 0.07 | ug/L | 5/17/2005 |
| JN | 0.26 | ug/L | 8/18/2005 |
| J | 0.22 | ug/L | 11/29/2005 |
| U | 0.16 | ug/L | 2/23/2006 |
| J | 0.22 | ug/L | 5/31/2006 |
| J | 0.19 | ug/L | 1/23/2007 |
| J | 0.21 | ug/L | 2/5/2007 |
| J | 0.19 | ug/L | 5/1/2007 |
| J | 0.19 | ug/L | 9/13/2007 |
| U | 1 | ug/L | 12/3/2007 |
| U | 0.046 | ug/L | 2/26/2008 |
| U | 1 | ug/L | 6/5/2008 |
| U | 1 | ug/L | 8/14/2008 |
| U | 1 | ug/L | 10/13/2008 |
| U | 1 | ug/L | 1/19/2009 |
| U | 1 | ug/L | 4/8/2009 |

| | | | |
|---|---|---|---|
| U | 1 | ug/L | 7/20/2009 |
| U | 0.16 | ug/L | 11/19/2002 |
| U | 0.16 | ug/L | 2/18/2003 |
| J | 0.16 | ug/L | 2/16/2005 |
| U | 0.04 | ug/L | 5/17/2005 |
| UN | 0.04 | ug/L | 8/18/2005 |
| J | 0.39 | ug/L | 11/29/2005 |
| U | 0.21 | ug/L | 2/23/2006 |
| U | 0.21 | ug/L | 5/31/2006 |
| U | 0.045 | ug/L | 1/23/2007 |
| U | 0.045 | ug/L | 2/5/2007 |
| U | 0.045 | ug/L | 5/1/2007 |
| U | 0.045 | ug/L | 9/13/2007 |
| U | 1 | ug/L | 12/3/2007 |
| U | 0.045 | ug/L | 2/26/2008 |
| U | 1 | ug/L | 6/5/2008 |
| U | 1 | ug/L | 8/14/2008 |
| U | 1 | ug/L | 10/13/2008 |
| U | 1 | ug/L | 1/19/2009 |
| U | 1 | ug/L | 4/8/2009 |
| U | 1 | ug/L | 7/20/2009 |
| U | 0.066 | ug/L | 5/21/1998 |
| U | 0.22 | ug/L | 8/20/1998 |
| U | 0.22 | ug/L | 12/1/1998 |
| U | 0.22 | ug/L | 2/10/1999 |
| U | 0.22 | ug/L | 8/18/1999 |
| U | 0.2 | ug/L | 2/13/1997 |
| U | 0.018 | ug/L | 5/15/1997 |
| | 0.5 | ug/L | 8/14/1997 |
| U | 0.018 | ug/L | 12/8/1997 |
| U | 0.018 | ug/L | 12/8/1997 |
| U | 0.018 | ug/L | 2/23/1998 |
| U | 0.02 | ug/L | 5/18/1999 |
| U | 0.34 | ug/L | 12/16/1999 |
| U | 0.34 | ug/L | 2/29/2000 |
| U | 0.34 | ug/L | 5/10/2000 |
| U | 0.34 | ug/L | 10/3/2000 |
| U | 0.34 | ug/L | 10/3/2000 |
| U | 0.34 | ug/L | 2/27/2001 |
| U | 0.18 | ug/L | 2/13/2002 |
| U | 0.18 | ug/L | 5/16/2002 |
| UN | 0.18 | ug/L | 11/19/2002 |
| U | 0.17 | ug/L | 5/8/2001 |
| U | 0.27 | ug/L | 8/22/2001 |
| U | 0.27 | ug/L | 8/22/2001 |
| U | 0.27 | ug/L | 11/16/2001 |
| U | 0.27 | ug/L | 2/13/2002 |

| | | | |
|---|---|---|---|
| U | 0.27 | ug/L | 5/16/2002 |
| U | 0.27 | ug/L | 8/26/2002 |
| U | 0.08 | ug/L | 11/19/2002 |
| U | 0.08 | ug/L | 2/18/2003 |
| U | 0.08 | ug/L | 5/16/2003 |
| U | 0.08 | ug/L | 8/13/2003 |
| U | 0.08 | ug/L | 11/18/2003 |
| U | 0.08 | ug/L | 11/18/2003 |
| U | 0.08 | ug/L | 3/30/2004 |
| U | 0.1 | ug/L | 5/17/2004 |
| UN | 0.21 | ug/L | 8/26/2004 |
| U | 0.21 | ug/L | 10/25/2004 |
| U | 0.09 | ug/L | 2/16/2005 |
| U | 0.09 | ug/L | 5/17/2005 |
| UN | 0.09 | ug/L | 8/18/2005 |
| U | 0.09 | ug/L | 11/29/2005 |
| U | 0.21 | ug/L | 2/23/2006 |
| U | 0.21 | ug/L | 5/31/2006 |
| U | 0.11 | ug/L | 1/23/2007 |
| U | 0.11 | ug/L | 2/5/2007 |
| U | 0.11 | ug/L | 5/1/2007 |
| U | 0.11 | ug/L | 9/13/2007 |
| U | 1 | ug/L | 12/3/2007 |
| U | 0.11 | ug/L | 2/26/2008 |
| U | 1 | ug/L | 6/5/2008 |
| U | 1 | ug/L | 8/14/2008 |
| U | 1 | ug/L | 10/13/2008 |
| U | 1 | ug/L | 1/19/2009 |
| U | 1 | ug/L | 4/8/2009 |
| U | 1 | ug/L | 7/20/2009 |
| U | 0.119 | ug/L | 5/21/1998 |
| U | 0.17 | ug/L | 8/20/1998 |
| U | 0.17 | ug/L | 12/1/1998 |
| U | 0.17 | ug/L | 2/10/1999 |
| U | 0.17 | ug/L | 8/18/1999 |
| U | 0.2 | ug/L | 2/13/1997 |
| U | 0.026 | ug/L | 5/15/1997 |
| J | 0.07 | ug/L | 8/14/1997 |
| U | 0.026 | ug/L | 12/8/1997 |
| U | 0.026 | ug/L | 12/8/1997 |
| U | 0.026 | ug/L | 2/23/1998 |
| U | 0.03 | ug/L | 5/18/1999 |
| U | 0.1 | ug/L | 12/16/1999 |
| U | 0.1 | ug/L | 2/29/2000 |
| U | 0.1 | ug/L | 5/10/2000 |
| U | 0.1 | ug/L | 10/3/2000 |
| U | 0.1 | ug/L | 10/3/2000 |

| | | | |
|---|---|---|---|
| U | 0.1 | ug/L | 2/27/2001 |
| U | 0.2 | ug/L | 2/13/1997 |
| U | 0.028 | ug/L | 5/15/1997 |
| BJ | 0.04 | ug/L | 8/14/1997 |
| U | 0.028 | ug/L | 12/8/1997 |
| U | 0.028 | ug/L | 12/8/1997 |
| U | 0.028 | ug/L | 2/23/1998 |
| U | 0.04 | ug/L | 2/13/2002 |
| U | 0.04 | ug/L | 5/16/2002 |
| U | 0.04 | ug/L | 11/19/2002 |
| U | 0.04 | ug/L | 2/18/2003 |
| U | 0.14 | ug/L | 5/8/2001 |
| U | 0.25 | ug/L | 8/22/2001 |
| U | 0.25 | ug/L | 8/22/2001 |
| U | 0.25 | ug/L | 11/16/2001 |
| U | 0.25 | ug/L | 2/13/2002 |
| U | 0.25 | ug/L | 5/16/2002 |
| U | 0.25 | ug/L | 8/26/2002 |
| U | 0.11 | ug/L | 11/19/2002 |
| U | 0.11 | ug/L | 2/18/2003 |
| U | 0.11 | ug/L | 5/16/2003 |
| U | 0.11 | ug/L | 8/13/2003 |
| U | 0.11 | ug/L | 11/18/2003 |
| U | 0.11 | ug/L | 11/18/2003 |
| U | 0.11 | ug/L | 3/30/2004 |
| U | 0.11 | ug/L | 5/17/2004 |
| UN | 0.11 | ug/L | 8/26/2004 |
| U | 0.11 | ug/L | 10/25/2004 |
| U | 0.09 | ug/L | 2/16/2005 |
| U | 0.09 | ug/L | 5/17/2005 |
| U | 0.09 | ug/L | 8/18/2005 |
| U | 0.09 | ug/L | 11/29/2005 |
| U | 0.2 | ug/L | 2/23/2006 |
| U | 0.2 | ug/L | 5/31/2006 |
| U | 0.047 | ug/L | 1/23/2007 |
| U | 0.047 | ug/L | 2/5/2007 |
| U | 0.047 | ug/L | 5/1/2007 |
| U | 0.1 | ug/L | 9/13/2007 |
| U | 1 | ug/L | 12/3/2007 |
| U | 0.1 | ug/L | 2/26/2008 |
| U | 1 | ug/L | 6/5/2008 |
| U | 1 | ug/L | 8/14/2008 |
| U | 1 | ug/L | 10/13/2008 |
| U | 1 | ug/L | 1/19/2009 |
| U | 1 | ug/L | 4/8/2009 |
| U | 1 | ug/L | 7/20/2009 |
| U | 9.5 | ug/L | 10/3/2000 |

| | | | |
|---|---|---|---|
| U | 9.5 | ug/L | 10/3/2000 |
| U | 13 | ug/L | 8/22/2001 |
| U | 13 | ug/L | 8/22/2001 |
| U | 13 | ug/L | 11/16/2001 |
| U | 13 | ug/L | 2/13/2002 |
| U | 13 | ug/L | 8/26/2002 |
| U | 11 | ug/L | 11/19/2002 |
| U | 11 | ug/L | 2/18/2003 |
| U | 11 | ug/L | 8/13/2003 |
| U | 11 | ug/L | 11/18/2003 |
| U | 11 | ug/L | 11/18/2003 |
| U | 11 | ug/L | 5/17/2004 |
| U | 11 | ug/L | 8/26/2004 |
| U | 2.6 | ug/L | 10/25/2004 |
| U | 2.6 | ug/L | 2/16/2005 |
| U | 2.6 | ug/L | 5/17/2005 |
| U | 2.6 | ug/L | 8/18/2005 |
| U | 2.6 | ug/L | 11/29/2005 |
| U | 12 | ug/L | 2/23/2006 |
| U | 12 | ug/L | 5/31/2006 |
| U | 12 | ug/L | 1/23/2007 |
| U | 12 | ug/L | 2/5/2007 |
| U | 12 | ug/L | 5/1/2007 |
| U | 12 | ug/L | 9/13/2007 |
| U | 12 | ug/L | 2/26/2008 |
| U | 2 | ug/L | 6/5/2008 |
| U | 2 | ug/L | 8/14/2008 |
| U | 2 | ug/L | 10/13/2008 |
| U | 5 | ug/L | 1/19/2009 |
| U | 5 | ug/L | 4/8/2009 |
| U | 6.6 | ug/L | 5/8/2001 |
| U | 4.9 | ug/L | 8/22/2001 |
| U | 4.9 | ug/L | 8/22/2001 |
| U | 4.9 | ug/L | 11/16/2001 |
| U | 4.9 | ug/L | 2/13/2002 |
| U | 4.9 | ug/L | 5/16/2002 |
| U | 4.9 | ug/L | 8/26/2002 |
| U | 4.6 | ug/L | 11/19/2002 |
| U | 4.6 | ug/L | 2/18/2003 |
| U | 4.6 | ug/L | 11/18/2003 |
| U | 4.6 | ug/L | 11/18/2003 |
| U | 4.6 | ug/L | 3/30/2004 |
| U | 4.6 | ug/L | 5/17/2004 |
| U | 4.6 | ug/L | 8/26/2004 |
| U | 3.8 | ug/L | 10/25/2004 |
| U | 1.1 | ug/L | 2/16/2005 |
| U | 1.1 | ug/L | 5/17/2005 |

| | | | |
|---|---|---|---|
| U | 1.1 | ug/L | 8/18/2005 |
| U | 1.1 | ug/L | 11/29/2005 |
| U | 2.6 | ug/L | 2/23/2006 |
| U | 2.6 | ug/L | 5/31/2006 |
| U | 14 | ug/L | 1/23/2007 |
| U | 14 | ug/L | 2/5/2007 |
| U | 14 | ug/L | 5/1/2007 |
| U | 14 | ug/L | 9/13/2007 |
| U | 100 | ug/L | 12/3/2007 |
| U | 14 | ug/L | 2/26/2008 |
| U | 100 | ug/L | 6/5/2008 |
| U | 100 | ug/L | 8/14/2008 |
| U | 100 | ug/L | 10/13/2008 |
| U | 100 | ug/L | 1/19/2009 |
| U | 100 | ug/L | 4/8/2009 |
| U | 100 | ug/L | 7/20/2009 |
| U | 0.7 | ug/L | 5/8/2001 |
| U | 0.39 | ug/L | 8/22/2001 |
| U | 0.39 | ug/L | 8/22/2001 |
| U | 0.39 | ug/L | 11/16/2001 |
| U | 0.39 | ug/L | 2/13/2002 |
| UN | 0.39 | ug/L | 5/16/2002 |
| U | 0.39 | ug/L | 8/26/2002 |
| U | 0.29 | ug/L | 11/19/2002 |
| U | 0.29 | ug/L | 2/18/2003 |
| U | 0.29 | ug/L | 5/16/2003 |
| U | 0.29 | ug/L | 8/13/2003 |
| U | 0.29 | ug/L | 11/18/2003 |
| U | 0.29 | ug/L | 11/18/2003 |
| U | 0.29 | ug/L | 3/30/2004 |
| U | 0.29 | ug/L | 5/17/2004 |
| U | 0.1 | ug/L | 8/26/2004 |
| U | 0.1 | ug/L | 10/25/2004 |
| U | 0.33 | ug/L | 2/16/2005 |
| U | 0.33 | ug/L | 5/17/2005 |
| U | 0.33 | ug/L | 8/18/2005 |
| U | 0.33 | ug/L | 11/29/2005 |
| U | 0.56 | ug/L | 2/23/2006 |
| U | 0.56 | ug/L | 5/31/2006 |
| U | 1.8 | ug/L | 1/23/2007 |
| U | 1.8 | ug/L | 2/5/2007 |
| U | 1.8 | ug/L | 5/1/2007 |
| U | 1.8 | ug/L | 9/13/2007 |
| U | 1 | ug/L | 12/3/2007 |
| U | 1.8 | ug/L | 2/26/2008 |
| U | 1 | ug/L | 6/5/2008 |
| U | 1 | ug/L | 8/14/2008 |

| | | | |
|---|---|---|---|
| U | 1 | ug/L | 10/13/2008 |
| U | 1 | ug/L | 1/19/2009 |
| U | 1 | ug/L | 4/8/2009 |
| U | 1 | ug/L | 7/20/2009 |
| U | 1.3 | ug/L | 5/8/2001 |
| U | 0.42 | ug/L | 8/22/2001 |
| U | 0.42 | ug/L | 8/22/2001 |
| U | 0.42 | ug/L | 11/16/2001 |
| U | 0.42 | ug/L | 2/13/2002 |
| UN | 0.42 | ug/L | 5/16/2002 |
| U | 0.42 | ug/L | 8/26/2002 |
| U | 0.35 | ug/L | 11/19/2002 |
| U | 0.35 | ug/L | 2/18/2003 |
| U | 0.35 | ug/L | 5/16/2003 |
| U | 0.35 | ug/L | 8/13/2003 |
| U | 0.35 | ug/L | 11/18/2003 |
| U | 0.35 | ug/L | 11/18/2003 |
| U | 0.35 | ug/L | 3/30/2004 |
| U | 0.35 | ug/L | 5/17/2004 |
| U | 0.19 | ug/L | 8/26/2004 |
| U | 0.19 | ug/L | 10/25/2004 |
| U | 0.1 | ug/L | 2/16/2005 |
| U | 0.1 | ug/L | 5/17/2005 |
| U | 0.1 | ug/L | 8/18/2005 |
| U | 0.1 | ug/L | 11/29/2005 |
| U | 0.53 | ug/L | 2/23/2006 |
| U | 0.53 | ug/L | 5/31/2006 |
| U | 0.21 | ug/L | 1/23/2007 |
| U | 0.21 | ug/L | 2/5/2007 |
| U | 0.21 | ug/L | 5/1/2007 |
| U | 0.21 | ug/L | 9/13/2007 |
| U | 1 | ug/L | 12/3/2007 |
| U | 0.21 | ug/L | 2/26/2008 |
| U | 1 | ug/L | 6/5/2008 |
| U | 1 | ug/L | 8/14/2008 |
| U | 1 | ug/L | 10/13/2008 |
| U | 1 | ug/L | 1/19/2009 |
| U | 1 | ug/L | 4/8/2009 |
| U | 1 | ug/L | 7/20/2009 |
| U | 4 | ug/L | 5/8/2001 |
| U | 0.3 | ug/L | 8/22/2001 |
| U | 0.3 | ug/L | 8/22/2001 |
| J | 1.8 | ug/L | 11/16/2001 |
| JB | 1.4 | ug/L | 2/13/2002 |
| JB | 1.3 | ug/L | 5/16/2002 |
| J | 1.3 | ug/L | 8/26/2002 |
| U | 0.66 | ug/L | 11/19/2002 |

| | | | |
|---|---|---|---|
| U | 0.66 | ug/L | 2/18/2003 |
| U | 0.66 | ug/L | 5/16/2003 |
| U | 0.66 | ug/L | 8/13/2003 |
| U | 0.66 | ug/L | 11/18/2003 |
| U | 0.66 | ug/L | 11/18/2003 |
| U | 0.66 | ug/L | 3/30/2004 |
| U | 0.21 | ug/L | 5/17/2004 |
| U | 0.21 | ug/L | 8/26/2004 |
| JB | 1.4 | ug/L | 10/25/2004 |
| U | 0.21 | ug/L | 2/16/2005 |
| U | 0.21 | ug/L | 5/17/2005 |
| UN | 0.21 | ug/L | 8/18/2005 |
| U | 1 | ug/L | 11/29/2005 |
| U | 0.7 | ug/L | 2/23/2006 |
| UN | 0.8 | ug/L | 5/31/2006 |
| U | 0.8 | ug/L | 1/23/2007 |
| U | 0.8 | ug/L | 2/5/2007 |
| U | 0.8 | ug/L | 5/1/2007 |
| U | 0.8 | ug/L | 9/13/2007 |
| U | 1 | ug/L | 12/3/2007 |
| U | 0.8 | ug/L | 2/26/2008 |
| B | 7.3 | ug/L | 6/5/2008 |
| U | 1 | ug/L | 8/14/2008 |
| U | 1 | ug/L | 10/13/2008 |
| U | 1 | ug/L | 1/19/2009 |
| U | 1 | ug/L | 4/8/2009 |
| U | 1 | ug/L | 7/20/2009 |
| | 219000 | ug/L | 2/13/1997 |
| | 202000 | ug/L | 5/15/1997 |
| | 214000 | ug/L | 8/14/1997 |
| | 217000 | ug/L | 12/8/1997 |
| | 216000 | ug/L | 12/8/1997 |
| | 211000 | ug/L | 2/23/1998 |
| | 226000 | ug/L | 5/21/1998 |
| | 248000 | ug/L | 8/20/1998 |
| | 242000 | ug/L | 12/1/1998 |
| | 238000 | ug/L | 2/10/1999 |
| | 232000 | ug/L | 5/18/1999 |
| U | 28 | ug/L | 2/13/1997 |
| U | 28 | ug/L | 5/15/1997 |
| U | 33.6 | ug/L | 8/14/1997 |
| U | 10.7 | ug/L | 12/8/1997 |
| U | 10.7 | ug/L | 12/8/1997 |
| U | 10.7 | ug/L | 2/23/1998 |
| U | 10.7 | ug/L | 5/21/1998 |
| U | 10.7 | ug/L | 8/20/1998 |

| | | | |
|---|---|---|---|
| U | 36.6 | ug/L | 12/1/1998 |
| U | 36.6 | ug/L | 2/10/1999 |
| U | 36.6 | ug/L | 5/18/1999 |
| U | 36.6 | ug/L | 8/18/1999 |
| U | 36.6 | ug/L | 12/16/1999 |
| U | 36.6 | ug/L | 2/29/2000 |
| U | 36.6 | ug/L | 5/10/2000 |
| U | 36.6 | ug/L | 10/3/2000 |
| U | 36.6 | ug/L | 10/3/2000 |
| U | 36.6 | ug/L | 2/27/2001 |
| | 82.7 | ug/L | 5/8/2001 |
| U | 15.7 | ug/L | 8/22/2001 |
| U | 15.7 | ug/L | 8/22/2001 |
| U | 15.7 | ug/L | 11/16/2001 |
| U | 14.5 | ug/L | 2/13/2002 |
| U | 14.5 | ug/L | 5/16/2002 |
| U | 14.5 | ug/L | 8/26/2002 |
| | 269 | ug/L | 11/19/2002 |
| U | 14.5 | ug/L | 2/18/2003 |
| U | 26.3 | ug/L | 5/16/2003 |
| U | 26.3 | ug/L | 8/13/2003 |
| U | 26.3 | ug/L | 11/18/2003 |
| U | 26.3 | ug/L | 11/18/2003 |
| U | 26.3 | ug/L | 3/30/2004 |
| UN | 26.3 | ug/L | 5/17/2004 |
| U | 26.3 | ug/L | 8/26/2004 |
| U | 7.05 | ug/L | 10/25/2004 |
| UN | 7.05 | ug/L | 2/16/2005 |
| U | 7.05 | ug/L | 5/17/2005 |
| U | 7.05 | ug/L | 8/18/2005 |
| UN | 6.69 | ug/L | 11/29/2005 |
| U | 6.69 | ug/L | 2/23/2006 |
| U | 6.69 | ug/L | 5/31/2006 |
| U | 6.69 | ug/L | 1/23/2007 |
| BC | 11.9 | ug/L | 5/1/2007 |
| U | 6.08 | ug/L | 9/13/2007 |
| B | 30.5 | ug/L | 2/5/2007 |
| B | 22.5 | ug/L | 12/3/2007 |
| | 33.9 | ug/L | 2/26/2008 |
| B | 13.7 | ug/L | 6/5/2008 |
| B | 15.8 | ug/L | 8/14/2008 |
| B | 7.34 | ug/L | 10/13/2008 |
| B | 19.8 | ug/L | 1/19/2009 |
| U | 5.15 | ug/L | 4/8/2009 |
| B | 18.8 | ug/L | 7/20/2009 |
| U | 32 | ug/L | 12/3/2007 |
| | 34.9 | ug/L | 2/26/2008 |

| | | | |
|---|---|---|---|
| U | 56 | ug/L | 6/5/2008 |
| U | 56 | ug/L | 8/14/2008 |
| U | 60 | ug/L | 10/13/2008 |
| U | 56 | ug/L | 1/19/2009 |
| U | 38 | ug/L | 4/8/2009 |
| U | 38 | ug/L | 7/20/2009 |
| | 2.57 | ug/L | 12/3/2007 |
| | 3.12 | ug/L | 2/26/2008 |
| | 2.23 | ug/L | 6/5/2008 |
| | 2.63 | ug/L | 8/14/2008 |
| B | 2.46 | ug/L | 10/13/2008 |
| | 3.06 | ug/L | 1/19/2009 |
| B | 3.29 | ug/L | 4/8/2009 |
| B | 2.7 | ug/L | 7/20/2009 |
| | 79.3 | ug/L | 12/3/2007 |
| | 80.3 | ug/L | 2/26/2008 |
| | 83.5 | ug/L | 6/5/2008 |
| | 77.6 | ug/L | 8/14/2008 |
| | 77.1 | ug/L | 10/13/2008 |
| | 79.7 | ug/L | 1/19/2009 |
| | 80 | ug/L | 4/8/2009 |
| | 75.6 | ug/L | 7/20/2009 |
| U | 0.146 | ug/L | 5/21/1998 |
| U | 0.3 | ug/L | 8/20/1998 |
| U | 0.3 | ug/L | 12/1/1998 |
| U | 0.3 | ug/L | 2/10/1999 |
| U | 0.2 | ug/L | 2/13/1997 |
| U | 0.031 | ug/L | 5/15/1997 |
| U | 0.031 | ug/L | 8/14/1997 |
| U | 0.031 | ug/L | 12/8/1997 |
| U | 0.031 | ug/L | 12/8/1997 |
| U | 0.031 | ug/L | 2/23/1998 |
| U | 0.06 | ug/L | 5/18/1999 |
| U | 0.25 | ug/L | 12/16/1999 |
| U | 0.25 | ug/L | 2/29/2000 |
| U | 0.25 | ug/L | 5/10/2000 |
| U | 0.25 | ug/L | 10/3/2000 |
| U | 0.25 | ug/L | 10/3/2000 |
| U | 0.25 | ug/L | 2/27/2001 |
| U | 0.04 | ug/L | 2/13/2002 |
| U | 0.04 | ug/L | 5/16/2002 |
| U | 0.04 | ug/L | 8/26/2002 |
| U | 0.04 | ug/L | 11/19/2002 |
| U | 0.04 | ug/L | 2/18/2003 |
| U | 0.23 | ug/L | 5/8/2001 |
| U | 0.23 | ug/L | 8/22/2001 |
| U | 0.23 | ug/L | 8/22/2001 |

| | | | |
|---|---|---|---|
| U | 0.23 | ug/L | 11/16/2001 |
| U | 0.23 | ug/L | 2/13/2002 |
| U | 0.23 | ug/L | 5/16/2002 |
| U | 0.23 | ug/L | 8/26/2002 |
| U | 0.07 | ug/L | 11/19/2002 |
| U | 0.07 | ug/L | 2/18/2003 |
| U | 0.07 | ug/L | 5/16/2003 |
| U | 0.07 | ug/L | 8/13/2003 |
| U | 0.07 | ug/L | 11/18/2003 |
| U | 0.07 | ug/L | 11/18/2003 |
| U | 0.07 | ug/L | 3/30/2004 |
| U | 0.07 | ug/L | 5/17/2004 |
| UN | 0.11 | ug/L | 8/26/2004 |
| U | 0.11 | ug/L | 10/25/2004 |
| U | 0.05 | ug/L | 2/16/2005 |
| U | 0.05 | ug/L | 5/17/2005 |
| UN | 0.05 | ug/L | 8/18/2005 |
| U | 0.05 | ug/L | 11/29/2005 |
| U | 0.17 | ug/L | 2/23/2006 |
| U | 0.17 | ug/L | 5/31/2006 |
| U | 0.064 | ug/L | 1/23/2007 |
| U | 0.064 | ug/L | 2/5/2007 |
| U | 0.064 | ug/L | 5/1/2007 |
| U | 0.1 | ug/L | 9/13/2007 |
| U | 1 | ug/L | 12/3/2007 |
| U | 0.1 | ug/L | 2/26/2008 |
| U | 1 | ug/L | 6/5/2008 |
| U | 1 | ug/L | 8/14/2008 |
| U | 1 | ug/L | 10/13/2008 |
| U | 1 | ug/L | 1/19/2009 |
| U | 1 | ug/L | 4/8/2009 |
| U | 1 | ug/L | 7/20/2009 |
| U | 4 | ug/L | 12/3/2007 |
| U | 4 | ug/L | 2/26/2008 |
| U | 4 | ug/L | 6/5/2008 |
| U | 4 | ug/L | 8/14/2008 |
| U | 4 | ug/L | 10/13/2008 |
| U | 4 | ug/L | 1/19/2009 |
| U | 4 | ug/L | 4/8/2009 |
| U | 4 | ug/L | 7/20/2009 |
| U | 23 | ug/L | 2/13/1997 |
| | 106 | ug/L | 5/15/1997 |
| U | 4 | ug/L | 12/3/2007 |
| U | 4 | ug/L | 2/26/2008 |
| U | 4 | ug/L | 6/5/2008 |
| U | 4 | ug/L | 8/14/2008 |
| U | 4 | ug/L | 10/13/2008 |

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|---|---|---|---|
| U | 4 | ug/L | 1/19/2009 |
| U | 4 | ug/L | 4/8/2009 |
| U | 4 | ug/L | 7/20/2009 |
| | 85600 | ug/L | 12/3/2007 |
| | 79100 | ug/L | 2/26/2008 |
| | 88200 | ug/L | 6/5/2008 |
| | 81100 | ug/L | 8/14/2008 |
| | 80900 | ug/L | 10/13/2008 |
| | 83300 | ug/L | 1/19/2009 |
| | 78100 | ug/L | 4/8/2009 |
| | 76700 | ug/L | 7/20/2009 |
| U | 0.3 | ug/L | 5/8/2001 |
| U | 0.29 | ug/L | 8/22/2001 |
| U | 0.29 | ug/L | 8/22/2001 |
| U | 0.29 | ug/L | 11/16/2001 |
| U | 0.29 | ug/L | 2/13/2002 |
| U | 0.29 | ug/L | 5/16/2002 |
| U | 0.29 | ug/L | 8/26/2002 |
| U | 0.43 | ug/L | 11/19/2002 |
| U | 0.43 | ug/L | 2/18/2003 |
| U | 0.43 | ug/L | 5/16/2003 |
| U | 0.43 | ug/L | 8/13/2003 |
| U | 0.43 | ug/L | 11/18/2003 |
| U | 0.43 | ug/L | 11/18/2003 |
| U | 0.43 | ug/L | 3/30/2004 |
| U | 0.13 | ug/L | 5/17/2004 |
| U | 0.06 | ug/L | 8/26/2004 |
| U | 0.06 | ug/L | 10/25/2004 |
| U | 0.25 | ug/L | 2/16/2005 |
| U | 0.25 | ug/L | 5/17/2005 |
| UN | 0.25 | ug/L | 8/18/2005 |
| U | 0.25 | ug/L | 11/29/2005 |
| U | 0.16 | ug/L | 2/23/2006 |
| U | 0.16 | ug/L | 5/31/2006 |
| U | 0.031 | ug/L | 1/23/2007 |
| U | 0.031 | ug/L | 2/5/2007 |
| U | 0.031 | ug/L | 5/1/2007 |
| U | 0.1 | ug/L | 9/13/2007 |
| U | 1 | ug/L | 12/3/2007 |
| U | 0.1 | ug/L | 2/26/2008 |
| U | 1 | ug/L | 6/5/2008 |
| U | 1 | ug/L | 8/14/2008 |
| U | 1 | ug/L | 10/13/2008 |
| U | 1 | ug/L | 1/19/2009 |
| U | 1 | ug/L | 4/8/2009 |
| U | 1 | ug/L | 7/20/2009 |
| U | 0.202 | ug/L | 5/21/1998 |

| | | | |
|---|---|---|---|
| U | 0.45 | ug/L | 8/20/1998 |
| U | 0.45 | ug/L | 12/1/1998 |
| U | 0.45 | ug/L | 2/10/1999 |
| U | 0.45 | ug/L | 8/18/1999 |
| U | 0.5 | ug/L | 2/13/1997 |
| J | 0.15 | ug/L | 5/15/1997 |
| | 0.58 | ug/L | 8/14/1997 |
| J | 0.06 | ug/L | 12/8/1997 |
| J | 0.1 | ug/L | 12/8/1997 |
| J | 0.15 | ug/L | 2/23/1998 |
| U | 0.02 | ug/L | 5/18/1999 |
| U | 0.32 | ug/L | 12/16/1999 |
| U | 0.32 | ug/L | 2/29/2000 |
| U | 0.32 | ug/L | 5/10/2000 |
| U | 0.32 | ug/L | 10/3/2000 |
| U | 0.32 | ug/L | 10/3/2000 |
| U | 0.32 | ug/L | 2/27/2001 |
| U | 0.16 | ug/L | 2/13/2002 |
| U | 0.16 | ug/L | 5/16/2002 |
| UN | 0.16 | ug/L | 11/19/2002 |
| U | 0.23 | ug/L | 5/8/2001 |
| U | 0.33 | ug/L | 8/22/2001 |
| U | 0.33 | ug/L | 8/22/2001 |
| U | 0.33 | ug/L | 11/16/2001 |
| U | 0.33 | ug/L | 2/13/2002 |
| U | 0.33 | ug/L | 5/16/2002 |
| U | 0.33 | ug/L | 8/26/2002 |
| U | 0.15 | ug/L | 11/19/2002 |
| U | 0.15 | ug/L | 2/18/2003 |
| U | 0.15 | ug/L | 5/16/2003 |
| U | 0.15 | ug/L | 8/13/2003 |
| U | 0.15 | ug/L | 11/18/2003 |
| U | 0.15 | ug/L | 11/18/2003 |
| U | 0.15 | ug/L | 3/30/2004 |
| U | 0.15 | ug/L | 5/17/2004 |
| UN | 0.1 | ug/L | 8/26/2004 |
| U | 0.1 | ug/L | 10/25/2004 |
| U | 0.09 | ug/L | 2/16/2005 |
| U | 0.09 | ug/L | 5/17/2005 |
| UN | 0.09 | ug/L | 8/18/2005 |
| U | 0.09 | ug/L | 11/29/2005 |
| U | 0.15 | ug/L | 2/23/2006 |
| U | 0.15 | ug/L | 5/31/2006 |
| U | 0.039 | ug/L | 1/23/2007 |
| U | 0.039 | ug/L | 2/5/2007 |
| U | 0.039 | ug/L | 5/1/2007 |
| U | 0.1 | ug/L | 9/13/2007 |

| | | | |
|---|---|---|---|
| U | 1 | ug/L | 12/3/2007 |
| U | 0.1 | ug/L | 2/26/2008 |
| U | 1 | ug/L | 6/5/2008 |
| U | 1 | ug/L | 8/14/2008 |
| U | 1 | ug/L | 10/13/2008 |
| U | 1 | ug/L | 1/19/2009 |
| U | 1 | ug/L | 4/8/2009 |
| U | 1 | ug/L | 7/20/2009 |
| U | 3000 | ug/L | 2/13/1997 |
| J | 5000 | ug/L | 5/15/1997 |
| U | 3070 | ug/L | 8/14/1997 |
| U | 3070 | ug/L | 12/8/1997 |
| U | 3070 | ug/L | 12/8/1997 |
| U | 3070 | ug/L | 2/23/1998 |
| U | 3070 | ug/L | 5/21/1998 |
| U | 3820 | ug/L | 8/20/1998 |
| U | 3820 | ug/L | 12/1/1998 |
| U | 3820 | ug/L | 2/10/1999 |
| | 41000 | ug/L | 5/18/1999 |
| U | 3820 | ug/L | 8/18/1999 |
| U | 3100 | ug/L | 12/16/1999 |
| | 5000 | ug/L | 2/29/2000 |
| U | 3100 | ug/L | 5/10/2000 |
| U | 3100 | ug/L | 10/3/2000 |
| U | 3100 | ug/L | 10/3/2000 |
| U | 3100 | ug/L | 2/27/2001 |
| U | 3900 | ug/L | 5/8/2001 |
| U | 3900 | ug/L | 8/22/2001 |
| U | 3900 | ug/L | 8/22/2001 |
| U | 3900 | ug/L | 11/16/2001 |
| U | 3900 | ug/L | 2/13/2002 |
| U | 7500 | ug/L | 5/16/2002 |
| U | 7500 | ug/L | 8/26/2002 |
| U | 4800 | ug/L | 11/19/2002 |
| U | 4800 | ug/L | 2/18/2003 |
| | 6000 | ug/L | 5/16/2003 |
| U | 3600 | ug/L | 8/13/2003 |
| U | 3600 | ug/L | 11/18/2003 |
| U | 3600 | ug/L | 11/18/2003 |
| U | 3600 | ug/L | 3/30/2004 |
| U | 9000 | ug/L | 5/17/2004 |
| | 17000 | ug/L | 8/26/2004 |
| U | 3000 | ug/L | 10/25/2004 |
| | 10000 | ug/L | 2/16/2005 |
| | 23000 | ug/L | 5/17/2005 |
| B | 8000 | ug/L | 8/18/2005 |
| N | 52000 | ug/L | 11/29/2005 |

| | | | |
|---|---|---|---|
| N | 26000 | ug/L | 2/23/2006 |
| U | 9200 | ug/L | 5/31/2006 |
| U | 14400 | ug/L | 1/23/2007 |
| U | 10000 | ug/L | 2/5/2007 |
| | 17000 | ug/L | 5/1/2007 |
| U | 10000 | ug/L | 9/13/2007 |
| U | 10000 | ug/L | 12/3/2007 |
| U | 10000 | ug/L | 2/26/2008 |
| U | 10000 | ug/L | 6/5/2008 |
| U | 10000 | ug/L | 8/14/2008 |
| U | 10000 | ug/L | 10/13/2008 |
| U | 10000 | ug/L | 1/19/2009 |
| U | 10000 | ug/L | 4/8/2009 |
| U | 10000 | ug/L | 7/20/2009 |
| D | 5470 | ug/L | 2/13/1997 |
| D | 5530 | ug/L | 5/15/1997 |
| D | 5430 | ug/L | 8/14/1997 |
| CD | 5950 | ug/L | 12/8/1997 |
| CD | 5890 | ug/L | 12/8/1997 |
| D | 6150 | ug/L | 2/23/1998 |
| D | 5400 | ug/L | 5/21/1998 |
| CD | 6070 | ug/L | 8/20/1998 |
| CD | 5520 | ug/L | 12/1/1998 |
| CD | 5640 | ug/L | 2/10/1999 |
| CD | 5220 | ug/L | 5/18/1999 |
| D | 5840 | ug/L | 8/18/1999 |
| D | 5300 | ug/L | 12/16/1999 |
| D | 5200 | ug/L | 2/29/2000 |
| D | 5200 | ug/L | 5/10/2000 |
| D | 5400 | ug/L | 10/3/2000 |
| D | 5400 | ug/L | 10/3/2000 |
| DC | 6400 | ug/L | 2/27/2001 |
| D | 6100 | ug/L | 5/8/2001 |
| D | 5700 | ug/L | 8/22/2001 |
| D | 5900 | ug/L | 8/22/2001 |
| CD | 5500 | ug/L | 11/16/2001 |
| CD | 5900 | ug/L | 2/13/2002 |
| CD | 5600 | ug/L | 5/16/2002 |
| CD | 6700 | ug/L | 8/26/2002 |
| CD | 6400 | ug/L | 11/19/2002 |
| CD | 6400 | ug/L | 2/18/2003 |
| D | 6300 | ug/L | 5/16/2003 |
| CD | 6600 | ug/L | 8/13/2003 |
| D | 6100 | ug/L | 11/18/2003 |
| D | 6200 | ug/L | 11/18/2003 |
| D | 6500 | ug/L | 3/30/2004 |
| D | 6300 | ug/L | 5/17/2004 |

| | | | |
|---|---|---|---|
| CD | 6100 | ug/L | 8/26/2004 |
| D | 5900 | ug/L | 10/25/2004 |
| D | 6400 | ug/L | 2/16/2005 |
| CD | 7100 | ug/L | 5/17/2005 |
| D | 6000 | ug/L | 8/18/2005 |
| U | 25 | ug/L | 11/29/2005 |
| CD | 6300 | ug/L | 2/23/2006 |
| CD | 7400 | ug/L | 5/31/2006 |
| CD | 7800 | ug/L | 1/23/2007 |
| BCDN | 9300 | ug/L | 2/5/2007 |
| D | 5400 | ug/L | 5/1/2007 |
| | 6210 | ug/L | 9/13/2007 |
| | 6370 | ug/L | 12/3/2007 |
| D | 6450 | ug/L | 2/26/2008 |
| DN | 6310 | ug/L | 6/5/2008 |
| D | 6160 | ug/L | 8/14/2008 |
| DN | 6080 | ug/L | 10/13/2008 |
| D | 6370 | ug/L | 1/19/2009 |
| D | 6160 | ug/L | 4/8/2009 |
| D | 6420 | ug/L | 7/20/2009 |
| U | 1 | ug/L | 12/3/2007 |
| U | 1 | ug/L | 6/5/2008 |
| U | 1 | ug/L | 8/14/2008 |
| U | 1 | ug/L | 10/13/2008 |
| U | 1 | ug/L | 1/19/2009 |
| U | 1 | ug/L | 4/8/2009 |
| U | 1 | ug/L | 7/20/2009 |
| U | 0.108 | ug/L | 5/21/1998 |
| U | 0.29 | ug/L | 8/20/1998 |
| U | 0.29 | ug/L | 12/1/1998 |
| U | 0.29 | ug/L | 2/10/1999 |
| U | 0.29 | ug/L | 8/18/1999 |
| U | 0.2 | ug/L | 2/13/1997 |
| J | 0.05 | ug/L | 5/15/1997 |
| | 0.34 | ug/L | 8/14/1997 |
| U | 0.028 | ug/L | 12/8/1997 |
| U | 0.028 | ug/L | 12/8/1997 |
| U | 0.028 | ug/L | 2/23/1998 |
| U | 0.03 | ug/L | 5/18/1999 |
| U | 0.38 | ug/L | 12/16/1999 |
| U | 0.38 | ug/L | 2/29/2000 |
| U | 0.38 | ug/L | 5/10/2000 |
| U | 0.38 | ug/L | 10/3/2000 |
| U | 0.38 | ug/L | 10/3/2000 |
| U | 0.38 | ug/L | 2/27/2001 |
| U | 0.12 | ug/L | 2/13/2002 |

| | | | |
|---|---|---|---|
| U | 0.12 | ug/L | 5/16/2002 |
| U | 0.12 | ug/L | 11/19/2002 |
| U | 0.23 | ug/L | 5/8/2001 |
| U | 0.21 | ug/L | 8/22/2001 |
| U | 0.21 | ug/L | 8/22/2001 |
| U | 0.21 | ug/L | 11/16/2001 |
| U | 0.21 | ug/L | 2/13/2002 |
| U | 0.21 | ug/L | 5/16/2002 |
| U | 0.21 | ug/L | 8/26/2002 |
| U | 0.07 | ug/L | 11/19/2002 |
| U | 0.07 | ug/L | 2/18/2003 |
| U | 0.07 | ug/L | 5/16/2003 |
| U | 0.07 | ug/L | 8/13/2003 |
| U | 0.07 | ug/L | 11/18/2003 |
| U | 0.07 | ug/L | 11/18/2003 |
| U | 0.07 | ug/L | 3/30/2004 |
| U | 0.07 | ug/L | 5/17/2004 |
| UN | 0.11 | ug/L | 8/26/2004 |
| U | 0.11 | ug/L | 10/25/2004 |
| U | 0.07 | ug/L | 2/16/2005 |
| U | 0.07 | ug/L | 5/17/2005 |
| UN | 0.07 | ug/L | 8/18/2005 |
| U | 0.07 | ug/L | 11/29/2005 |
| U | 0.19 | ug/L | 2/23/2006 |
| U | 0.19 | ug/L | 5/31/2006 |
| U | 0.048 | ug/L | 1/23/2007 |
| U | 0.048 | ug/L | 2/5/2007 |
| U | 0.048 | ug/L | 5/1/2007 |
| U | 0.1 | ug/L | 9/13/2007 |
| U | 1 | ug/L | 12/3/2007 |
| U | 0.1 | ug/L | 2/26/2008 |
| U | 1 | ug/L | 6/5/2008 |
| U | 1 | ug/L | 8/14/2008 |
| U | 1 | ug/L | 10/13/2008 |
| U | 1 | ug/L | 1/19/2009 |
| U | 1 | ug/L | 4/8/2009 |
| U | 1 | ug/L | 7/20/2009 |
| U | 4 | ug/L | 12/3/2007 |
| C | 15.5 | ug/L | 2/26/2008 |
| U | 13 | ug/L | 6/5/2008 |
| U | 13 | ug/L | 8/14/2008 |
| U | 10 | ug/L | 10/13/2008 |
| U | 13 | ug/L | 1/19/2009 |
| U | 13 | ug/L | 4/8/2009 |
| U | 13 | ug/L | 7/20/2009 |
| U | 4 | ug/L | 12/3/2007 |
| U | 4 | ug/L | 2/26/2008 |

| | | | |
|---|---|---|---|
| U | 4 | ug/L | 6/5/2008 |
| U | 4 | ug/L | 8/14/2008 |
| U | 5 | ug/L | 10/13/2008 |
| U | 4 | ug/L | 1/19/2009 |
| U | 4 | ug/L | 4/8/2009 |
| U | 4 | ug/L | 7/20/2009 |
| U | 0 | Col/100mL | 2/13/1997 |
| U | 0 | Col/100mL | 5/15/1997 |
| U | 0 | Col/100mL | 8/14/1997 |
| U | 0 | Col/100mL | 12/8/1997 |
| U | 0 | Col/100mL | 12/8/1997 |
| U | 0 | Col/100mL | 2/23/1998 |
| U | 0 | Col/100mL | 8/20/1998 |
| U | 0 | Col/100mL | 12/1/1998 |
| U | 0 | Col/100mL | 2/10/1999 |
| U | 0 | Col/100mL | 5/18/1999 |
| U | 0 | Col/100mL | 8/18/1999 |
| U | 0 | Col/100mL | 12/16/1999 |
| U | 0 | Col/100mL | 2/29/2000 |
| U | 0 | Col/100mL | 5/10/2000 |
| | 450 | Col/100mL | 10/3/2000 |
| | 180 | Col/100mL | 10/3/2000 |
| U | 0 | Col/100mL | 2/27/2001 |
| U | 0 | Col/100mL | 5/8/2001 |
| U | 0 | Col/100mL | 2/13/2002 |
| U | 0 | Col/100mL | 5/16/2002 |
| | 260 | Col/100mL | 8/26/2002 |
| U | 0 | Col/100mL | 11/19/2002 |
| U | 0 | Col/100mL | 2/18/2003 |
| U | 0 | Col/100mL | 5/16/2003 |
| U | 0 | Col/100mL | 8/13/2003 |
| | 120 | Col/100mL | 11/18/2003 |
| | 129 | Col/100mL | 11/18/2003 |
| U | 0 | Col/100mL | 3/30/2004 |
| U | 0 | Col/100mL | 5/17/2004 |
| U | 0 | Col/100mL | 8/26/2004 |
| U | 0 | Col/100mL | 10/25/2004 |
| U | 0 | Col/100mL | 2/16/2005 |
| U | 0 | Col/100mL | 5/17/2005 |
| | 9.8 | Col/100mL | 8/18/2005 |
| U | 1 | Col/100mL | 11/29/2005 |
| | 13.2 | Col/100mL | 2/23/2006 |
| U | 1 | Col/100mL | 5/31/2006 |
| U | 1 | Col/100mL | 1/23/2007 |
| U | 1 | Col/100mL | 2/5/2007 |
| U | 1 | Col/100mL | 5/1/2007 |
| U | 0 | Col/100mL | 9/13/2007 |

| | | | |
|---|---|---|---|
| | 2 | Col/100mL | 12/3/2007 |
| U | 1 | Col/100mL | 2/26/2008 |
| U | 1 | Col/100mL | 6/5/2008 |
| U | 1 | Col/100mL | 8/14/2008 |
| U | 1 | Col/100mL | 10/13/2008 |
| | 62 | Col/100mL | 1/19/2009 |
| U | 1 | Col/100mL | 4/8/2009 |
| U | 4 | ug/L | 12/3/2007 |
| U | 4 | ug/L | 2/26/2008 |
| U | 6 | ug/L | 6/5/2008 |
| U | 6 | ug/L | 8/14/2008 |
| U | 6 | ug/L | 10/13/2008 |
| U | 6 | ug/L | 1/19/2009 |
| U | 4 | ug/L | 4/8/2009 |
| U | 4 | ug/L | 7/20/2009 |
| U | 2.6 | ug/L | 5/8/2001 |
| U | 2 | ug/L | 8/22/2001 |
| U | 2 | ug/L | 8/22/2001 |
| U | 2 | ug/L | 11/16/2001 |
| U | 2 | ug/L | 2/13/2002 |
| U | 2 | ug/L | 5/16/2002 |
| U | 2 | ug/L | 8/26/2002 |
| U | 1.3 | ug/L | 11/19/2002 |
| U | 1.3 | ug/L | 2/18/2003 |
| U | 1.3 | ug/L | 5/16/2003 |
| U | 1.3 | ug/L | 8/13/2003 |
| U | 1.3 | ug/L | 11/18/2003 |
| U | 1.3 | ug/L | 11/18/2003 |
| U | 1.3 | ug/L | 3/30/2004 |
| U | 1.3 | ug/L | 5/17/2004 |
| U | 1.3 | ug/L | 8/26/2004 |
| U | 0.68 | ug/L | 10/25/2004 |
| U | 0.88 | ug/L | 2/16/2005 |
| U | 0.88 | ug/L | 5/17/2005 |
| U | 0.88 | ug/L | 8/18/2005 |
| U | 0.88 | ug/L | 11/29/2005 |
| U | 1.7 | ug/L | 2/23/2006 |
| U | 1.7 | ug/L | 5/31/2006 |
| U | 1.7 | ug/L | 1/23/2007 |
| U | 1.7 | ug/L | 2/5/2007 |
| U | 1.7 | ug/L | 5/1/2007 |
| U | 1.7 | ug/L | 9/13/2007 |
| U | 2 | ug/L | 12/3/2007 |
| U | 1.7 | ug/L | 2/26/2008 |
| U | 2 | ug/L | 6/5/2008 |
| U | 2 | ug/L | 8/14/2008 |
| U | 2 | ug/L | 10/13/2008 |

| | | | |
|---|---|---|---|
| U | 2 | ug/L | 1/19/2009 |
| U | 2 | ug/L | 4/8/2009 |
| U | 2 | ug/L | 7/20/2009 |
| U | 0.161 | ug/L | 5/21/1998 |
| U | 0.27 | ug/L | 8/20/1998 |
| U | 0.27 | ug/L | 12/1/1998 |
| U | 0.27 | ug/L | 2/10/1999 |
| U | 0.2 | ug/L | 2/13/1997 |
| U | 0.035 | ug/L | 5/15/1997 |
| U | 0.035 | ug/L | 8/14/1997 |
| U | 0.035 | ug/L | 12/8/1997 |
| U | 0.035 | ug/L | 12/8/1997 |
| U | 0.035 | ug/L | 2/23/1998 |
| U | 0.05 | ug/L | 5/18/1999 |
| U | 0.12 | ug/L | 12/16/1999 |
| U | 0.12 | ug/L | 2/29/2000 |
| U | 0.12 | ug/L | 5/10/2000 |
| U | 0.12 | ug/L | 10/3/2000 |
| U | 0.12 | ug/L | 10/3/2000 |
| U | 0.12 | ug/L | 2/27/2001 |
| U | 0.05 | ug/L | 2/13/2002 |
| U | 0.05 | ug/L | 5/16/2002 |
| U | 0.05 | ug/L | 8/26/2002 |
| U | 0.05 | ug/L | 11/19/2002 |
| U | 0.05 | ug/L | 2/18/2003 |
| U | 0.35 | ug/L | 5/8/2001 |
| U | 0.24 | ug/L | 8/22/2001 |
| U | 0.24 | ug/L | 8/22/2001 |
| U | 0.24 | ug/L | 11/16/2001 |
| U | 0.24 | ug/L | 8/26/2002 |
| U | 0.14 | ug/L | 2/18/2003 |
| U | 0.14 | ug/L | 5/16/2003 |
| U | 0.14 | ug/L | 11/18/2003 |
| U | 0.14 | ug/L | 11/18/2003 |
| U | 0.14 | ug/L | 3/30/2004 |
| U | 0.07 | ug/L | 2/16/2005 |
| U | 0.07 | ug/L | 5/17/2005 |
| U | 0.07 | ug/L | 8/18/2005 |
| U | 0.07 | ug/L | 11/29/2005 |
| U | 0.22 | ug/L | 2/23/2006 |
| U | 0.22 | ug/L | 5/31/2006 |
| U | 0.064 | ug/L | 1/23/2007 |
| U | 0.064 | ug/L | 2/5/2007 |
| U | 0.064 | ug/L | 5/1/2007 |
| U | 0.064 | ug/L | 9/13/2007 |
| U | 1 | ug/L | 12/3/2007 |
| U | 0.064 | ug/L | 2/26/2008 |

| | | | |
|---|---|---|---|
| U | 1 | ug/L | 6/5/2008 |
| U | 1 | ug/L | 8/14/2008 |
| U | 1 | ug/L | 10/13/2008 |
| U | 1 | ug/L | 1/19/2009 |
| U | 1 | ug/L | 4/8/2009 |
| U | 1 | ug/L | 7/20/2009 |
| | 510 | ug/L | 2/13/1997 |
| | 368 | ug/L | 5/15/1997 |
| | 346 | ug/L | 8/14/1997 |
| | 383 | ug/L | 12/8/1997 |
| | 446 | ug/L | 12/8/1997 |
| | 353 | ug/L | 2/23/1998 |
| | 337 | ug/L | 5/21/1998 |
| | 349 | ug/L | 8/20/1998 |
| | 334 | ug/L | 12/1/1998 |
| | 342 | ug/L | 2/10/1999 |
| | 278 | ug/L | 5/18/1999 |
| | 299 | ug/L | 8/18/1999 |
| | 320 | ug/L | 12/16/1999 |
| | 330 | ug/L | 2/29/2000 |
| | 330 | ug/L | 5/10/2000 |
| | 380 | ug/L | 10/3/2000 |
| | 330 | ug/L | 10/3/2000 |
| | 370 | ug/L | 2/27/2001 |
| | 380 | ug/L | 5/8/2001 |
| | 330 | ug/L | 8/22/2001 |
| | 340 | ug/L | 8/22/2001 |
| | 330 | ug/L | 11/16/2001 |
| | 310 | ug/L | 2/13/2002 |
| C | 400 | ug/L | 5/16/2002 |
| | 350 | ug/L | 8/26/2002 |
| | 420 | ug/L | 11/19/2002 |
| | 440 | ug/L | 2/18/2003 |
| | 420 | ug/L | 5/16/2003 |
| C | 460 | ug/L | 8/13/2003 |
| | 340 | ug/L | 11/18/2003 |
| | 320 | ug/L | 11/18/2003 |
| | 310 | ug/L | 3/30/2004 |
| | 340 | ug/L | 5/17/2004 |
| | 300 | ug/L | 8/26/2004 |
| | 270 | ug/L | 10/25/2004 |
| | 260 | ug/L | 2/16/2005 |
| | 330 | ug/L | 5/17/2005 |
| | 320 | ug/L | 8/18/2005 |
| U | 5.1 | ug/L | 11/29/2005 |
| | 300 | ug/L | 2/23/2006 |
| | 340 | ug/L | 5/31/2006 |

| | | | |
|---|---|---|---|
| | 460 | ug/L | 1/23/2007 |
| N | 370 | ug/L | 2/5/2007 |
| N | 380 | ug/L | 5/1/2007 |
| | 310 | ug/L | 9/13/2007 |
| | 299 | ug/L | 12/3/2007 |
| D | 244 | ug/L | 2/26/2008 |
| D | 262 | ug/L | 6/5/2008 |
| BD | 101 | ug/L | 8/14/2008 |
| BD | 126 | ug/L | 10/13/2008 |
| D | 218 | ug/L | 1/19/2009 |
| BD | 192 | ug/L | 4/8/2009 |
| BD | 248 | ug/L | 7/20/2009 |
| | 4.96 | pCi/L | 5/21/1998 |
| | 4.3 | pCi/L | 8/20/1998 |
| J | 2.96 | pCi/L | 12/1/1998 |
| | 5.47 | pCi/L | 2/10/1999 |
| | 5.32 | pCi/L | 5/18/1999 |
| J | 2.88 | pCi/L | 8/18/1999 |
| | 5.52 | pCi/L | 12/16/1999 |
| | 3.8 | pCi/L | 2/29/2000 |
| | 5.42 | pCi/L | 5/10/2000 |
| | 5.12 | pCi/L | 10/3/2000 |
| U | 2.13 | pCi/L | 10/3/2000 |
| | 4.82 | pCi/L | 2/27/2001 |
| | 3.46 | pCi/L | 8/22/2001 |
| | 4.94 | pCi/L | 8/22/2001 |
| | 3.36 | pCi/L | 2/13/1997 |
| | 3.22 | pCi/L | 5/15/1997 |
| | 3.9 | pCi/L | 8/14/1997 |
| | 5.16 | pCi/L | 12/8/1997 |
| | 4.76 | pCi/L | 12/8/1997 |
| J | 2.84 | pCi/L | 2/23/1998 |
| | 12.2 | pCi/L | 5/21/1998 |
| | 13.4 | pCi/L | 8/20/1998 |
| | 11.7 | pCi/L | 12/1/1998 |
| | 9.9 | pCi/L | 2/10/1999 |
| | 15.3 | pCi/L | 5/18/1999 |
| | 10.6 | pCi/L | 8/18/1999 |
| | 17.1 | pCi/L | 12/16/1999 |
| | 12.9 | pCi/L | 2/29/2000 |
| | 11.6 | pCi/L | 5/10/2000 |
| | 11.9 | pCi/L | 10/3/2000 |
| | 14.4 | pCi/L | 10/3/2000 |
| | 11.3 | pCi/L | 2/27/2001 |
| | 11 | pCi/L | 8/22/2001 |
| | 15.6 | pCi/L | 8/22/2001 |

| | | | |
|---|---|---|---|
| | 12.4 | pCi/L | 2/13/1997 |
| | 9.78 | pCi/L | 5/15/1997 |
| | 10.1 | pCi/L | 8/14/1997 |
| | 12.8 | pCi/L | 12/8/1997 |
| | 13.6 | pCi/L | 12/8/1997 |
| | 10.4 | pCi/L | 2/23/1998 |
| U | 9 | ug/L | 12/3/2007 |
| C | 87.2 | ug/L | 2/26/2008 |
| | 107 | ug/L | 6/5/2008 |
| B | 81.1 | ug/L | 8/14/2008 |
| B | 51.3 | ug/L | 10/13/2008 |
| B | 66.2 | ug/L | 1/19/2009 |
| B | 52.5 | ug/L | 4/8/2009 |
| BC | 52.4 | ug/L | 7/20/2009 |
| | 16100 | ug/L | 12/3/2007 |
| | 16100 | ug/L | 2/26/2008 |
| | 16700 | ug/L | 6/5/2008 |
| | 16200 | ug/L | 8/14/2008 |
| | 15600 | ug/L | 10/13/2008 |
| | 15600 | ug/L | 1/19/2009 |
| | 16100 | ug/L | 4/8/2009 |
| | 16100 | ug/L | 7/20/2009 |
| U | 4 | ug/L | 12/3/2007 |
| U | 4 | ug/L | 2/26/2008 |
| U | 4 | ug/L | 6/5/2008 |
| U | 4 | ug/L | 8/14/2008 |
| U | 4 | ug/L | 10/13/2008 |
| U | 4 | ug/L | 1/19/2009 |
| U | 4 | ug/L | 4/8/2009 |
| U | 4 | ug/L | 7/20/2009 |
| U | 0.285 | ug/L | 5/21/1998 |
| U | 0.28 | ug/L | 8/20/1998 |
| B | 5 | ug/L | 12/1/1998 |
| U | 0.28 | ug/L | 2/10/1999 |
| U | 0.28 | ug/L | 8/18/1999 |
| U | 0.2 | ug/L | 2/13/1997 |
| U | 0.207 | ug/L | 5/15/1997 |
| U | 0.2 | ug/L | 8/14/1997 |
| U | 0.207 | ug/L | 12/8/1997 |
| U | 0.207 | ug/L | 12/8/1997 |
| U | 0.207 | ug/L | 2/23/1998 |
| U | 0.21 | ug/L | 5/18/1999 |
| U | 2.4 | ug/L | 12/16/1999 |
| U | 2.4 | ug/L | 2/29/2000 |
| U | 2.4 | ug/L | 5/10/2000 |
| U | 2.4 | ug/L | 10/3/2000 |
| U | 2.4 | ug/L | 10/3/2000 |

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|---|---|---|---|
| U | 2.4 | ug/L | 2/27/2001 |
| U | 0.12 | ug/L | 2/13/2002 |
| JB | 0.12 | ug/L | 11/19/2002 |
| JB | 1.7 | ug/L | 5/8/2001 |
| U | 0.24 | ug/L | 8/22/2001 |
| U | 0.24 | ug/L | 8/22/2001 |
| JB | 1.2 | ug/L | 11/16/2001 |
| U | 0.24 | ug/L | 2/13/2002 |
| U | 0.24 | ug/L | 5/16/2002 |
| J | 0.3 | ug/L | 8/26/2002 |
| JB | 0.92 | ug/L | 11/19/2002 |
| U | 0.3 | ug/L | 2/18/2003 |
| U | 0.3 | ug/L | 5/16/2003 |
| U | 0.3 | ug/L | 8/13/2003 |
| U | 0.3 | ug/L | 11/18/2003 |
| U | 0.3 | ug/L | 11/18/2003 |
| U | 0.3 | ug/L | 3/30/2004 |
| U | 0.12 | ug/L | 5/17/2004 |
| U | 0.17 | ug/L | 8/26/2004 |
| U | 0.17 | ug/L | 10/25/2004 |
| UN | 0.12 | ug/L | 2/16/2005 |
| U | 0.12 | ug/L | 5/17/2005 |
| UN | 0.12 | ug/L | 8/18/2005 |
| U | 0.12 | ug/L | 11/29/2005 |
| U | 0.1 | ug/L | 2/23/2006 |
| U | 0.1 | ug/L | 5/31/2006 |
| U | 0.6 | ug/L | 1/23/2007 |
| U | 0.6 | ug/L | 2/5/2007 |
| U | 0.6 | ug/L | 5/1/2007 |
| U | 0.1 | ug/L | 9/13/2007 |
| U | 1 | ug/L | 12/3/2007 |
| U | 0.1 | ug/L | 2/26/2008 |
| U | 1 | ug/L | 6/5/2008 |
| U | 1 | ug/L | 8/14/2008 |
| U | 1 | ug/L | 10/13/2008 |
| U | 1 | ug/L | 1/19/2009 |
| U | 1 | ug/L | 4/8/2009 |
| U | 1 | ug/L | 7/20/2009 |
| U | 4 | ug/L | 12/3/2007 |
| | 7.7 | ug/L | 2/26/2008 |
| | 9.3 | ug/L | 6/5/2008 |
| U | 4 | ug/L | 8/14/2008 |
| U | 6 | ug/L | 10/13/2008 |
| B | 7.1 | ug/L | 1/19/2009 |
| B | 6.1 | ug/L | 4/8/2009 |
| B | 4 | ug/L | 7/20/2009 |
| D | 10500 | ug/L | 2/13/1997 |

| | | | |
|---|---|---|---|
| D | 11300 | ug/L | 5/15/1997 |
| D | 10900 | ug/L | 8/14/1997 |
| D | 12000 | ug/L | 12/8/1997 |
| D | 12000 | ug/L | 12/8/1997 |
| D | 12000 | ug/L | 2/23/1998 |
| D | 11300 | ug/L | 5/21/1998 |
| D | 11300 | ug/L | 8/20/1998 |
| D | 11200 | ug/L | 12/1/1998 |
| D | 12000 | ug/L | 2/10/1999 |
| D | 10900 | ug/L | 5/18/1999 |
| D | 11300 | ug/L | 8/18/1999 |
| D | 11100 | ug/L | 12/16/1999 |
| D | 11100 | ug/L | 2/29/2000 |
| D | 10600 | ug/L | 5/10/2000 |
| D | 10600 | ug/L | 10/3/2000 |
| D | 10600 | ug/L | 10/3/2000 |
| D | 10200 | ug/L | 2/27/2001 |
| D | 9740 | ug/L | 5/8/2001 |
| D | 11100 | ug/L | 8/22/2001 |
| D | 11100 | ug/L | 8/22/2001 |
| D | 11100 | ug/L | 11/16/2001 |
| D | 11500 | ug/L | 2/13/2002 |
| D | 10600 | ug/L | 5/16/2002 |
| D | 11100 | ug/L | 8/26/2002 |
| DN | 11500 | ug/L | 11/19/2002 |
| CD | 11500 | ug/L | 2/18/2003 |
| D | 11500 | ug/L | 5/16/2003 |
| D | 12000 | ug/L | 8/13/2003 |
| DN | 11500 | ug/L | 11/18/2003 |
| DN | 11500 | ug/L | 11/18/2003 |
| D | 11100 | ug/L | 3/30/2004 |
| D | 12000 | ug/L | 5/17/2004 |
| D | 11100 | ug/L | 8/26/2004 |
| D | 10200 | ug/L | 10/25/2004 |
| D | 15500 | ug/L | 2/16/2005 |
| CD | 12000 | ug/L | 5/17/2005 |
| D | 12800 | ug/L | 8/18/2005 |
| U | 44.3 | ug/L | 11/29/2005 |
| D | 12800 | ug/L | 2/23/2006 |
| D | 12000 | ug/L | 5/31/2006 |
| DN | 12400 | ug/L | 1/23/2007 |
| DN | 12400 | ug/L | 2/5/2007 |
| D | 12400 | ug/L | 5/1/2007 |
| | 11600 | ug/L | 9/13/2007 |
| | 12900 | ug/L | 12/3/2007 |
| D | 12900 | ug/L | 2/26/2008 |
| D | 13900 | ug/L | 6/5/2008 |

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|---|---|---|---|
| D | 12700 | ug/L | 8/14/2008 |
| DN | 12500 | ug/L | 10/13/2008 |
| D | 13400 | ug/L | 1/19/2009 |
| D | 12500 | ug/L | 4/8/2009 |
| D | 12000 | ug/L | 7/20/2009 |
| U | 6.57 | ug/L | 2/13/1997 |
| U | 6.57 | ug/L | 5/15/1997 |
| U | 6.57 | ug/L | 8/14/1997 |
| U | 3.28 | ug/L | 12/8/1997 |
| U | 3.28 | ug/L | 12/8/1997 |
| UD | 6.57 | ug/L | 2/23/1998 |
| U | 3.28 | ug/L | 5/21/1998 |
| U | 55.8 | ug/L | 8/20/1998 |
| U | 55.8 | ug/L | 12/1/1998 |
| U | 23 | ug/L | 2/10/1999 |
| U | 23 | ug/L | 5/18/1999 |
| U | 23 | ug/L | 8/18/1999 |
| U | 24.3 | ug/L | 12/16/1999 |
| U | 24.3 | ug/L | 2/29/2000 |
| U | 24.3 | ug/L | 5/10/2000 |
| U | 24.3 | ug/L | 10/3/2000 |
| U | 24.3 | ug/L | 10/3/2000 |
| U | 24.3 | ug/L | 2/27/2001 |
| U | 6.57 | ug/L | 5/8/2001 |
| U | 6.57 | ug/L | 8/22/2001 |
| U | 6.57 | ug/L | 8/22/2001 |
| U | 6.57 | ug/L | 11/16/2001 |
| U | 36.1 | ug/L | 2/13/2002 |
| U | 36.1 | ug/L | 5/16/2002 |
| U | 36.1 | ug/L | 8/26/2002 |
| U | 36.1 | ug/L | 11/19/2002 |
| U | 36.1 | ug/L | 2/18/2003 |
| U | 36.1 | ug/L | 5/16/2003 |
| U | 24.3 | ug/L | 8/13/2003 |
| U | 24.3 | ug/L | 11/18/2003 |
| U | 24.3 | ug/L | 11/18/2003 |
| U | 24.3 | ug/L | 3/30/2004 |
| U | 9.85 | ug/L | 5/17/2004 |
| U | 13.1 | ug/L | 8/26/2004 |
| U | 13.1 | ug/L | 10/25/2004 |
| U | 13.1 | ug/L | 2/16/2005 |
| UN | 20 | ug/L | 5/17/2005 |
| UN | 20 | ug/L | 8/18/2005 |
| U | 20 | ug/L | 11/29/2005 |
| UN | 20 | ug/L | 2/23/2006 |
| B | 55.8 | ug/L | 5/31/2006 |
| UN | 13.1 | ug/L | 1/23/2007 |

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|---|---|---|---|
| N | 526 | ug/L | 2/5/2007 |
| UN | 13.1 | ug/L | 5/1/2007 |
| U | 32.8 | ug/L | 9/13/2007 |
| B | 55.2 | ug/L | 12/3/2007 |
| DU | 65.7 | ug/L | 2/26/2008 |
| DU | 65 | ug/L | 6/5/2008 |
| DU | 84.1 | ug/L | 8/14/2008 |
| UD | 98.5 | ug/L | 10/13/2008 |
| DU | 84.1 | ug/L | 1/19/2009 |
| UD | 85.4 | ug/L | 4/8/2009 |
| UD | 118 | ug/L | 7/20/2009 |
| U | 36 | ug/L | 2/13/1997 |
| U | 86 | ug/L | 5/15/1997 |
| | 7670 | ug/L | 12/3/2007 |
| | 8100 | ug/L | 2/26/2008 |
| | 6680 | ug/L | 6/5/2008 |
| | 7880 | ug/L | 8/14/2008 |
| | 8180 | ug/L | 10/13/2008 |
| | 7540 | ug/L | 1/19/2009 |
| | 7730 | ug/L | 4/8/2009 |
| | 8040 | ug/L | 7/20/2009 |
| U | 5 | ug/L | 12/3/2007 |
| U | 5 | ug/L | 2/26/2008 |
| U | 5 | ug/L | 6/5/2008 |
| U | 5 | ug/L | 8/14/2008 |
| U | 5 | ug/L | 10/13/2008 |
| U | 5 | ug/L | 1/19/2009 |
| U | 5 | ug/L | 4/8/2009 |
| U | 5 | ug/L | 7/20/2009 |
| | 20000 | ug/L | 12/3/2007 |
| | 21100 | ug/L | 2/26/2008 |
| | 21500 | ug/L | 6/5/2008 |
| | 20200 | ug/L | 8/14/2008 |
| | 20400 | ug/L | 10/13/2008 |
| | 20700 | ug/L | 1/19/2009 |
| | 21900 | ug/L | 4/8/2009 |
| | 23000 | ug/L | 7/20/2009 |
| C | 510 | uS/cm | 12/1/1998 |
| C | 538 | uS/cm | 2/10/1999 |
| C | 553 | uS/cm | 5/18/1999 |
| C | 538 | uS/cm | 12/16/1999 |
| | 601 | uS/cm | 11/29/2005 |
| | 599 | uS/cm | 2/23/2006 |
| | 575 | uS/cm | 5/31/2006 |
| | 576 | uS/cm | 1/23/2007 |
| | 565 | uS/cm | 2/5/2007 |
| | 526 | uS/cm | 2/13/1997 |

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|---|---|---|---|
| | 526 | uS/cm | 2/13/1997 |
| | 526 | uS/cm | 2/13/1997 |
| | 526 | uS/cm | 2/13/1997 |
| | 536 | uS/cm | 5/15/1997 |
| | 536 | uS/cm | 5/15/1997 |
| | 536 | uS/cm | 5/15/1997 |
| | 535 | uS/cm | 5/15/1997 |
| | 597 | uS/cm | 8/14/1997 |
| | 548 | uS/cm | 8/14/1997 |
| | 550 | uS/cm | 8/14/1997 |
| | 597 | uS/cm | 8/14/1997 |
| | 472 | uS/cm | 12/8/1997 |
| | 457 | uS/cm | 12/8/1997 |
| | 465 | uS/cm | 12/8/1997 |
| | 458 | uS/cm | 12/8/1997 |
| | 534 | uS/cm | 2/23/1998 |
| | 535 | uS/cm | 2/23/1998 |
| | 539 | uS/cm | 2/23/1998 |
| | 534 | uS/cm | 2/23/1998 |
| | 362 | uS/cm | 5/21/1998 |
| | 361 | uS/cm | 5/21/1998 |
| | 361 | uS/cm | 5/21/1998 |
| | 361 | uS/cm | 5/21/1998 |
| | 545 | uS/cm | 8/20/1998 |
| | 544 | uS/cm | 8/20/1998 |
| | 545 | uS/cm | 8/20/1998 |
| | 547 | uS/cm | 8/20/1998 |
| | 526 | uS/cm | 12/1/1998 |
| | 525 | uS/cm | 12/1/1998 |
| | 525 | uS/cm | 12/1/1998 |
| | 525 | uS/cm | 12/1/1998 |
| | 1030 | uS/cm | 2/10/1999 |
| | 1035 | uS/cm | 2/10/1999 |
| | 1029 | uS/cm | 2/10/1999 |
| | 1035 | uS/cm | 2/10/1999 |
| | 569 | uS/cm | 5/18/1999 |
| | 569 | uS/cm | 5/18/1999 |
| | 569 | uS/cm | 5/18/1999 |
| | 569 | uS/cm | 5/18/1999 |
| | 565 | uS/cm | 8/18/1999 |
| | 566 | uS/cm | 8/18/1999 |
| | 564 | uS/cm | 8/18/1999 |
| | 566 | uS/cm | 8/18/1999 |
| | 567 | uS/cm | 12/16/1999 |
| | 566 | uS/cm | 12/16/1999 |
| | 567 | uS/cm | 12/16/1999 |
| | 566 | uS/cm | 12/16/1999 |

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|---|---|---|---|
| | 539 | uS/cm | 2/29/2000 |
| | 526 | uS/cm | 2/29/2000 |
| | 540 | uS/cm | 2/29/2000 |
| | 538 | uS/cm | 2/29/2000 |
| | 578 | uS/cm | 5/10/2000 |
| | 586 | uS/cm | 10/3/2000 |
| | 541 | uS/cm | 2/27/2001 |
| | 577 | uS/cm | 5/8/2001 |
| | 607 | uS/cm | 8/22/2001 |
| | 609 | uS/cm | 11/16/2001 |
| | 609 | uS/cm | 2/13/2002 |
| | 613 | uS/cm | 5/16/2002 |
| | 614 | uS/cm | 8/26/2002 |
| | 597 | uS/cm | 11/19/2002 |
| | 578 | uS/cm | 2/18/2003 |
| | 605 | uS/cm | 5/16/2003 |
| | 592 | uS/cm | 8/13/2003 |
| | 611 | uS/cm | 3/30/2004 |
| | 601 | uS/cm | 5/17/2004 |
| | 604 | uS/cm | 8/26/2004 |
| | 616 | uS/cm | 10/25/2004 |
| | 588 | uS/cm | 2/16/2005 |
| | 599 | uS/cm | 5/17/2005 |
| | 604 | uS/cm | 8/18/2005 |
| | 560 | uS/cm | 5/1/2007 |
| | 591 | uS/cm | 9/13/2007 |
| | 587 | uS/cm | 12/3/2007 |
| | 581 | uS/cm | 2/26/2008 |
| | 429 | uS/cm | 6/5/2008 |
| | 589 | uS/cm | 8/14/2008 |
| | 578 | uS/cm | 10/13/2008 |
| | 579 | uS/cm | 1/19/2009 |
| | 547 | uS/cm | 4/8/2009 |
| | 580 | uS/cm | 7/20/2009 |
| | 307 | ug/L | 12/3/2007 |
| | 316 | ug/L | 2/26/2008 |
| | 361 | ug/L | 6/5/2008 |
| | 438 | ug/L | 8/14/2008 |
| | 491 | ug/L | 10/13/2008 |
| | 457 | ug/L | 1/19/2009 |
| | 325 | ug/L | 4/8/2009 |
| | 323 | ug/L | 7/20/2009 |
| D | 38400 | ug/L | 2/13/1997 |
| D | 41700 | ug/L | 5/15/1997 |
| D | 42300 | ug/L | 8/14/1997 |
| D | 41600 | ug/L | 12/8/1997 |
| D | 41700 | ug/L | 12/8/1997 |

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|---|---|---|---|
| D | 41600 | ug/L | 2/23/1998 |
| D | 41100 | ug/L | 5/21/1998 |
| D | 42200 | ug/L | 8/20/1998 |
| D | 45700 | ug/L | 12/1/1998 |
| D | 45000 | ug/L | 2/10/1999 |
| D | 42400 | ug/L | 5/18/1999 |
| D | 44100 | ug/L | 8/18/1999 |
| D | 43700 | ug/L | 12/16/1999 |
| D | 44000 | ug/L | 2/29/2000 |
| D | 42400 | ug/L | 5/10/2000 |
| D | 45400 | ug/L | 10/3/2000 |
| D | 44600 | ug/L | 10/3/2000 |
| D | 44900 | ug/L | 2/27/2001 |
| D | 44300 | ug/L | 5/8/2001 |
| D | 47800 | ug/L | 8/22/2001 |
| D | 46900 | ug/L | 8/22/2001 |
| D | 45300 | ug/L | 11/16/2001 |
| D | 45100 | ug/L | 2/13/2002 |
| D | 47000 | ug/L | 5/16/2002 |
| D | 48200 | ug/L | 8/26/2002 |
| DN | 45200 | ug/L | 11/19/2002 |
| D | 44600 | ug/L | 2/18/2003 |
| D | 46300 | ug/L | 5/16/2003 |
| CD | 47800 | ug/L | 8/13/2003 |
| D | 45900 | ug/L | 11/18/2003 |
| D | 45700 | ug/L | 11/18/2003 |
| D | 44900 | ug/L | 3/30/2004 |
| D | 47600 | ug/L | 5/17/2004 |
| D | 43400 | ug/L | 8/26/2004 |
| D | 43300 | ug/L | 10/25/2004 |
| D | 43200 | ug/L | 2/16/2005 |
| D | 50500 | ug/L | 5/17/2005 |
| D | 48000 | ug/L | 8/18/2005 |
| U | 61 | ug/L | 11/29/2005 |
| D | 45000 | ug/L | 2/23/2006 |
| D | 44600 | ug/L | 5/31/2006 |
| DN | 41500 | ug/L | 1/23/2007 |
| BD | 41200 | ug/L | 2/5/2007 |
| D | 42300 | ug/L | 5/1/2007 |
| | 43200 | ug/L | 9/13/2007 |
| | 42900 | ug/L | 12/3/2007 |
| D | 46500 | ug/L | 2/26/2008 |
| D | 46600 | ug/L | 6/5/2008 |
| D | 44800 | ug/L | 8/14/2008 |
| D | 44500 | ug/L | 10/13/2008 |
| D | 46000 | ug/L | 1/19/2009 |
| D | 43700 | ug/L | 4/8/2009 |

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|---|---|---|---|
| D | 45100 | ug/L | 7/20/2009 |
| | 17.2 | Deg C | 11/29/2005 |
| | 17.7 | Deg C | 2/23/2006 |
| | 18.5 | Deg C | 5/31/2006 |
| | 17.4 | Deg C | 1/23/2007 |
| | 17.5 | Deg C | 2/5/2007 |
| | 17.6 | Deg C | 2/13/1997 |
| | 17.7 | Deg C | 2/13/1997 |
| | 17.6 | Deg C | 2/13/1997 |
| | 17.6 | Deg C | 2/13/1997 |
| | 18.3 | Deg C | 5/15/1997 |
| | 18.3 | Deg C | 5/15/1997 |
| | 18.3 | Deg C | 5/15/1997 |
| | 18.3 | Deg C | 5/15/1997 |
| | 19 | Deg C | 8/14/1997 |
| | 18.9 | Deg C | 8/14/1997 |
| | 18.8 | Deg C | 8/14/1997 |
| | 18.9 | Deg C | 8/14/1997 |
| | 17 | Deg C | 12/8/1997 |
| | 17 | Deg C | 12/8/1997 |
| | 17 | Deg C | 12/8/1997 |
| | 17 | Deg C | 12/8/1997 |
| | 17 | Deg C | 2/23/1998 |
| | 17 | Deg C | 2/23/1998 |
| | 17 | Deg C | 2/23/1998 |
| | 17 | Deg C | 2/23/1998 |
| | 19.3 | Deg C | 5/21/1998 |
| | 19.3 | Deg C | 5/21/1998 |
| | 19.2 | Deg C | 5/21/1998 |
| | 19.2 | Deg C | 5/21/1998 |
| | 18.2 | Deg C | 8/20/1998 |
| | 18.2 | Deg C | 8/20/1998 |
| | 18.2 | Deg C | 8/20/1998 |
| | 18.2 | Deg C | 8/20/1998 |
| | 17 | Deg C | 12/1/1998 |
| | 16.9 | Deg C | 12/1/1998 |
| | 16.8 | Deg C | 12/1/1998 |
| | 16.9 | Deg C | 12/1/1998 |
| | 17 | Deg C | 2/10/1999 |
| | 17 | Deg C | 2/10/1999 |
| | 17.1 | Deg C | 2/10/1999 |
| | 17.1 | Deg C | 2/10/1999 |
| | 17.8 | Deg C | 5/18/1999 |
| | 17.8 | Deg C | 5/18/1999 |
| | 17.9 | Deg C | 5/18/1999 |
| | 17.8 | Deg C | 5/18/1999 |
| | 18.9 | Deg C | 8/18/1999 |

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|---|---|---|---|
| | 18.9 | Deg C | 8/18/1999 |
| | 18.8 | Deg C | 8/18/1999 |
| | 18.8 | Deg C | 8/18/1999 |
| | 17.6 | Deg C | 12/16/1999 |
| | 17.6 | Deg C | 12/16/1999 |
| | 17.6 | Deg C | 12/16/1999 |
| | 17.6 | Deg C | 12/16/1999 |
| | 17 | Deg C | 2/29/2000 |
| | 17 | Deg C | 2/29/2000 |
| | 17 | Deg C | 2/29/2000 |
| | 17 | Deg C | 2/29/2000 |
| | 17.6 | Deg C | 5/10/2000 |
| | 17.2 | Deg C | 10/3/2000 |
| | 17.1 | Deg C | 2/27/2001 |
| | 17.7 | Deg C | 5/8/2001 |
| | 18 | Deg C | 8/22/2001 |
| | 17.3 | Deg C | 11/16/2001 |
| | 17.1 | Deg C | 2/13/2002 |
| | 17.6 | Deg C | 5/16/2002 |
| | 19 | Deg C | 8/26/2002 |
| | 17.8 | Deg C | 11/19/2002 |
| | 17.2 | Deg C | 2/18/2003 |
| | 19.2 | Deg C | 5/16/2003 |
| | 18.3 | Deg C | 8/13/2003 |
| | 17.9 | Deg C | 3/30/2004 |
| | 17.9 | Deg C | 5/17/2004 |
| | 18.7 | Deg C | 8/26/2004 |
| | 17.6 | Deg C | 10/25/2004 |
| | 16.3 | Deg C | 2/16/2005 |
| | 18.1 | Deg C | 5/17/2005 |
| | 18.4 | Deg C | 8/18/2005 |
| | 18 | Deg C | 5/1/2007 |
| | 18.7 | Deg C | 9/13/2007 |
| | 17.9 | Deg C | 12/3/2007 |
| | 17.5 | Deg C | 2/26/2008 |
| | 18.4 | Deg C | 6/5/2008 |
| | 19.7 | Deg C | 8/14/2008 |
| | 18.1 | Deg C | 10/13/2008 |
| | 17.2 | Deg C | 1/19/2009 |
| | 18.1 | Deg C | 4/8/2009 |
| | 19.8 | Deg C | 7/20/2009 |
| | 2 | ug/L | 5/21/1998 |
| | 0.8 | ug/L | 8/20/1998 |
| | 3 | ug/L | 12/1/1998 |
| | 0.8 | ug/L | 2/10/1999 |
| | 1 | ug/L | 8/18/1999 |
| | 1.4 | ug/L | 2/13/1997 |

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|---|---|---|---|
| | 0.95 | ug/L | 5/15/1997 |
| | 1.9 | ug/L | 8/14/1997 |
| | 0.79 | ug/L | 12/8/1997 |
| | 0.97 | ug/L | 12/8/1997 |
| | 1.3 | ug/L | 2/23/1998 |
| U | 0.03 | ug/L | 5/18/1999 |
| | 1.1 | ug/L | 12/16/1999 |
| J | 0.98 | ug/L | 2/29/2000 |
| J | 1 | ug/L | 5/10/2000 |
| | 1.1 | ug/L | 10/3/2000 |
| | 1.2 | ug/L | 10/3/2000 |
| U | 0.15 | ug/L | 2/27/2001 |
| | 1 | ug/L | 2/13/2002 |
| J | 0.94 | ug/L | 5/16/2002 |
| J | 0.63 | ug/L | 11/19/2002 |
| JB | 0.82 | ug/L | 5/8/2001 |
| J | 0.92 | ug/L | 8/22/2001 |
| J | 0.94 | ug/L | 8/22/2001 |
| J | 1.1 | ug/L | 11/16/2001 |
| J | 1.2 | ug/L | 2/13/2002 |
| | 1.2 | ug/L | 5/16/2002 |
| J | 0.97 | ug/L | 8/26/2002 |
| | 1 | ug/L | 11/19/2002 |
| J | 0.99 | ug/L | 2/18/2003 |
| | 1.1 | ug/L | 5/16/2003 |
| J | 0.77 | ug/L | 8/13/2003 |
| J | 0.78 | ug/L | 11/18/2003 |
| J | 0.77 | ug/L | 11/18/2003 |
| | 1 | ug/L | 3/30/2004 |
| J | 0.7 | ug/L | 5/17/2004 |
| JN | 0.92 | ug/L | 8/26/2004 |
| J | 0.7 | ug/L | 10/25/2004 |
| JN | 0.53 | ug/L | 2/16/2005 |
| J | 0.47 | ug/L | 5/17/2005 |
| J | 0.86 | ug/L | 8/18/2005 |
| J | 0.39 | ug/L | 11/29/2005 |
| | 1.2 | ug/L | 2/23/2006 |
| J | 0.79 | ug/L | 5/31/2006 |
| J | 0.64 | ug/L | 1/23/2007 |
| J | 0.94 | ug/L | 2/5/2007 |
| J | 0.45 | ug/L | 5/1/2007 |
| J | 0.23 | ug/L | 9/13/2007 |
| U | 1 | ug/L | 12/3/2007 |
| U | 0.17 | ug/L | 2/26/2008 |
| U | 1 | ug/L | 6/5/2008 |
| U | 1 | ug/L | 8/14/2008 |
| U | 1 | ug/L | 10/13/2008 |

| | | | |
|---|---|---|---|
| J | 4.3 | ug/L | 1/19/2009 |
| U | 1 | ug/L | 4/8/2009 |
| U | 1 | ug/L | 7/20/2009 |
| U | 1.5 | ug/L | 5/8/2001 |
| U | 2.3 | ug/L | 8/22/2001 |
| U | 2.3 | ug/L | 8/22/2001 |
| U | 2.3 | ug/L | 11/16/2001 |
| U | 2.3 | ug/L | 2/13/2002 |
| U | 2.3 | ug/L | 5/16/2002 |
| U | 2.3 | ug/L | 8/26/2002 |
| U | 1.7 | ug/L | 11/19/2002 |
| U | 1.7 | ug/L | 2/18/2003 |
| U | 1.7 | ug/L | 5/16/2003 |
| U | 1.7 | ug/L | 8/13/2003 |
| U | 1.7 | ug/L | 11/18/2003 |
| U | 1.7 | ug/L | 11/18/2003 |
| U | 1.7 | ug/L | 3/30/2004 |
| U | 1.7 | ug/L | 5/17/2004 |
| U | 1.7 | ug/L | 8/26/2004 |
| U | 1.2 | ug/L | 10/25/2004 |
| U | 1.2 | ug/L | 2/16/2005 |
| U | 1.2 | ug/L | 5/17/2005 |
| U | 1.2 | ug/L | 8/18/2005 |
| U | 1.2 | ug/L | 11/29/2005 |
| U | 2.9 | ug/L | 2/23/2006 |
| U | 2.9 | ug/L | 5/31/2006 |
| U | 1.2 | ug/L | 1/23/2007 |
| U | 1.2 | ug/L | 2/5/2007 |
| U | 1.2 | ug/L | 5/1/2007 |
| U | 1.2 | ug/L | 9/13/2007 |
| U | 2 | ug/L | 12/3/2007 |
| U | 1.2 | ug/L | 2/26/2008 |
| U | 2 | ug/L | 6/5/2008 |
| U | 2 | ug/L | 8/14/2008 |
| U | 2 | ug/L | 10/13/2008 |
| U | 2 | ug/L | 1/19/2009 |
| U | 2 | ug/L | 4/8/2009 |
| U | 2 | ug/L | 7/20/2009 |
| U | 0.093 | ug/L | 5/21/1998 |
| U | 0.22 | ug/L | 8/20/1998 |
| U | 0.22 | ug/L | 12/1/1998 |
| U | 0.22 | ug/L | 2/10/1999 |
| U | 0.2 | ug/L | 2/13/1997 |
| U | 0.024 | ug/L | 5/15/1997 |
| U | 0.024 | ug/L | 8/14/1997 |
| J | 0.16 | ug/L | 12/8/1997 |
| U | 0.024 | ug/L | 12/8/1997 |

| | | | |
|---|---|---|---|
| U | 0.024 | ug/L | 2/23/1998 |
| U | 0.1 | ug/L | 5/18/1999 |
| U | 0.21 | ug/L | 12/16/1999 |
| U | 0.21 | ug/L | 2/29/2000 |
| U | 0.21 | ug/L | 5/10/2000 |
| U | 0.21 | ug/L | 10/3/2000 |
| U | 0.21 | ug/L | 10/3/2000 |
| U | 0.21 | ug/L | 2/27/2001 |
| U | 0.05 | ug/L | 2/13/2002 |
| U | 0.05 | ug/L | 5/16/2002 |
| U | 0.05 | ug/L | 8/26/2002 |
| J | 0.41 | ug/L | 11/19/2002 |
| U | 0.05 | ug/L | 2/18/2003 |
| U | 0.33 | ug/L | 5/8/2001 |
| U | 0.23 | ug/L | 8/22/2001 |
| U | 0.23 | ug/L | 8/22/2001 |
| U | 0.23 | ug/L | 11/16/2001 |
| U | 0.23 | ug/L | 2/13/2002 |
| U | 0.23 | ug/L | 5/16/2002 |
| U | 0.23 | ug/L | 8/26/2002 |
| U | 0.12 | ug/L | 11/19/2002 |
| U | 0.12 | ug/L | 2/18/2003 |
| U | 0.12 | ug/L | 5/16/2003 |
| U | 0.12 | ug/L | 8/13/2003 |
| U | 0.12 | ug/L | 11/18/2003 |
| U | 0.12 | ug/L | 11/18/2003 |
| U | 0.12 | ug/L | 3/30/2004 |
| U | 0.07 | ug/L | 5/17/2004 |
| UN | 0.07 | ug/L | 8/26/2004 |
| U | 0.07 | ug/L | 10/25/2004 |
| U | 0.08 | ug/L | 2/16/2005 |
| U | 0.08 | ug/L | 5/17/2005 |
| U | 0.08 | ug/L | 8/18/2005 |
| U | 0.08 | ug/L | 11/29/2005 |
| U | 0.2 | ug/L | 2/23/2006 |
| U | 0.2 | ug/L | 5/31/2006 |
| U | 0.025 | ug/L | 1/23/2007 |
| U | 0.025 | ug/L | 2/5/2007 |
| U | 0.025 | ug/L | 5/1/2007 |
| U | 0.1 | ug/L | 9/13/2007 |
| U | 1 | ug/L | 12/3/2007 |
| U | 0.1 | ug/L | 2/26/2008 |
| U | 1 | ug/L | 6/5/2008 |
| U | 1 | ug/L | 8/14/2008 |
| U | 1 | ug/L | 10/13/2008 |
| U | 1 | ug/L | 1/19/2009 |
| U | 1 | ug/L | 4/8/2009 |

| | | | |
|---|---|---|---|
| U | 1 | ug/L | 7/20/2009 |
| | 62400 | ug/L | 2/13/1997 |
| | 34100 | ug/L | 5/15/1997 |
| | 46800 | ug/L | 8/14/1997 |
| | 46200 | ug/L | 12/8/1997 |
| | 43800 | ug/L | 12/8/1997 |
| C | 46600 | ug/L | 2/23/1998 |
| | 45900 | ug/L | 5/21/1998 |
| D | 36900 | ug/L | 8/20/1998 |
| D | 41000 | ug/L | 12/1/1998 |
| | 25800 | ug/L | 2/10/1999 |
| C | 18100 | ug/L | 5/18/1999 |
| | 312000 | ug/L | 2/13/1997 |
| | 344000 | ug/L | 5/15/1997 |
| | 332000 | ug/L | 8/14/1997 |
| | 342000 | ug/L | 12/8/1997 |
| | 331000 | ug/L | 12/8/1997 |
| | 316000 | ug/L | 2/23/1998 |
| | 349000 | ug/L | 5/21/1998 |
| | 349000 | ug/L | 8/20/1998 |
| | 358000 | ug/L | 12/1/1998 |
| | 366000 | ug/L | 2/10/1999 |
| | 367000 | ug/L | 5/18/1999 |
| U | 532 | ug/L | 2/13/1997 |
| U | 532 | ug/L | 2/13/1997 |
| U | 532 | ug/L | 2/13/1997 |
| U | 532 | ug/L | 2/13/1997 |
| U | 532 | ug/L | 5/15/1997 |
| U | 532 | ug/L | 5/15/1997 |
| U | 532 | ug/L | 5/15/1997 |
| U | 532 | ug/L | 5/15/1997 |
| U | 370 | ug/L | 8/14/1997 |
| U | 370 | ug/L | 8/14/1997 |
| U | 370 | ug/L | 8/14/1997 |
| U | 370 | ug/L | 8/14/1997 |
| U | 370 | ug/L | 12/8/1997 |
| U | 370 | ug/L | 12/8/1997 |
| U | 370 | ug/L | 12/8/1997 |
| U | 370 | ug/L | 12/8/1997 |
| U | 370 | ug/L | 12/8/1997 |
| U | 370 | ug/L | 12/8/1997 |
| U | 370 | ug/L | 12/8/1997 |
| U | 370 | ug/L | 12/8/1997 |
| BC | 900 | ug/L | 2/23/1998 |
| BC | 819 | ug/L | 2/23/1998 |
| BC | 852 | ug/L | 2/23/1998 |
| BC | 798 | ug/L | 2/23/1998 |

| | | | |
|---|---|---|---|
| BC | 601 | ug/L | 5/21/1998 |
| BC | 638 | ug/L | 5/21/1998 |
| BC | 538 | ug/L | 5/21/1998 |
| BC | 538 | ug/L | 5/21/1998 |
| U | 256 | ug/L | 8/20/1998 |
| U | 256 | ug/L | 8/20/1998 |
| B | 296 | ug/L | 8/20/1998 |
| B | 381 | ug/L | 8/20/1998 |
| B | 539 | ug/L | 12/1/1998 |
| B | 544 | ug/L | 12/1/1998 |
| B | 484 | ug/L | 12/1/1998 |
| B | 539 | ug/L | 12/1/1998 |
| B | 478 | ug/L | 2/10/1999 |
| B | 437 | ug/L | 2/10/1999 |
| B | 276 | ug/L | 2/10/1999 |
| U | 222 | ug/L | 2/10/1999 |
| B | 496 | ug/L | 5/18/1999 |
| B | 407 | ug/L | 5/18/1999 |
| B | 370 | ug/L | 5/18/1999 |
| B | 303 | ug/L | 5/18/1999 |
| B | 416 | ug/L | 8/18/1999 |
| U | 222 | ug/L | 8/18/1999 |
| B | 537 | ug/L | 8/18/1999 |
| B | 300 | ug/L | 8/18/1999 |
| B | 350 | ug/L | 12/16/1999 |
| B | 300 | ug/L | 12/16/1999 |
| B | 460 | ug/L | 12/16/1999 |
| B | 340 | ug/L | 12/16/1999 |
| B | 640 | ug/L | 2/29/2000 |
| B | 640 | ug/L | 2/29/2000 |
| B | 450 | ug/L | 2/29/2000 |
| B | 570 | ug/L | 2/29/2000 |
| B | 300 | ug/L | 5/10/2000 |
| U | 220 | ug/L | 10/3/2000 |
| B | 340 | ug/L | 10/3/2000 |
| B | 520 | ug/L | 2/27/2001 |
| BC | 370 | ug/L | 5/8/2001 |
| B | 190 | ug/L | 8/22/2001 |
| B | 270 | ug/L | 8/22/2001 |
| U | 120 | ug/L | 11/16/2001 |
| B | 340 | ug/L | 2/13/2002 |
| B | 310 | ug/L | 5/16/2002 |
| U | 140 | ug/L | 8/26/2002 |
| C | 1900 | ug/L | 11/19/2002 |
| | 1400 | ug/L | 2/18/2003 |
| N | 5000 | ug/L | 5/16/2003 |

| | | | |
|---|---|---|---|
| | 690 | ug/L | 8/13/2003 |
| | 5100 | ug/L | 8/13/2003 |
| U | 390 | ug/L | 11/18/2003 |
| U | 390 | ug/L | 11/18/2003 |
| | 1000 | ug/L | 3/30/2004 |
| B | 560 | ug/L | 5/17/2004 |
| U | 390 | ug/L | 8/26/2004 |
| U | 390 | ug/L | 10/25/2004 |
| B | 570 | ug/L | 2/16/2005 |
| U | 1000 | ug/L | 5/17/2005 |
| BC | 780 | ug/L | 8/18/2005 |
| U | 470 | ug/L | 11/29/2005 |
| | 2200 | ug/L | 2/23/2006 |
| U | 470 | ug/L | 5/31/2006 |
| U | 760 | ug/L | 1/23/2007 |
| U | 760 | ug/L | 2/5/2007 |
| U | 760 | ug/L | 5/1/2007 |
| U | 760 | ug/L | 9/13/2007 |
| | 573 | ug/L | 12/3/2007 |
| | 12800 | ug/L | 2/26/2008 |
| | 663 | ug/L | 6/5/2008 |
| B | 370 | ug/L | 8/14/2008 |
| U | 200 | ug/L | 10/13/2008 |
| | 644 | ug/L | 1/19/2009 |
| B | 609 | ug/L | 4/8/2009 |
| B | 799 | ug/L | 7/20/2009 |
| U | 2.65 | ug/L | 2/13/1997 |
| | 6.05 | ug/L | 2/13/1997 |
| | 6.95 | ug/L | 2/13/1997 |
| U | 2.65 | ug/L | 2/13/1997 |
| | 7.1 | ug/L | 5/15/1997 |
| | 17.3 | ug/L | 5/15/1997 |
| U | 2.65 | ug/L | 5/15/1997 |
| | 5.6 | ug/L | 5/15/1997 |
| | 8.95 | ug/L | 8/14/1997 |
| | 11.4 | ug/L | 8/14/1997 |
| | 11.4 | ug/L | 8/14/1997 |
| | 19.5 | ug/L | 8/14/1997 |
| B | 4.85 | ug/L | 12/8/1997 |
| | 5.9 | ug/L | 12/8/1997 |
| U | 4.62 | ug/L | 12/8/1997 |
| B | 4.9 | ug/L | 12/8/1997 |
| | 11.8 | ug/L | 12/8/1997 |
| B | 4.85 | ug/L | 12/8/1997 |
| B | 4.95 | ug/L | 12/8/1997 |
| | 6.2 | ug/L | 12/8/1997 |
| | 13.9 | ug/L | 2/23/1998 |

| | | | |
|---|---|---|---|
| | 70 | ug/L | 2/23/1998 |
| | 29.3 | ug/L | 2/23/1998 |
| U | 4.62 | ug/L | 2/23/1998 |
| | 7.65 | ug/L | 5/21/1998 |
| | 5.5 | ug/L | 5/21/1998 |
| | 5.2 | ug/L | 5/21/1998 |
| B | 4.75 | ug/L | 5/21/1998 |
| | 5.3 | ug/L | 8/20/1998 |
| B | 3.8 | ug/L | 8/20/1998 |
| | 6.7 | ug/L | 8/20/1998 |
| B | 3.9 | ug/L | 8/20/1998 |
| B | 3 | ug/L | 12/1/1998 |
| U | 2.38 | ug/L | 12/1/1998 |
| U | 2.38 | ug/L | 12/1/1998 |
| U | 2.38 | ug/L | 12/1/1998 |
| | 7.4 | ug/L | 2/10/1999 |
| | 7.9 | ug/L | 2/10/1999 |
| | 5.15 | ug/L | 2/10/1999 |
| | 5.15 | ug/L | 2/10/1999 |
| B | 3.4 | ug/L | 5/18/1999 |
| B | 3.25 | ug/L | 5/18/1999 |
| B | 2.65 | ug/L | 5/18/1999 |
| B | 3.5 | ug/L | 5/18/1999 |
| | 5.8 | ug/L | 8/18/1999 |
| B | 4.3 | ug/L | 8/18/1999 |
| U | 4.27 | ug/L | 8/18/1999 |
| U | 4.27 | ug/L | 8/18/1999 |
| | 18.4 | ug/L | 12/16/1999 |
| | 14.8 | ug/L | 12/16/1999 |
| B | 4.3 | ug/L | 12/16/1999 |
| | 7.3 | ug/L | 12/16/1999 |
| U | 4.3 | ug/L | 2/29/2000 |
| U | 4.3 | ug/L | 2/29/2000 |
| U | 4.3 | ug/L | 2/29/2000 |
| U | 4.3 | ug/L | 2/29/2000 |
| B | 4.6 | ug/L | 5/10/2000 |
| U | 4.3 | ug/L | 10/3/2000 |
| B | 4.4 | ug/L | 10/3/2000 |
| U | 4.3 | ug/L | 2/27/2001 |
| U | 3.6 | ug/L | 5/8/2001 |
| | 5.5 | ug/L | 8/22/2001 |
| | 13.3 | ug/L | 11/16/2001 |
| | 0.7 | ug/L | 5/21/1998 |
| J | 0.3 | ug/L | 8/20/1998 |
| B | 1 | ug/L | 12/1/1998 |
| J | 0.4 | ug/L | 2/10/1999 |
| J | 0.5 | ug/L | 8/18/1999 |

| | | | |
|---|---|---|---|
| | 0.6 | ug/L | 2/13/1997 |
| | 0.4 | ug/L | 5/15/1997 |
| B | 1.1 | ug/L | 8/14/1997 |
| | 0.35 | ug/L | 12/8/1997 |
| | 0.42 | ug/L | 12/8/1997 |
| B | 0.52 | ug/L | 2/23/1998 |
| U | 0.03 | ug/L | 5/18/1999 |
| J | 0.94 | ug/L | 12/16/1999 |
| U | 0.26 | ug/L | 2/29/2000 |
| J | 0.36 | ug/L | 5/10/2000 |
| U | 0.26 | ug/L | 10/3/2000 |
| U | 0.26 | ug/L | 10/3/2000 |
| U | 0.26 | ug/L | 2/27/2001 |
| J | 0.32 | ug/L | 2/13/2002 |
| J | 0.33 | ug/L | 5/16/2002 |
| U | 0.21 | ug/L | 11/19/2002 |
| J | 0.38 | ug/L | 5/8/2001 |
| J | 0.53 | ug/L | 8/22/2001 |
| J | 0.51 | ug/L | 8/22/2001 |
| J | 0.49 | ug/L | 11/16/2001 |
| J | 0.51 | ug/L | 2/13/2002 |
| J | 0.54 | ug/L | 5/16/2002 |
| J | 0.43 | ug/L | 8/26/2002 |
| J | 0.35 | ug/L | 11/19/2002 |
| J | 0.39 | ug/L | 2/18/2003 |
| | 0.4 | ug/L | 5/16/2003 |
| J | 0.31 | ug/L | 8/13/2003 |
| J | 0.38 | ug/L | 11/18/2003 |
| J | 0.36 | ug/L | 11/18/2003 |
| J | 0.45 | ug/L | 3/30/2004 |
| J | 0.35 | ug/L | 5/17/2004 |
| J | 0.32 | ug/L | 8/26/2004 |
| J | 0.4 | ug/L | 10/25/2004 |
| J | 0.37 | ug/L | 2/16/2005 |
| J | 0.19 | ug/L | 5/17/2005 |
| JN | 0.43 | ug/L | 8/18/2005 |
| J | 0.43 | ug/L | 11/29/2005 |
| U | 0.2 | ug/L | 2/23/2006 |
| J | 0.48 | ug/L | 5/31/2006 |
| J | 0.42 | ug/L | 1/23/2007 |
| J | 0.5 | ug/L | 2/5/2007 |
| J | 0.35 | ug/L | 5/1/2007 |
| J | 0.39 | ug/L | 9/13/2007 |
| U | 1 | ug/L | 12/3/2007 |
| J | 0.36 | ug/L | 2/26/2008 |
| U | 1 | ug/L | 6/5/2008 |
| U | 1 | ug/L | 8/14/2008 |

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|---|---|---|---|
| U | 1 | ug/L | 10/13/2008 |
| U | 1 | ug/L | 1/19/2009 |
| U | 1 | ug/L | 4/8/2009 |
| U | 1 | ug/L | 7/20/2009 |
| | 1640 | pCi/L | 12/1/1998 |
| | 1120 | pCi/L | 2/10/1999 |
| | 648 | pCi/L | 5/18/1999 |
| J | 391 | pCi/L | 8/18/1999 |
| | 669 | pCi/L | 12/16/1999 |
| | 414 | pCi/L | 2/29/2000 |
| | 490 | pCi/L | 5/10/2000 |
| | 726 | pCi/L | 10/3/2000 |
| | 702 | pCi/L | 10/3/2000 |
| | 5010 | pCi/L | 2/13/1997 |
| | 3720 | pCi/L | 5/15/1997 |
| | 2860 | pCi/L | 8/14/1997 |
| | 7180 | pCi/L | 12/8/1997 |
| | 6640 | pCi/L | 12/8/1997 |
| | 5910 | pCi/L | 2/23/1998 |
| | 5340 | pCi/L | 5/21/1998 |
| | 1900 | pCi/L | 8/20/1998 |
| | 0.76 | NTU | 11/29/2005 |
| | 1.39 | NTU | 2/23/2006 |
| | 2.52 | NTU | 5/31/2006 |
| | 2.63 | NTU | 1/23/2007 |
| | 1.43 | NTU | 2/5/2007 |
| | 1.05 | NTU | 5/15/1997 |
| | 1.67 | NTU | 8/14/1997 |
| | 2.02 | NTU | 8/14/1997 |
| | 1.18 | NTU | 12/8/1997 |
| | 3.72 | NTU | 2/23/1998 |
| | 4.78 | NTU | 2/23/1998 |
| | 1.91 | NTU | 5/21/1998 |
| | 3.62 | NTU | 5/21/1998 |
| | 1.67 | NTU | 8/20/1998 |
| | 1.66 | NTU | 8/20/1998 |
| | 1.94 | NTU | 8/20/1998 |
| | 2.11 | NTU | 8/20/1998 |
| | 2.2 | NTU | 12/1/1998 |
| | 2.28 | NTU | 12/1/1998 |
| | 2.26 | NTU | 12/1/1998 |
| | 4.14 | NTU | 12/1/1998 |
| | 2.38 | NTU | 2/10/1999 |
| | 3.14 | NTU | 2/10/1999 |
| | 2.01 | NTU | 5/18/1999 |
| | 2.31 | NTU | 5/18/1999 |
| | 1.63 | NTU | 8/18/1999 |

| | | | |
|---|---|---|---|
| | 1.84 | NTU | 8/18/1999 |
| | 2.25 | NTU | 8/18/1999 |
| | 1.74 | NTU | 8/18/1999 |
| | 1.75 | NTU | 12/16/1999 |
| | 2.39 | NTU | 12/16/1999 |
| | 2.6 | NTU | 12/16/1999 |
| | 2.21 | NTU | 12/16/1999 |
| | 1.85 | NTU | 2/29/2000 |
| | 2.19 | NTU | 2/29/2000 |
| | 1.73 | NTU | 2/29/2000 |
| | 1.84 | NTU | 2/29/2000 |
| | 1.98 | NTU | 5/10/2000 |
| | 0.88 | NTU | 10/3/2000 |
| | 0.74 | NTU | 2/27/2001 |
| | 1.41 | NTU | 5/8/2001 |
| | 2.04 | NTU | 8/22/2001 |
| | 1.63 | NTU | 11/16/2001 |
| | 1.91 | NTU | 2/13/2002 |
| | 3.67 | NTU | 5/16/2002 |
| | 1.12 | NTU | 8/26/2002 |
| | 6.7 | NTU | 11/19/2002 |
| | 2.84 | NTU | 2/18/2003 |
| | 1.62 | NTU | 5/16/2003 |
| | 0.92 | NTU | 8/13/2003 |
| | 1.76 | NTU | 3/30/2004 |
| | 1.52 | NTU | 5/17/2004 |
| | 1.34 | NTU | 8/26/2004 |
| | 1.5 | NTU | 10/25/2004 |
| | 0.91 | NTU | 2/16/2005 |
| | 1.36 | NTU | 5/17/2005 |
| | 1.7 | NTU | 8/18/2005 |
| | 1.38 | NTU | 5/1/2007 |
| | 0.73 | NTU | 9/13/2007 |
| | 2.67 | NTU | 12/3/2007 |
| | 0.83 | NTU | 2/26/2008 |
| | 4.35 | NTU | 6/5/2008 |
| | 2.26 | NTU | 8/14/2008 |
| | 2.37 | NTU | 10/13/2008 |
| | 2.25 | NTU | 1/19/2009 |
| | 1.65 | NTU | 4/8/2009 |
| | 1.9 | NTU | 7/20/2009 |
| | 18 | ug/L | 12/3/2007 |
| C | 20 | ug/L | 2/26/2008 |
| U | 12 | ug/L | 6/5/2008 |
| U | 12 | ug/L | 8/14/2008 |
| U | 10 | ug/L | 10/13/2008 |
| B | 14.1 | ug/L | 1/19/2009 |

| | | | |
|---|---|---|---|
| U | 12 | ug/L | 4/8/2009 |
| U | 12 | ug/L | 7/20/2009 |
| U | 0.144 | ug/L | 5/21/1998 |
| U | 0.5 | ug/L | 8/20/1998 |
| U | 0.5 | ug/L | 12/1/1998 |
| U | 0.5 | ug/L | 2/10/1999 |
| U | 0.5 | ug/L | 8/18/1999 |
| U | 1 | ug/L | 2/13/1997 |
| U | 0.294 | ug/L | 5/15/1997 |
| J | 0.37 | ug/L | 8/14/1997 |
| U | 0.294 | ug/L | 12/8/1997 |
| U | 0.294 | ug/L | 12/8/1997 |
| U | 0.294 | ug/L | 2/23/1998 |
| U | 0.29 | ug/L | 5/18/1999 |
| U | 0.25 | ug/L | 12/16/1999 |
| U | 0.25 | ug/L | 2/29/2000 |
| U | 0.25 | ug/L | 5/10/2000 |
| U | 0.25 | ug/L | 10/3/2000 |
| U | 0.25 | ug/L | 10/3/2000 |
| U | 0.25 | ug/L | 2/27/2001 |
| U | 0.21 | ug/L | 2/13/2002 |
| U | 0.21 | ug/L | 5/16/2002 |
| U | 0.21 | ug/L | 11/19/2002 |
| U | 0.17 | ug/L | 5/8/2001 |
| U | 0.32 | ug/L | 8/22/2001 |
| U | 0.32 | ug/L | 8/22/2001 |
| U | 0.32 | ug/L | 11/16/2001 |
| U | 0.32 | ug/L | 2/13/2002 |
| U | 0.32 | ug/L | 5/16/2002 |
| U | 0.32 | ug/L | 8/26/2002 |
| U | 0.25 | ug/L | 11/19/2002 |
| U | 0.25 | ug/L | 2/18/2003 |
| U | 0.25 | ug/L | 5/16/2003 |
| U | 0.25 | ug/L | 8/13/2003 |
| U | 0.25 | ug/L | 11/18/2003 |
| U | 0.25 | ug/L | 11/18/2003 |
| U | 0.25 | ug/L | 3/30/2004 |
| U | 0.19 | ug/L | 5/17/2004 |
| U | 0.08 | ug/L | 8/26/2004 |
| U | 0.08 | ug/L | 10/25/2004 |
| U | 0.07 | ug/L | 2/16/2005 |
| U | 0.07 | ug/L | 5/17/2005 |
| U | 0.07 | ug/L | 8/18/2005 |
| U | 0.07 | ug/L | 11/29/2005 |
| U | 0.23 | ug/L | 2/23/2006 |
| U | 0.23 | ug/L | 5/31/2006 |
| U | 0.044 | ug/L | 1/23/2007 |

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|---|---|---|---|
| U | 0.044 | ug/L | 2/5/2007 |
| U | 0.044 | ug/L | 5/1/2007 |
| U | 0.044 | ug/L | 9/13/2007 |
| U | 1 | ug/L | 12/3/2007 |
| U | 0.044 | ug/L | 2/26/2008 |
| U | 1 | ug/L | 6/5/2008 |
| U | 1 | ug/L | 8/14/2008 |
| U | 1 | ug/L | 10/13/2008 |
| U | 1 | ug/L | 1/19/2009 |
| U | 1 | ug/L | 4/8/2009 |
| U | 1 | ug/L | 7/20/2009 |
| U | 0.57 | ug/L | 2/10/1999 |
| U | 0.6 | ug/L | 2/13/1997 |
| U | 0.065 | ug/L | 5/15/1997 |
| U | 0.065 | ug/L | 8/14/1997 |
| U | 0.065 | ug/L | 12/8/1997 |
| U | 0.065 | ug/L | 12/8/1997 |
| U | 0.1 | ug/L | 2/23/1998 |
| U | 0.33 | ug/L | 12/16/1999 |
| U | 0.33 | ug/L | 2/29/2000 |
| U | 0.61 | ug/L | 5/8/2001 |
| U | 0.66 | ug/L | 8/22/2001 |
| U | 0.66 | ug/L | 8/22/2001 |
| U | 0.66 | ug/L | 11/16/2001 |
| U | 0.66 | ug/L | 2/13/2002 |
| U | 0.66 | ug/L | 5/16/2002 |
| U | 0.66 | ug/L | 8/26/2002 |
| U | 0.28 | ug/L | 11/19/2002 |
| U | 0.28 | ug/L | 2/18/2003 |
| U | 0.28 | ug/L | 5/16/2003 |
| U | 0.28 | ug/L | 8/13/2003 |
| U | 0.28 | ug/L | 11/18/2003 |
| U | 0.28 | ug/L | 11/18/2003 |
| U | 0.28 | ug/L | 3/30/2004 |
| U | 0.28 | ug/L | 5/17/2004 |
| U | 0.28 | ug/L | 8/26/2004 |
| U | 0.34 | ug/L | 10/25/2004 |
| U | 0.13 | ug/L | 2/16/2005 |
| U | 0.13 | ug/L | 5/17/2005 |
| U | 0.13 | ug/L | 8/18/2005 |
| U | 0.13 | ug/L | 11/29/2005 |
| U | 0.58 | ug/L | 2/23/2006 |
| U | 0.58 | ug/L | 5/31/2006 |
| U | 0.13 | ug/L | 1/23/2007 |
| U | 0.13 | ug/L | 2/5/2007 |
| U | 0.13 | ug/L | 5/1/2007 |
| U | 0.3 | ug/L | 9/13/2007 |

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|---|---|---|---|
| U | 1 | ug/L | 12/3/2007 |
| U | 0.3 | ug/L | 2/26/2008 |
| U | 1 | ug/L | 6/5/2008 |
| U | 1 | ug/L | 8/14/2008 |
| U | 1 | ug/L | 10/13/2008 |
| U | 1 | ug/L | 1/19/2009 |
| U | 1 | ug/L | 4/8/2009 |
| U | 1 | ug/L | 7/20/2009 |
| U | 4 | ug/L | 12/3/2007 |
| | 8.3 | ug/L | 2/26/2008 |
| | 11.1 | ug/L | 6/5/2008 |
| U | 9 | ug/L | 8/14/2008 |
| U | 9 | ug/L | 10/13/2008 |
| B | 14.8 | ug/L | 1/19/2009 |
| B | 5.5 | ug/L | 4/8/2009 |
| U | 6 | ug/L | 7/20/2009 |
| U | 0.108 | ug/L | 5/21/1998 |
| U | 0.37 | ug/L | 8/20/1998 |
| U | 0.37 | ug/L | 12/1/1998 |
| U | 0.37 | ug/L | 2/10/1999 |
| U | 0.37 | ug/L | 8/18/1999 |
| U | 0.2 | ug/L | 2/13/1997 |
| U | 0.025 | ug/L | 5/15/1997 |
| | 0.23 | ug/L | 8/14/1997 |
| U | 0.025 | ug/L | 12/8/1997 |
| U | 0.025 | ug/L | 12/8/1997 |
| U | 0.025 | ug/L | 2/23/1998 |
| U | 0.02 | ug/L | 5/18/1999 |
| U | 0.33 | ug/L | 12/16/1999 |
| U | 0.33 | ug/L | 2/29/2000 |
| U | 0.33 | ug/L | 5/10/2000 |
| U | 0.33 | ug/L | 10/3/2000 |
| U | 0.33 | ug/L | 10/3/2000 |
| U | 0.33 | ug/L | 2/27/2001 |
| U | 0.14 | ug/L | 2/13/2002 |
| U | 0.14 | ug/L | 5/16/2002 |
| U | 0.14 | ug/L | 11/19/2002 |
| U | 0.18 | ug/L | 5/8/2001 |
| U | 0.24 | ug/L | 8/22/2001 |
| U | 0.24 | ug/L | 8/22/2001 |
| U | 0.24 | ug/L | 11/16/2001 |
| U | 0.24 | ug/L | 2/13/2002 |
| U | 0.24 | ug/L | 5/16/2002 |
| U | 0.24 | ug/L | 8/26/2002 |
| U | 0.06 | ug/L | 11/19/2002 |
| U | 0.06 | ug/L | 2/18/2003 |
| U | 0.06 | ug/L | 5/16/2003 |

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|---|---|---|---|
| U | 0.06 | ug/L | 8/13/2003 |
| U | 0.06 | ug/L | 11/18/2003 |
| U | 0.06 | ug/L | 11/18/2003 |
| U | 0.06 | ug/L | 3/30/2004 |
| U | 0.11 | ug/L | 5/17/2004 |
| U | 0.1 | ug/L | 8/26/2004 |
| U | 0.1 | ug/L | 10/25/2004 |
| U | 0.27 | ug/L | 2/16/2005 |
| U | 0.27 | ug/L | 5/17/2005 |
| UN | 0.27 | ug/L | 8/18/2005 |
| U | 0.27 | ug/L | 11/29/2005 |
| U | 0.19 | ug/L | 2/23/2006 |
| U | 0.19 | ug/L | 5/31/2006 |
| U | 0.048 | ug/L | 1/23/2007 |
| U | 0.048 | ug/L | 2/5/2007 |
| U | 0.048 | ug/L | 5/1/2007 |
| U | 0.048 | ug/L | 9/13/2007 |
| U | 1 | ug/L | 12/3/2007 |
| U | 0.048 | ug/L | 2/26/2008 |
| U | 1 | ug/L | 6/5/2008 |
| U | 1 | ug/L | 8/14/2008 |
| U | 1 | ug/L | 10/13/2008 |
| U | 1 | ug/L | 1/19/2009 |
| U | 1 | ug/L | 4/8/2009 |
| U | 1 | ug/L | 7/20/2009 |
| U | 0.132 | ug/L | 5/21/1998 |
| U | 0.32 | ug/L | 8/20/1998 |
| U | 0.32 | ug/L | 12/1/1998 |
| U | 0.05 | ug/L | 5/18/1999 |
| U | 0.13 | ug/L | 12/16/1999 |
| U | 0.13 | ug/L | 2/29/2000 |
| U | 0.13 | ug/L | 5/10/2000 |
| U | 0.13 | ug/L | 10/3/2000 |
| U | 0.13 | ug/L | 10/3/2000 |
| U | 0.13 | ug/L | 2/27/2001 |
| U | 0.06 | ug/L | 2/13/2002 |
| U | 0.06 | ug/L | 5/16/2002 |
| U | 0.06 | ug/L | 8/26/2002 |
| U | 0.06 | ug/L | 11/19/2002 |
| U | 0.06 | ug/L | 2/18/2003 |
| U | 0.34 | ug/L | 5/8/2001 |
| U | 0.2 | ug/L | 8/22/2001 |
| U | 0.2 | ug/L | 8/22/2001 |
| U | 0.2 | ug/L | 11/16/2001 |
| U | 0.1 | ug/L | 5/16/2003 |
| | 6.94 | unitless | 2/13/1997 |
| | 6.98 | unitless | 2/13/1997 |

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|---|---|---|---|
| | 6.95 | unitless | 2/13/1997 |
| | 6.95 | unitless | 2/13/1997 |
| | 7.07 | unitless | 5/15/1997 |
| | 7.07 | unitless | 5/15/1997 |
| | 7.07 | unitless | 5/15/1997 |
| | 7.06 | unitless | 5/15/1997 |
| | 7.15 | unitless | 8/14/1997 |
| | 7.15 | unitless | 8/14/1997 |
| | 7.16 | unitless | 8/14/1997 |
| | 7.16 | unitless | 8/14/1997 |
| | 6.92 | unitless | 12/8/1997 |
| | 6.9 | unitless | 12/8/1997 |
| | 6.99 | unitless | 12/8/1997 |
| | 6.93 | unitless | 12/8/1997 |
| | 6.79 | unitless | 2/23/1998 |
| | 6.74 | unitless | 2/23/1998 |
| | 6.72 | unitless | 2/23/1998 |
| | 6.78 | unitless | 2/23/1998 |
| | 6.8 | unitless | 5/21/1998 |
| | 6.8 | unitless | 5/21/1998 |
| | 6.8 | unitless | 5/21/1998 |
| | 6.81 | unitless | 5/21/1998 |
| | 6.95 | unitless | 8/20/1998 |
| | 6.95 | unitless | 8/20/1998 |
| | 6.96 | unitless | 8/20/1998 |
| | 6.96 | unitless | 8/20/1998 |
| | 6.94 | unitless | 12/1/1998 |
| | 6.95 | unitless | 12/1/1998 |
| | 6.94 | unitless | 12/1/1998 |
| | 6.95 | unitless | 12/1/1998 |
| | 7.07 | unitless | 2/10/1999 |
| | 7.02 | unitless | 2/10/1999 |
| | 7.03 | unitless | 2/10/1999 |
| | 7.06 | unitless | 2/10/1999 |
| | 6.96 | unitless | 5/18/1999 |
| | 6.96 | unitless | 5/18/1999 |
| | 6.95 | unitless | 5/18/1999 |
| | 6.95 | unitless | 5/18/1999 |
| | 6.9 | unitless | 8/18/1999 |
| | 6.9 | unitless | 8/18/1999 |
| | 6.9 | unitless | 8/18/1999 |
| | 6.91 | unitless | 8/18/1999 |
| | 7.17 | unitless | 12/16/1999 |
| | 7.17 | unitless | 12/16/1999 |
| | 7.17 | unitless | 12/16/1999 |
| | 7.16 | unitless | 12/16/1999 |
| | 7.12 | unitless | 2/29/2000 |

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|---|---|---|---|
| | 7.13 | unitless | 2/29/2000 |
| | 7.14 | unitless | 2/29/2000 |
| | 7.13 | unitless | 2/29/2000 |
| | 6.83 | unitless | 5/10/2000 |
| | 6.87 | unitless | 10/3/2000 |
| | 6.88 | unitless | 2/27/2001 |
| | 6.82 | unitless | 5/8/2001 |
| | 6.83 | unitless | 8/22/2001 |
| | 6.94 | unitless | 11/16/2001 |
| | 6.89 | unitless | 2/13/2002 |
| | 6.82 | unitless | 5/16/2002 |
| | 6.84 | unitless | 8/26/2002 |
| | 6.9 | unitless | 11/19/2002 |
| | 6.94 | unitless | 2/18/2003 |
| | 6.89 | unitless | 5/16/2003 |
| | 6.9 | unitless | 8/13/2003 |
| | 6.77 | unitless | 3/30/2004 |
| | 6.89 | unitless | 5/17/2004 |
| | 6.88 | unitless | 8/26/2004 |
| | 7.73 | unitless | 10/25/2004 |
| | 6.87 | unitless | 2/16/2005 |
| | 6.82 | unitless | 5/17/2005 |
| | 6.88 | unitless | 8/18/2005 |
| | 6.77 | unitless | 11/29/2005 |
| | 6.73 | unitless | 2/23/2006 |
| | 6.76 | unitless | 5/31/2006 |
| | 6.94 | unitless | 1/23/2007 |
| | 6.74 | unitless | 2/5/2007 |
| | 6.86 | unitless | 5/1/2007 |
| | 6.83 | unitless | 9/13/2007 |
| | 6.73 | unitless | 12/3/2007 |
| | 6.75 | unitless | 2/26/2008 |
| | 6.62 | unitless | 6/5/2008 |
| | 6.65 | unitless | 8/14/2008 |
| | 6.57 | unitless | 10/13/2008 |
| | 6.72 | unitless | 1/19/2009 |
| | 6.79 | unitless | 4/8/2009 |
| | 6.76 | unitless | 7/20/2009 |
| U | 0.196 | ug/L | 5/21/1998 |
| U | 0.33 | ug/L | 8/20/1998 |
| U | 0.33 | ug/L | 12/1/1998 |
| U | 0.33 | ug/L | 2/10/1999 |
| U | 0.33 | ug/L | 8/18/1999 |
| U | 0.2 | ug/L | 2/13/1997 |
| U | 0.031 | ug/L | 5/15/1997 |
| J | 0.15 | ug/L | 8/14/1997 |
| U | 0.031 | ug/L | 12/8/1997 |

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|---|---|---|---|
| U | 0.031 | ug/L | 12/8/1997 |
| U | 0.031 | ug/L | 2/23/1998 |
| U | 0.03 | ug/L | 5/18/1999 |
| U | 0.43 | ug/L | 12/16/1999 |
| U | 0.43 | ug/L | 2/29/2000 |
| U | 0.43 | ug/L | 5/10/2000 |
| U | 0.43 | ug/L | 10/3/2000 |
| U | 0.43 | ug/L | 10/3/2000 |
| U | 0.43 | ug/L | 2/27/2001 |
| U | 0.14 | ug/L | 2/13/2002 |
| U | 0.14 | ug/L | 11/19/2002 |
| U | 0.26 | ug/L | 5/8/2001 |
| U | 0.23 | ug/L | 8/22/2001 |
| U | 0.23 | ug/L | 8/22/2001 |
| U | 0.23 | ug/L | 11/16/2001 |
| U | 0.23 | ug/L | 2/13/2002 |
| U | 0.23 | ug/L | 5/16/2002 |
| U | 0.23 | ug/L | 8/26/2002 |
| U | 0.17 | ug/L | 11/19/2002 |
| U | 0.17 | ug/L | 2/18/2003 |
| U | 0.17 | ug/L | 5/16/2003 |
| U | 0.17 | ug/L | 8/13/2003 |
| U | 0.17 | ug/L | 11/18/2003 |
| U | 0.17 | ug/L | 11/18/2003 |
| U | 0.17 | ug/L | 3/30/2004 |
| U | 0.15 | ug/L | 5/17/2004 |
| U | 0.09 | ug/L | 8/26/2004 |
| U | 0.09 | ug/L | 10/25/2004 |
| U | 0.08 | ug/L | 2/16/2005 |
| U | 0.08 | ug/L | 5/17/2005 |
| UN | 0.08 | ug/L | 8/18/2005 |
| U | 0.08 | ug/L | 11/29/2005 |
| U | 0.16 | ug/L | 2/23/2006 |
| U | 0.16 | ug/L | 5/31/2006 |
| U | 0.016 | ug/L | 1/23/2007 |
| U | 0.016 | ug/L | 2/5/2007 |
| U | 0.016 | ug/L | 5/1/2007 |
| U | 0.1 | ug/L | 9/13/2007 |
| U | 1 | ug/L | 12/3/2007 |
| U | 0.1 | ug/L | 2/26/2008 |
| U | 1 | ug/L | 6/5/2008 |
| U | 1 | ug/L | 8/14/2008 |
| U | 1 | ug/L | 10/13/2008 |
| U | 1 | ug/L | 1/19/2009 |
| U | 1 | ug/L | 4/8/2009 |
| U | 1 | ug/L | 7/20/2009 |

| RESULT_COMMENT |
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| /Duplicate analysis out of QC limits |
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| /Duplicate analysis out of QC limits |
| /Duplicate analysis out of QC limits |

/Associated with suspect field blank analysis

/Associated with suspect field blank (FTB975/699-22-35)

/Associated with suspect field blank (FXR 1501)

/Associated with suspect field blank (FTB447/699-24-34C)

/Associated with suspect field blank (FXR765)

"Y" Review flag added per RDR 080903WSCF-R5099/Associated with suspect field blank (FXR 1461)

/Field blank collected same date is suspect

"GH" Review flag added per RDR 000427ST-R781

"Y" Review flag added per RDR 030417STLSL-R2083

"YP" Review flag added per RDR 030417STLSL-R2084

"F" Review flag added per RDR 090826WSCF-R5891

"G" Flag added per RDR 990409QL-R502

"Y" Review flag added per RDR 990823QL-R607

"G" Review flag added per RDR 000413QL-R753

"Y" Review flag added per RDR 001207ST-R969

/Associated with suspect field blank (FTB884/699-23-34B)

/Associated with suspect field blank (FTB976/699-26-35A)

"Y" Review flag added per RDR 060403STLSL-R3376

/Associated with suspect field blank (FTB 699-24-33)

/Associated with suspect field blank analysis

/Associated with suspect field blank (FTB278/699-26-34B)

/Associated with suspect field blank (FTB362/699-23-34B)

/Associated with suspect field blank (FTB392/699-24-33)

/Associated with suspect field blank (FTB739/699-23-34B)

/Associated with suspect field blank (FTB975/699-22-35)

"Y" Review flag added per RDR 060118STLSL-R3288
/Associated with suspect field blank (FTB 699-24-34A)
/Associated with suspect field blank (FTB 699-24-34B)

/Associated with suspect field blank (FTB 699-26-35A)/"Y" Review flag added per RDR 070710STLSL-R3953

/Field blank collected same date is suspect

Added Q per 2qtr97bf.db

/Associated with suspect field blank analysis
/Associated with suspect field blank analysis

/Associated with suspect field blank (FXR843)

"Y" Review flag added per RDR 060118STLSL-R3288

"G" Review flag added per RDR 991111QL-R648 <= before mod -- /CID:B0W1L9 (D1GW5), LOT:J9K1201351 v2.4

/CID:B0WW97, LOT:J9L1602881 v2.4

/CID:B0WW97, LOT:J9L1602881 v2.4

/Duplicate analysis out of QC limits

/Duplicate analysis out of QC limits

/Associated with out of control field blank (B0T5N5)
/Associated with suspect field blank (FXR311)

/Associated with suspect field blank analysis
/Associated with suspect field blank analysis

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| /Associated with suspect field blank (FTB392/699-24-33) |
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| /Associated with suspect field blank (FTB447/699-24-34C) |
| /Associated with suspect field blank (FTB467/699-23-34A) |
| /Associated with suspect field blank (FXR682) |
| /Associated with suspect field blank (FXR708)/Associated with suspect field blank (FXR708) |
| /Associated with suspect field blank (FXR726) |
| /Associated with suspect field blank (FXR765) |
| /Associated with suspect field blank (FXR783) |
| /Associated with suspect field blank (FXR818) |
| /Associated with suspect field blank (FXR842) |
| /Associated with suspect field blank (FXR842) |
| /Associated with suspect field blank (FXR843) |
| |
| |
| /Associated with suspect field blank (FTB929/699-24-35) |
| /Associated with suspect field blank (FXR966) |
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| /Associated with suspect field blank (FXR 1057) |
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| /Associated with suspect field blank (FXR 1124) |
| /Associated with suspect field blank (FXR 1176) |
| /Associated with suspect field blank (FXR 1254) |
| /Associated with suspect field blank (FXR 1192) |
| /Associated with suspect field blank (FXR 1331) |
| /Associated with suspect field blank (FXR 1347) |
| /Associated with suspect field blank (FXR 1371) |
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| /Associated with suspect field blank (FXR 1599) |
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/Field blank collected same date is suspect

/Associated with suspect field blank (FTB884/699-23-34B)

"Y" Review flag added per RDR 060118STLSL-R3288

"R" Review flag added per RDR 070710STLSL-R3953

/Associated with suspect field blank (FTB215/299-E17-12)

Y Review qualifier added per RDR 981105QL-R376
Y Review qualifier added per RDR 981105QL-R376
Y Review qualifier added per RDR 981105QL-R376
Y Review qualifier added per RDR 981105QL-R376

Y Review qualifier added per RDR 981105QL-R376
Y Review qualifier added per RDR 981105QL-R376
Y Review qualifier added per RDR 981105QL-R376
Y Review qualifier added per RDR 981105QL-R376

"R" Review flag added per RDR 990518QL-R522. Value is associated with possible bad standard.
"R" Review flag added per RDR 990518QL-R522. Value is associated with possible bad standard.
"R" Review flag added per RDR 990518QL-R522. Value is associated with possible bad standard.
"R" Review flag added per RDR 990518QL-R522. Value is associated with possible bad standard.

/Field blank analyzed same date is suspect

/Associated with suspect field blank (FTB447/699-24-34C)

/Associated with suspect field blank (FTB837/699-24-34A)

/Associated with suspect field blank (FTB837/699-24-34A)

/Associated with suspect field blank (FTB884/699-23-34B)

"Y" Review flag added per RDR 060118STLSL-R3288

"Y" Review Flag added per 080429QTESSL-R4830

/Duplicate analysis out of QC limits

/Duplicate analysis out of QC limits

/Associated with suspect field blank analysis

/Field blank collected same date is suspect

/Associated with suspect field blank analysis

/Associated with suspect field blank analysis

/Associated with suspect field blank analysis

/Associated with suspect field blank analysis

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Geophysical Investigation of NRDWL

(WHC-SD-EN-TI-116)

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# 1.0 INTRODUCTION

## 1.1 BACKGROUND

The Nonradioactive Dangerous Waste Landfill (NRDWL) is located on the Hanford Site approximately 3.5 miles southeast of 200 East Area (Figure 1). The NRDWL is a treatment storage and/or disposal unit and is designated for closure under the *Resource Conservation and Recovery Act of 1976*. The NRDWL has been assigned to the 200-IU-3 operable unit. It was used for dangerous waste disposal from January 1975 through May 1985. The waste was generated from process operations, research and development laboratories, maintenance activities, and transportation functions throughout the Hanford Site.

The NRDWL covers approximately 10 acres and is located at the northern end of the Solid Waste Landfill (Figure 2). It includes 19 unlined trench locations, each approximately 400 ft long and 46 ft wide. Six of the trenches contain chemical waste, nine trenches contain asbestos waste, one trench contains sanitary solid waste, and three trench locations were never used. See *Nonradioactive Dangerous Waste Landfill Closure/Postclosure Plan* (DOE-RL 1990) for detailed descriptions of the wastes contained within each trench.

Site closure includes placing a cover over the facility to prevent postclosure escape of buried waste. A subsurface site characterization is required to provide information to support final cover design and associated activities. A noninvasive subsurface characterization is also important to the groundwater monitoring program.

This report summarizes the results of the geophysical investigations conducted for site characterization. Ground-penetrating radar (GPR) and electromagnetic induction (EMI) were the two techniques used in the investigation. GPR was specifically identified in DOE-RL (1990). EMI was used to supplement the GPR, particularly in areas where the GPR effectiveness was limited by the terrain.

## 1.2 OBJECTIVES

The primary objectives of the geophysical investigation were to:

- Define trench boundaries
- Evaluate soil properties
- Assess the presence and extent of voids in the landfill area.

Results of the geophysical surveys were used to assist selection of soil-gas sampling locations and specifically to minimize the risk of penetration of buried hazards during installation of soil-gas probes. The results will be used to: (1) locate monitoring wells, (2) approximate locations of waste containers, and (3) locate and characterize a trench designated J.A. Jones (JAJ) trench, a nonhazardous waste trench immediately to the south of the hazardous trenches (Figure 2).

# 2.0 GEOLOGIC SETTING

The NRDWL is located within the Cold Creek syncline, an asymmetrical, relatively flat-bottomed structure between the Umtanum Ridge-Gable Mountain uplift and the Yakima Ridge uplift (Figure 3). The site is located on the northern flank of the syncline where bedrock (basalt) is gently dipping, approximately 5°, to the south.

Approximately 600 ft of suprabasalt sediments overlay the layers of basalt that make up the bedrock that defines the Cold Creek syncline. The sediments include the Ringold Formation, early Plio-Pleistocene soils, the Hanford formation, and Holocene surficial deposits (Figure 4). The focus of the geophysical investigations were on the Holocene and upper Hanford formation (Figure 4). Figure 5 is an east-west geologic cross section depicting the sediments at the NRDWL.

The Holocene sediments are primarily eolian sands and silts interspersed with lenses of sands mixed with gravel. The Hanford formation, which are cataclysmic Missoula flood deposits, contains primarily gravely sand to sandy gravel in the study area.

Clastic dikes have been observed in the vicinity of the NRDWL. Clastic dikes are commonly associated with, but not restricted to, the cataclysmic flood deposits.

# 3.0 METHODOLOGY

The closure/postclosure plan designated GPR as the geophysical method to be used for characterization. But due to the unfavorable GPR conditions in parts of NRDWL, caused by the mounds of sand around open trenches, EMI data were collected to supplement the GPR. The terrain also adversely affects the EMI, but not to the extent it has on GPR.

## 3.1 GROUND-PENETRATING RADAR

The GPR system used for this work utilized a 300-megahertz antenna to transmit the electromagnetic (EM) energy into the ground. The transmitted energy is reflected back to a receiving antenna where variations in the return signal are recorded. Common reflectors include natural geologic conditions such as bedding, cementation, moisture, and clay, or man-made objects such as pipes, barrels, foundations, and buried wires.

Depth of penetration at NRDWL was generally 5 to 15 ft. The method is limited in depth by transmit power, receiver sensitivity, and attenuation of the transmitted energy. Depth of investigation is also influenced by highly conductive material, such as metal drums, which reflect all the energy; therefore, the method cannot "see" below such objects.

Display and interpretation of the data are similar to seismic reflection data. In some areas interpretations can be straight forward, but often unknown parameters with a highly variable subsurface yields complex data.

Data for these surveys were collected with a Geophysical Survey Systems Inc. (GSSI) Subsurface Interface Radar (SIR) System 8, model 4800 and digitally stored on a GSSI DT6000A tape drive. A recording window of 100 nanoseconds, two-way travel time, was used, yielding a maximum depth of investigation of about 16 ft.

## 3.2 ELECTROMAGNETIC INDUCTION

EMI techniques are used to determine the electrical conductivity of the subsurface soil, rock, and groundwater. They are generally used for shallow investigations. The method is based on a transmitting coil radiating an electromagnetic field that induces eddy currents in the earth. A resulting secondary electromagnetic field is measured at a receiving coil as a voltage that is linearly related to the subsurface conductivity.

Terrain or ground conductivity is a function of the natural soil matrix and pore fluid electrical conductivity. The depth of investigation depends on the: (1) electrical conductivity of the subsurface, (2) distance between the transmitting and receiving coils, and (3) sensitivity of equipment and power of the source. The conductivity value resulting from a measurement is a composite and represents the combined effects of the thickness of the stratigraphic layers, depths, specific conductivities, and any man-made conductive objects that may be present such as metal objects. Metallic objects generally overwhelm the natural conductivity.

An EM-31D (a trademark of Geonics Company) was used for the survey and has a maximum depth of penetration of approximately 20 ft. Two measurements were collected, the quadrature and in-phase components. The in-phase component is more sensitive to highly conductive material such as metals.

## 3.3 GRID/TRENCH PARAMETERS

The survey boundary is rectangular, measuring 550 ft by 920 ft. The long axis of the survey strikes N68° W. Within the survey boundary are 19 parallel, hazardous waste trenches, and a J.A. Jones (JAJ) nonhazardous waste trench that is perpendicular to and south of the other trenches (Figure 6). The boundary line separating the NRDWL from the Solid Waste Landfill is halfway between the JAJ trench and the southern boundary of the NRDWL trenches (DOE-RL 1990).

All trenches were designed to be approximately 400 ft long, 16 ft wide at the base, 15 ft deep, with 46 ft from center to center. Trenches were designed to be separated by a triangular column of undisturbed soil with approximately 1:1 side slopes. The final design profile of the trenches varied depending on the type of waste the trench received. Typical trench design is shown in Figure 7.

The initial grid lines were designed to be parallel and orthogonal to the strike of the trench centerlines as predicted from engineering drawings. Additionally, the north-south grid lines were spaced at 11.5-ft intervals so the grid lines would theoretically fall on trench centerlines every 46 ft. The data collection was centered around a 20 by 11.5-ft surveyed grid of the NRDWL site. All distances were measured and posted in feet. The southeast corner of the grid is designated E100/N00. The letters "N" or "E" refers to a direction that trends generally north or east, respectively. The number refers to a distance in feet. For example, E200/N300 is 100 ft east and 300 ft north of E100/N00.

The survey was divided into seven sections (Figures 6). Section boundaries were based on topography and changes in the predicted scope of the survey as the data collection and interpretation progressed.

## 4.0 RESULTS

The following discussion presents the results of the geophysical investigation. The discussion focuses on interpreted trench boundaries and locating the major concentrations of waste within the trenches. The integrated interpretation (Plate 2) divides the NRDWL into three interpretive categories: (1) undisturbed areas outside the excavated trench boundaries, (2) areas of concentrated anomalies, and (3) scattered, isolated anomalies within the interpreted trench boundaries. In most cases, the anomalies detected are interpreted as buried debris from within the trenches. However, not all anomalies are located within the interpreted trench boundaries.

A pervasive reflecting horizon, interpreted as a calcified zone, proved very significant when interpreting trenches and trench boundaries (Figure 8). The zone is generally found 3 to 5 ft below the surface. A second, similar reflector, is found 3 to 5 ft below the upper calcified layer, but is not reliable as a marker horizon. The caliche horizons are assumed to be relatively flat. Variations in depth to these horizons are interpreted to be a function of the thickness of the overlying eolian deposits (i.e., surface elevation). The upper caliche zone is exposed on the eastern slope of both trench 26 and trench 19N, the two open trenches. In general, if the upper caliche zone was present in the data, it was interpreted as an area outside of the excavated trenches and noted as "undisturbed." It is assumed that during the excavation of the NRDWL trenches, the caliche zone was broken up and removed since the trenches are approximately 15 ft deep and the caliche zone is 3 to 5 ft below the surface. Figure 8 is a GPR profile that shows this relationship.

Generally, the amount of fill overlying the buried waste varied in thickness from 1 to 8 ft. Some trenches had high concentrations of anomalies and in others, the anomalies were relatively spread out. Figure 9 is an example of a section of a GPR profile down the middle of a trench. Note the variation of depths to the debris and the scattered distribution of the anomalies.

EMI data (Plate I) proved very useful, especially when mapping concentrations of anomalies and in areas where the topography limited GPR data acquisition. Plate 2 shows the integrated interpretation and should be referred to during the following discussions. All of the data is included in Mitchell and Bergstrom (1993).

## 4.1 SECTION A

Section A is the western-most portion of NRDWL, from E100 to E399 (Figure 6). It contains one Sanitary trench (1N), and five asbestos trenches (2N, 20,21,22, and 23). The terrain is relatively flat in the southern half, but in the northern half the terrain drops roughly 8 ft in elevation between N310 to N530.

Subsidence (due to caving in) was observed in three locations; E190/N140, E340/N450, and E340/N300. The subsidence appears to be a result of settling of the overlying fill into voids within buried waste.

Between N100 and N550 the GPR data were collected on a 11.5 by 20-ft grid with east-west profiles every 20 ft and north-south profiles every 11.5 ft. EMI data were collected along north-south profiles 11.5 ft apart with data recorded at 5-ft intervals (Figure 10). Data from Section E west and Section E west extension were also significant to the interpretation of these trenches. Refer to Plate 2, which shows the integrated interpretation for the following trenches.

### 4.1.1 Sanitary Trench 1N

Trench 1N contains sanitary waste, which is not considered a dangerous waste but is included as part of NRDWL because of its proximity to the chemical waste trenches and its impact on the design of a postclosure cover (DOE-RL 1990). Generally, this type of waste would be a part of the Solid Waste Landfill. Trench 1N was opened in January 1976 and closed in September 1976.

The trench appears to extend the entire length of the surveyed area, N00 to N550 (Plate 2). The northern extent of the trench was not unequivocally determined. A scattering of GPR anomalies were detected along GPR profile N550. If these anomalies are in the trench, then the northern boundary of the trench was not determined. However, these anomalies are shallow (less than 2 ft below the surface) and could be scattered debris (i.e., cables, pipes, etc.) such as that observed on the surface throughout the site; very little buried debris north of N470 is observed. Because of the lack of debris detected in the northern part of the trench, the preferred interpretation is that the trench actually ends between N530 and N550.

The trench continues beyond the southern survey boundary N00. The western edge of the trench is approximately E123 and the eastern edge, when detectable, is around E169. The center of the trench is approximately E146.

Along its eastern boarder, trench 1N appears to merge with the asbestos trench 2N between N110 to N130 and N330 to N365. A concentration of anomalies was detected in these zones with no indication of a trench boundary between

them. The northern zone appears to be buried debris. It was not possible to determine in which trench the debris was originally buried. The southern zone, N110 to N130, is more ambiguous. The anomalies found in this zone could represent geologic features rather than debris.

The depth to the top of the anomalies varied from 2 ft to over 10 ft below the surface. Most of the anomalies within the trench are covered with a minimum of 4 to 5 ft of fill.

Generally, the heaviest concentration of buried anomalies are south of N270. The average depth to the uppermost anomalies is around 4 ft. Other relatively high concentrations of anomalies are between N310 and N370 and between N410 and N470. The later zone having a considerable number of anomalies in the 1 to 3-ft range.

### 4.1.2 Asbestos Trench 2N

Trench 2N is the western-most asbestos trench. It was opened in May 1985 and closed in October 1986. The center of trench 2N is essentially E192 (see Plate 2). The southern termination is near N50 with the northern termination near N530. The western edge is generally E169 with the exception of N110 to N130 and from N330 to N370 as discussed previously in Section 4.1.1. The eastern trench boundary undulates around E210 with no apparent breaches with trench 20 to the east.

The detectable anomalies appear to be relatively scattered throughout the trench with major concentrations centered around N100 and between N390 to N419. Thickness of the fill overlying the anomalies varies from 1 to 10 ft with most anomalies in the 2 to 4-ft depth range.

### 4.1.3 Asbestos Trench 20

Asbestos trench 20 was opened in July 1979 and closed in July 1981. The center of the trench is roughly E238 (see Plate 2). The trench extends from N150 to approximately N540. The western edge is basically E215 and is relatively intact. The eastern edge is roughly E260 and appears to be intact as well.

The trench has relatively high concentrations of anomalies throughout the entire length. The thickness of the overlying fill varies from 2 to 10 ft, but most areas averaged around 6 ft of fill.

### 4.1.4 Asbestos Trench 21

Asbestos trench 21 was opened in January 1984 and closed in May 1985. Trench 21 is centered at approximately E284 and extends from roughly N90 to N540 (see Plate 2). Its western edge is quite variable, ranging from approximately E255 to E275. However, the trench does not have any obvious breaches between its western neighbor, trench 20. North of N310 the eastern edge is roughly at E307. South of N310 the eastern edge is not clearly defined. From N265 to N310, trench 21 and trench 22 appear to coalesce.

The same is true between N195 and N230. South of N195 the eastern edge of the trench varies from roughly E290 to E305.

The largest concentration of anomalies is between N130 and N340. North of N340, the anomalies are either more scattered and not as concentrated and/or they are covered with a thicker cover of fill. The anomalies that were identified are generally 8 to 10 ft below the surface in the north end of the trench and 3 to 10 ft in the south end.

### 4.1.5 Asbestos Trench 22

Asbestos trench 22 was opened in October 1986 and closed in May 1988. Trench 22 is centered around E330 (see Plate 2). The northern end terminates near N530 but the southern end merges with the east-west trending JAJ trench. The western boundary is fairly distinct north of N310 and south of N190. However, between N190 and N310, a boundary separating trench 21 and trench 22 is not apparent, as discussed previously.

The largest concentration of anomalies lies between N390 and N490. Other relatively major concentrations of anomalies are in the proximity of E330/N330, E318/N270, E307/N210, E330/N170, and E318/N150. Most of the anomalies have 4 to 6 ft of fill over them. One exception is at E318/N150, where as little as 1 to 2 ft of fill is present.

### 4.1.6 Asbestos Trench 23

Documentation indicates that an asbestos trench should be centered around E376 (see Plate 2). According to DOE-RL (1990), the trench was opened in July 1981 and closed in September 1982. However, the data shows no indication of a trench in this area and there are no anomalies indicative of buried debris.

## 4.2 SECTION B

Section B extends from E399 to E629 and is centered around an open trench that extends from N110 to N490. The trench is approximately 15 ft deep and 15 ft wide at its base. It appears to be much deeper because it is paralleled by two north-south trending berms. The berms are up to 8 ft higher than the normal ground elevation and are a consequence of the spoils created during the excavation of the open trench. The berms cover several trenches, complicating their characterization.

The induced topography caused by the open trench and surrounding berms severely limited the GPR data acquisition. Those data that were collected were of mixed quality. GPR data collection was limited to north-south profiles every 23 ft. East-west profiles south of N150 and north of the open trench (Figure 11) were also collected.

North-south EMI profiles were spaced every 11.5 ft with readings at 5-ft intervals. However, the additional thickness of soil from the berm prevented the tool from reaching the desired depth of investigation. Given the above limitations, EMI was the more effective of the two methods north of N150,

primarily because EMI data acquisition was possible in places where GPR was not. Because of the limitations described previously, Section B was not characterized nearly to the degree as Sections A and C. These limitations should be considered in the following discussion of the trenches within Section B. Refer to Plates 1 and 2, as they are an integral part of the following trench discussions.

### 4.2.1 Unused Trench 24

DOE-RL (1990) states that trench 24 apparently was never opened or used. The trench, if it were to be opened, would be centered along profile E422 (see Plate 2). Good GPR data were collected east of E422. West of E422, the data were limited by the terrain. The data that were collected were of poor quality because of the topography. EMI was the more effective of the two methods used east of E422.

The data, though limited, gave no indication that a trench was ever opened or used at this location.

### 4.2.2 Asbestos Trench 25

Asbestos trench 25 was opened in September 1982 and closed in March 1984. Trench 25 is located beneath the western berm that parallels open trench 26. Because of the topography, specifically the steep western slope of the open trench and the additional 3 to 8 ft of berm that must be penetrated, delineation of many trench characteristics is incomplete.

The southern end of trench 25 merges with the JAJ trench around N80 (see Plate 2). Though the two trenches merge, no buried anomalies appear in the southern end of the trench that could be confused with anomalies from the JAJ trench. The western boundary of the trench appears to vary between E425 and E435. However, the boundary was only traceable as far as N150. The eastern boundary was also traced as far north as N150. It is located in the vicinity of E468. The northern termination of the trench was not determined.

Anomalies were detected between N100 and N270 at a depth averaging around 9 ft. However, anomalies at N155 and N230 are relatively shallow, 4 ft below the surface, suggesting they are within the berm and quite possibly above the excavated portion of the trench (i.e., normal ground level).

Additional higher quality data, after berm removal, are required to more completely assess trench 25.

### 4.2.3 Corrosive Trench 26 (Open)

Corrosive trench 26 is the open trench, opened in January 1985, which dominates Section B. It was assumed that the southern and eastern boundary are still relatively intact as observed at the surface. The original western edge of the trench, which is downwind of the prevailing winds, has been hidden under an unknown thickness of windblown sand deposits. The northern end extends beyond the open portion of the trench to approximately N530 (see Plate 2).

A high concentration of GPR and EMI anomalies, approximately 35 ft wide (E505 to E540), extend from N480 to N510. Most of the anomalies originate from a depth 3 to 5 ft below the surface. These anomalies are interpreted to represent buried waste within the northern end of the trench. Three anomalous sections from the GPR data, N170 to N210, N265 to N290, and N360 to N380, were detected along profile E514. These were not noticeable in the EMI data. The GPR data were collected on the relatively steep western slope of the trench such that the radar signal was propagating into the "side" of the hill as much as vertically. Therefore, the depth estimates of 5 to 7 ft below the surface are questionable. It is not known whether these anomalies are within the confines of the original trench boundaries.

Clastic dikes, which have been observed in the vicinity of the NRDWL, can give a signature similar to these enigmatic anomalies. There is also a relatively continuous reflective horizon over each of the anomalous zones. Anomalies with these characteristics are usually geologic in origin, which is the preferred interpretation. However, the possibility that the anomalies are a consequence of buried debris cannot be discounted without further investigation.

### 4.2.4 Asbestos Trench 27

Asbestos trench 27, located beneath the eastern berm that parallels open trench 26, was opened in January 1975 and closed in July 1976. Because of the topography, specifically the steep eastern slope of the open trench and the additional 3 to 8 ft of berm that the signal must penetrate, GPR data collection and use were limited. Consequently, detailed trench characterization was not possible.

The southern end of the trench is at approximately N120 and the northern end is in the vicinity of N530 (see Plate 2). The eastern and western boundaries of the trench were not determined because of data limitations.

A relatively high concentration of GPR anomalies was detected along profile E560 between N160 and N410. Most were in the depth range of 8 to 11 ft. The east-west extent of these anomalies were not determined due to the lack of data. It is speculated that these anomalies represent buried debris within the trench. Also detected along profile E560 was an anomaly at N520, possibly buried debris. A moderate concentration of anomalies was found along profile E583 between N135 and N120.

### 4.2.5 Corrosive Trench 28

This trench was opened February 1984 and closed in January 1985. It is centered at about E615 along the south end and at about E620 at the north end of the trench. The north boundary is at about N540 and the south trench boundary is at about N80 (see Plate 2).

The primary data used to delineate the trench boundaries and location of concentrated anomalies were EMI data. The trench lies beneath a berm of soil from open trench 26. This additional cover and associated relief make GPR difficult or impossible to reliably collect and interpret along some profiles. Additionally, the "extra" soil cover reduces the effectiveness of shallow-

penetration, high-resolution tools such as GPR and EMI. These factors need to be considered in the following discussion on corrosive trench 28.

Neither the east or west edges of the trench are distinctly defined. Asbestos trench 27 and corrosive trench 28 may merge at N220. Trench 28 and asbestos trench 29 appear to merge at several locations; N130, around N290 to N330, and around N470 (see Plate 2).

Anomalies are concentrated in several zones along the entire length (see Plates 1 and 2). Depths to anomalies vary from 5 to 10 ft below the surface (i.e., from the berm level) where present.

## 4.3 SECTION C

Section C extends from E629 to E905 and covers six trench zones; asbestos trenches 29 and 30, chemical trenches 31, 33, and 34, and unused trench 32. This section is relatively flat with a gentle lowering in elevation of 4 to 5 ft along the northern portion of the section. Section C is bounded on the east and west by berms from open trenches 19N and 26, respectively.

GPR and EMI data were collected over the entire section. Between N100 and N550 the GPR data were collected on an 11.5 by 20-ft grid with east-west profiles every 20 ft and north-south profiles every 11.5 ft. A 10 by 11.5-ft grid between N00 and N100 with east-west profiles every 10 ft and north-south profiles every 11.5 ft. EMI data were collected along north-south profiles, 11.5 ft apart, with data collected at 5-ft intervals (Figure 12).

The integrated interpretation of Section C is shown on Plate 2. Refer to Plates 1 and 2 as they are an integral part of the following trench discussions.

### 4.3.1 Asbestos Trench 29

This trench was opened in September 1976 and closed in June 1979. The entire trench is centered at about E652 (see Plate 2). The edges of the trench are not obvious from the data. The trench appears to merge with asbestos trench 30 to the east and corrosive trench 28 to the west.

This trench contains three major areas of concentrated anomalies. The first is between N100 and N195. The top of the anomalies range from 2 to 5 ft below the surface. The next zone is between N230 and N290 with the depth to anomalies ranging from 2 to 7 ft below the surface. The most northern zone is between N310 and N350 and the anomalies range from 4 to 8 ft below the surface. Several isolated anomalies at about an 8-ft depth are located between N460 and N500. These anomalies are not distinctly separate from strong anomalies to the west in chemical trench 28.

The presence of the interpreted caliche horizon at about N520 marks the maximum northern extent of this trench. The southern end of the trench appears to be at about N80.

### 4.3.2 Asbestos Trench 30

This trench was open for only 1 month, from August 1976 to September 1976. The entire trench is centered on about E698. The northern extent of the trench is at about N540. The southern boundary is at about N90. An interpreted caliche horizon, roughly along the E721 line, marks the eastern extent of this trench (see Plate 2).

The western edge of the trench is not marked by the presence of the caliche horizon except south of N190. North of N190, this trench blends into asbestos trench 29. Three zones of concentrated anomalies are centered at N100, N370, and N540. These zones are shallow with anomalies starting at 2 to 5 ft below the surface.

### 4.3.3 Chemical Trench 31

This trench was opened in September 1982 and closed in April 1984. The trench centerline strikes about 5° more east than the other trenches in the NRDWL. The southern trench center is at E750. The northern trench center is at E785 (see Plate 2). The trench also appears to be significantly wider, approximately 75 ft, at the north end.

Three large areas of concentrated anomalies exist in this trench. The northern area begins at about N520, extends to about N325, and is about 35 ft wide. Anomalies are about 2 to 4 ft below the surface at the north end and become deeper towards N325, buried 5 to 8 ft below the surface with more gaps between individual anomalies.

The second concentrated zone of anomalies is centered at N290/E767. These anomalies begin at about 5 ft below the surface.

The southern third major area of concentrated anomalies ranges from about N40 to N210. This anomalous zone appears continuous into the JAJ trench (Section 4.5). Additionally, no shallow caliche horizon is present between the JAJ trench and trench 31, adding more evidence that the trenches are connected.

### 4.3.4 Unused Trench 32

Geophysical data (DOE-RL 1990) indicates that this unused trench location is underlain by a zone of undisturbed, shallow (1 to 3 ft deep), interpreted caliche horizon. The "undisturbed" zone is about 45 ft wide and centered on E790 along the N100 line (see Plate 2). The undisturbed zone narrows to 10 to 15 ft wide toward the north end of the trench location and centered at about E813. This orientation is skewed to the east similar to chemical trench 31.

### 4.3.5 Chemical Trench 33

This trench opened in November 1980 and closed in September 1982 and is centered at about E836 for its entire length. The north trench boundary is at about N525 (see Plate 2). No southern trench boundary is observed. The

caliche horizon, typically observed a few feet below the surface in undisturbed areas, is not present between chemical trench 33 and the JAJ trench. But as observed on Plate 2, anomalies, associated with possible debris, from the JAJ trench and trench 33 do not overlap.

The trench is about 30 ft wide with the major concentrations of anomalies near the centerline of the trench, located in three zones. The southern zone of anomalies extends from N90 to N170 with the anomalies beginning from 2 to 4 ft below the surface. Another zone is located between N340 to N440. The depth to the anomalies in this zone ranges from 3 to 9 ft. The third major area of anomalies ranges from N490 to N520.

### 4.3.6 Chemical Trench 34

This trench was opened in January 1975 and closed in November 1980. The western edge of the trench is between E865 and E870 (see Plate 2). The eastern boundary of the trench was not detected. This eastern boundary is below a berm created from the material removed from open trench 19N. Due to the berm, data are limited along the eastern boundary and into study area Section D.

The northern trench boundary is N530. No clear southern boundary exists in terms of an observable shallow caliche horizon. The trench itself appears to connect with the JAJ trench, although the most southern buried anomalies from chemical trench 34 are at about N90.

Anomalies are scattered along the entire trench but are concentrated in about five zones (see Plate 2). Anomalies in the zone from N90 to N160 are buried 2 to 6 ft below the surface. The zone from N170 to N240 has anomalies generally 3 to 5 ft below the surface. The third zone is centered at N330 and begins about 3 ft below the surface. From N360 to N490, the anomalies are buried 3 to 8 ft. The most northern observed anomalies occur at N510, about 2 ft below the surface.

## 4.4 SECTION D

Section D is the eastern portion of NRDWL, from E905 to E1020 (Figure 6). It contains two trench locations: (1) an unused trench location (18N), and (2) an open oxidizer trench (19N). Two berms, up to 8 ft high, parallel and flank open trench 19N. These berms and the associated open trench between, produce topography that severely limits GPR data acquisition. GPR data collection was primarily limited to north-south profiles every 23 ft. East-west GPR profiles were collected south of N190 and north of N530.

North-south EMI profiles were spaced every 11.5 ft with readings at 5-ft intervals. The additional thickness of soil from the berms prevents the signal from reaching desired depths of investigation below the natural surface elevation.

Due to limited data in this section, compared to Sections A and C, characterization was not as detailed. The data limits should be considered when referring to Plate 2 and in the following sections.

### 4.4.1 Unused Trench 18N

DOE-RL (1990) states that trench 18N, centered along profile E928, was never opened or used (see Plate 2). Data from both the GPR and EMI surveys support this conclusion. Even though the GPR data are limited both in coverage and in depth of exploration, there are indications that the area beneath the berm is undisturbed. The shallow caliche horizon appears continuous beneath the berm in this trench location.

One anomalous area does exist at N320/E928. The anomalies appear to be at or near the bottom of the berm, not necessarily in an "excavation". Both the GPR and EMI detected this anomalous zone.

### 4.4.2 Oxidizer Trench 19N (Open)

Oxidizer trench 19N, opened in March 1984, is the eastern-most open trench, dominating Section D. It is assumed that the southern, western, and eastern edges of the trench are relatively intact. The northern end of the trench is at about N530. The trench has been filled in to about N470. The only anomalies in this trench occur in this backfilled area. This anomalous zone extends from N500 to N525 and from E960 to E1000.

The southern end of the trench is at about N250. South of N250, the subsurface appears relatively undisturbed except at N190/E1020. This anomalous zone extends from N170 to N200 and from E1008 to beyond the eastern boundary of this survey. The anomalies are about 2 ft below the surface. They are interpreted as either shallow buried debris located outside of a detected trench or could be related to clastic dikes.

## 4.5 SECTION E/JAJ TRENCH

GPR data were collected over the entire JAJ trench, from E100 to E1020 and between N00 to N100 (see Plate 2). Data were collected on a 20-ft by 11.5-ft grid spacing from E284 to E698. Grid spacing of 10 ft by 11.5 ft were used from E100 to E307 and from E698 to E1020. EMI data were collected over the central portion of the trench, between E399 and E629. Three areas have no data due to steel tanks on the surface. These "no data" areas are relatively small, approximately 30 ft by 30 ft, and do not significantly impact the overall interpretation.

The JAJ trench strikes N68°W, parallel to the "E-W" survey grid lines. The trench is 725 ft long by 50 ft wide. The north, south, east, and west trench boundaries are located roughly at grid lines N75, N25, E985, and E260, respectively. The trench "boundaries" are inferred primarily from mapped boundaries of a shallow caliche horizon.

Concentrated anomalies within this trench are located between N30 and N70 and between E270 and E928. Depths to the top of major concentrations of anomalies are typically about 5 ft. Depths to specific anomalies are as little as 2 ft in several places (see Plate 2).

The JAJ trench is not clearly separated from the NRDWL trenches, chemical 34 and 31 and asbestos 25 and 22. This interconnection of trenches is inferred by the absence of the shallow (2 to 5 ft) caliche horizon. The absence of the interpreted caliche horizon is likely due to excavation. Anomalies from chemical trench 31 are continuous into the JAJ trench anomalies at E755 (Plate 2).

West of E260, numerous anomalies are located above the shallow caliche horizon. This indicates some shallow disposal, perhaps in 1 to 3-ft deep trenches, or at/near the surface and then covered by a 1 or 2 ft of fill. In particular, the area between about E175 to E200, and N00 to N40, the caliche horizon (paleosol) seems intact at about a 3 ft depth with metallic anomalies above.

## 5.0 CONCLUSIONS/RECOMMENDATIONS

The interpreted trench boundaries and major areas of concentrated anomalies were identified by a combination of GPR and EMI. Most of the trench centers are close to those predicted by documentation, but some vary by as much as 15 ft. An exception is asbestos trench 23 where a shallow reflector, interpreted to be a calcified geologic horizon, is still intact, which suggests that the trench was never opened or used. This calcified horizon is prevalent throughout most of the NRDWL except in the used trenches where it was removed during trench excavation.

The depths to the top of the debris within the trenches were determined. However, the depth to the bottom of the anomalies must be inferred from expected trench depths. Most debris appears to be covered with less fill material than the documented 4 ft in asbestos trenches and 10 ft in chemical trenches. The geophysical surveys indicate the buried debris is covered by as little as 2 ft of fill in many places.

Several NRDWL trenches appear to merge laterally. In addition, four NRDWL trenches merge with the east-west trending JAJ trench. Chemical trench 31 has anomalies continuous into the JAJ trench. This trench also is wider than documented and trends into the location of unused trench 32.

The berms of sand, that parallel open trenches 26 and 19N in Sections B and D, adversely affected the data quality and reduced profile coverage. This limited the subsequent interpretation to a few isolated areas within the sections. The open trenches need to be backfilled with the berm material, and the site roughly leveled, if more detailed data and interpretations are needed in Sections B and D.

A closely spaced grid would improve the delineation of trench boundaries and more accurately locate concentrations of debris within the NRDWL. Other geophysical methods such as magnetic gradiometer and deeper looking EMI, such as an EM-34, could enhance the interpretation if required.

## 6.0 REFERENCES

DOE-RL, 1990, *Nonradioactive Dangerous Waste Landfill Closure/Postclosure Plan*, DOE/RL-90-17, U.S. Department of Energy, Richland Field Office, Richland, Washington.

Mitchell, T. H. and K. A. Bergstrom, 1993, *Data Package for Geophysical Investigation of Nonradioactive Dangerous Waste Landfill (NRDWL)*, WHC-SD-EN-DP-064, Westinghouse Hanford Company, Richland, Washington.

Weekes, D. C., S. P. Luttrell, and M. R. Fuchs, 1987, *Interim Hydrogeologic Characterization Report and Groundwater Monitoring System for the Nonradioactive Dangerous Waste Landfill, Hanford Site, Washington*, WHC-EP-0021, Westinghouse Hanford Company, Richland, Washington.

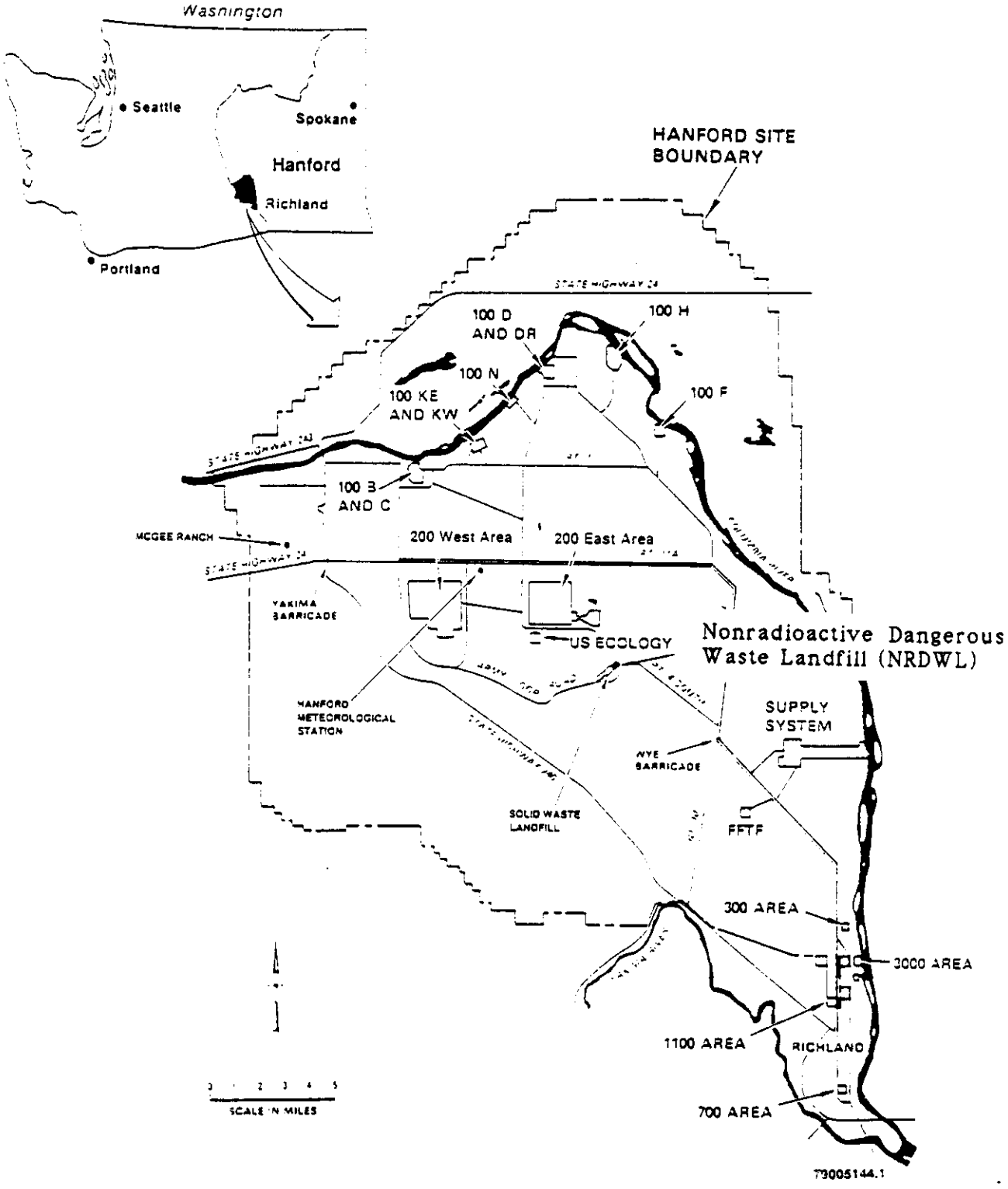



Figure 1. NRDWL Location Map.

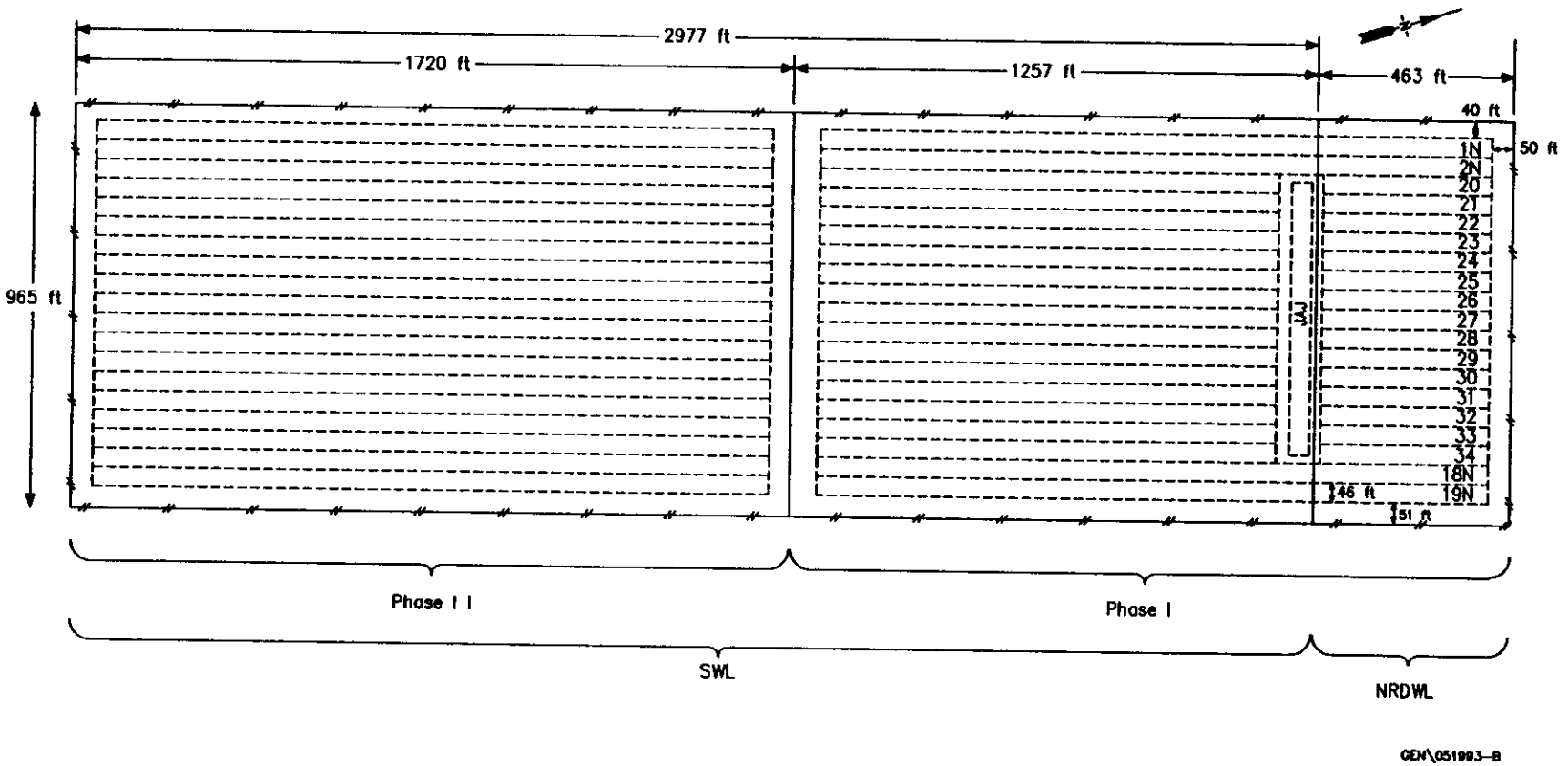



Figure 2. NRDWL at the Northern End of the Solid Waste Landfill.

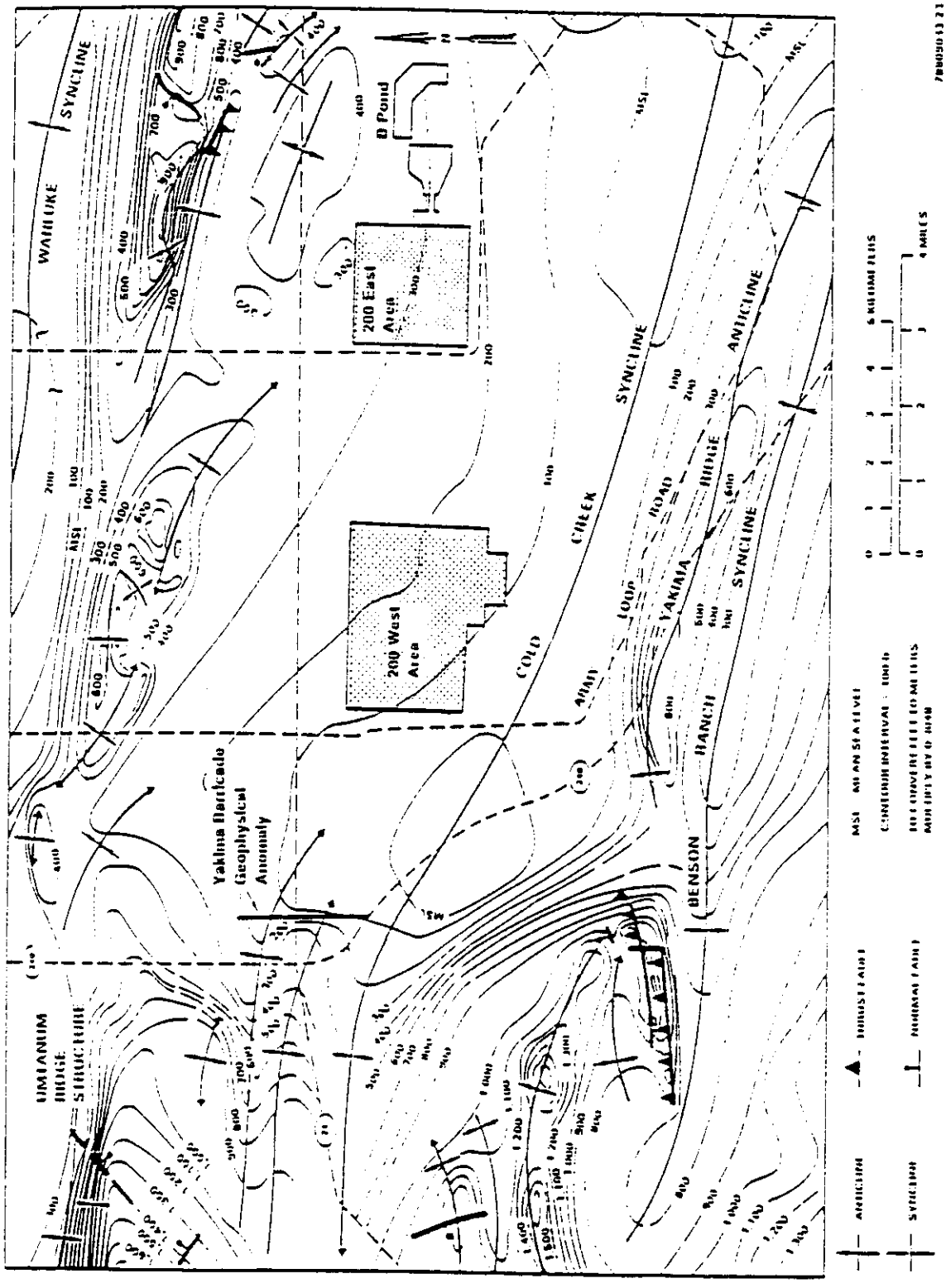



Figure 3. Structure Contour Map of the Top of the Basalt Beneath NRDWL. (Weekes et al. 1987)

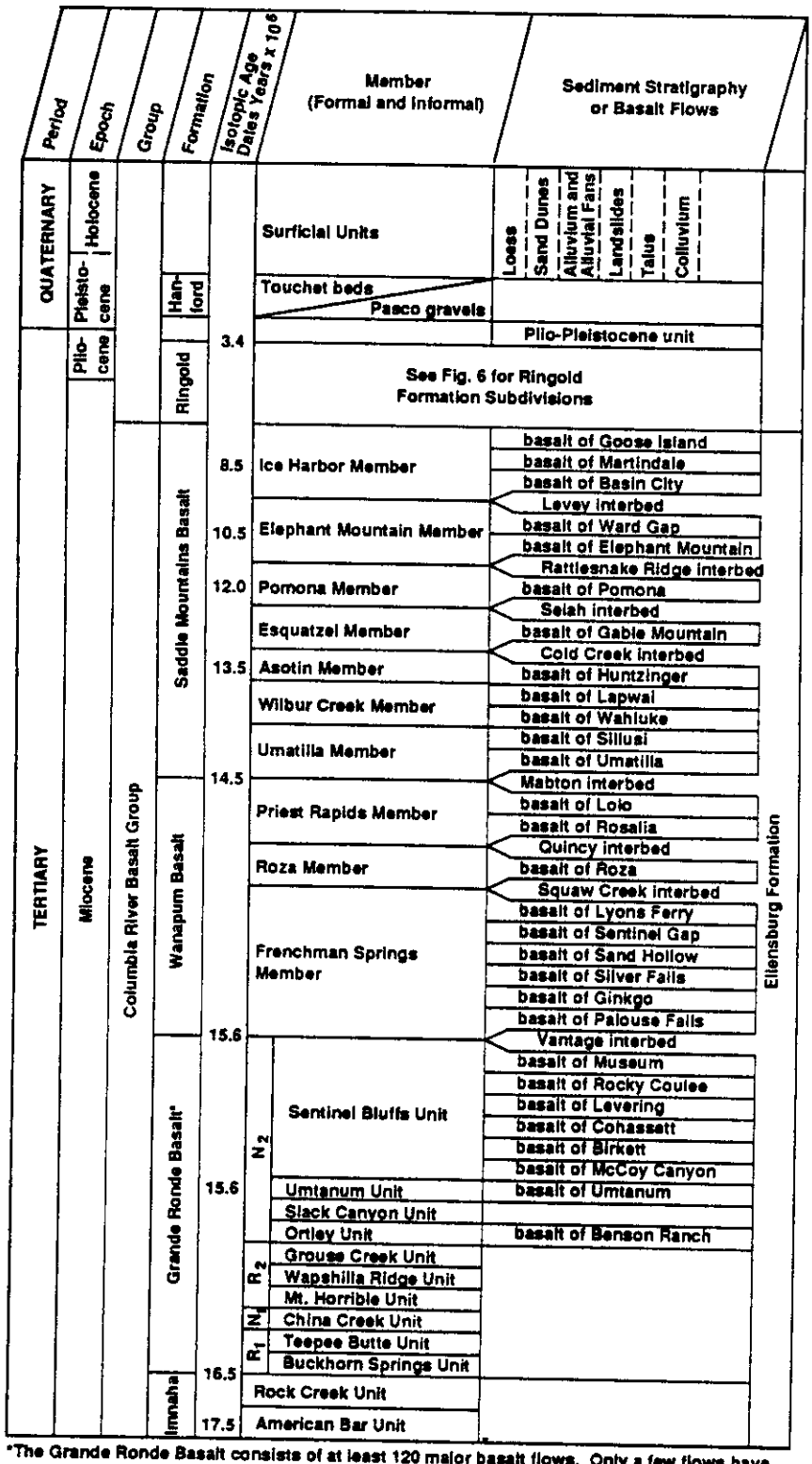



Figure 4. Stratigraphic Nomenclature of Units Penetrated Within the Pasco Basin.

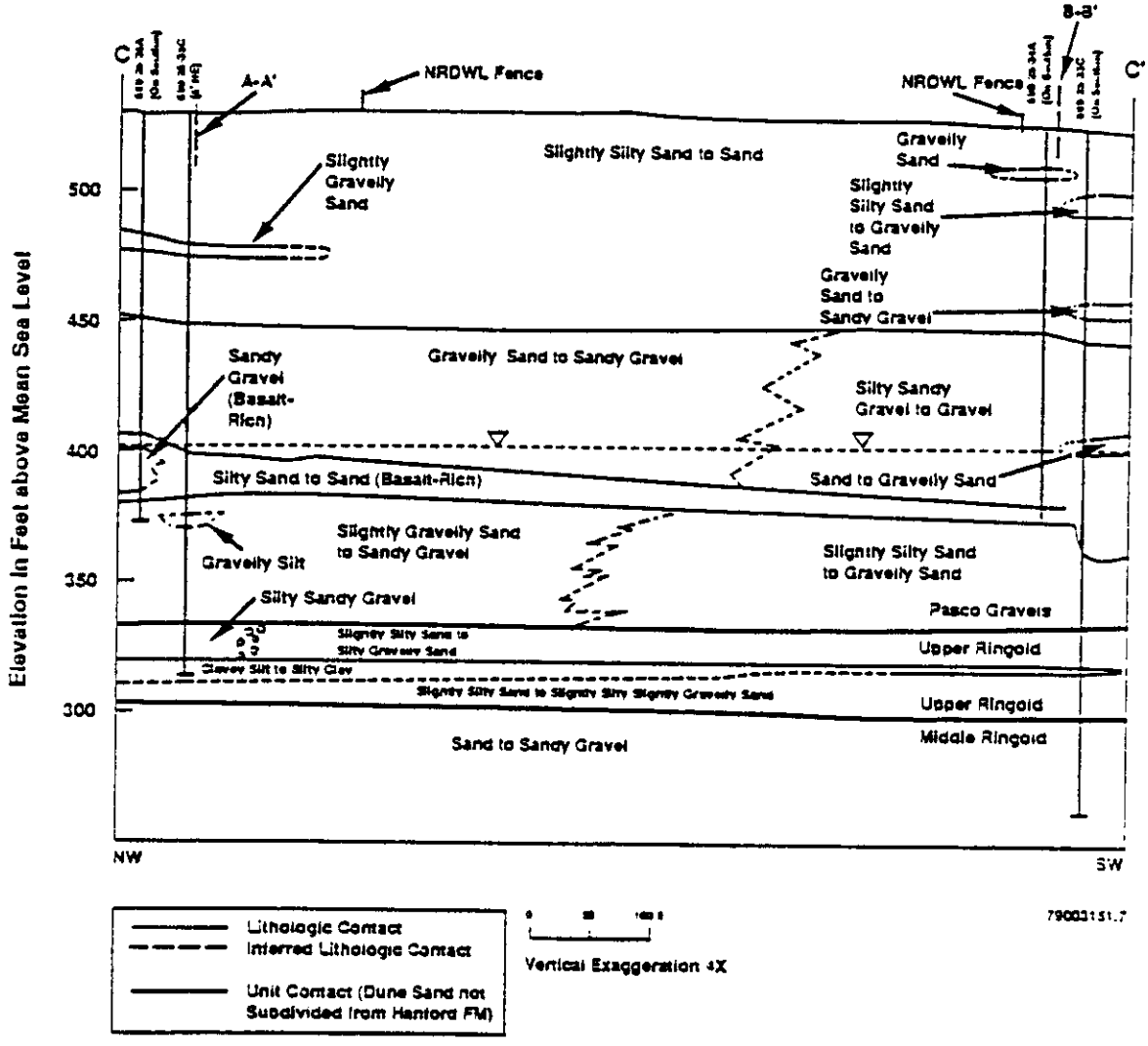



Figure 5. Geologic Cross Section of Sediments at the NRDWL (Weekes et al. 1987).

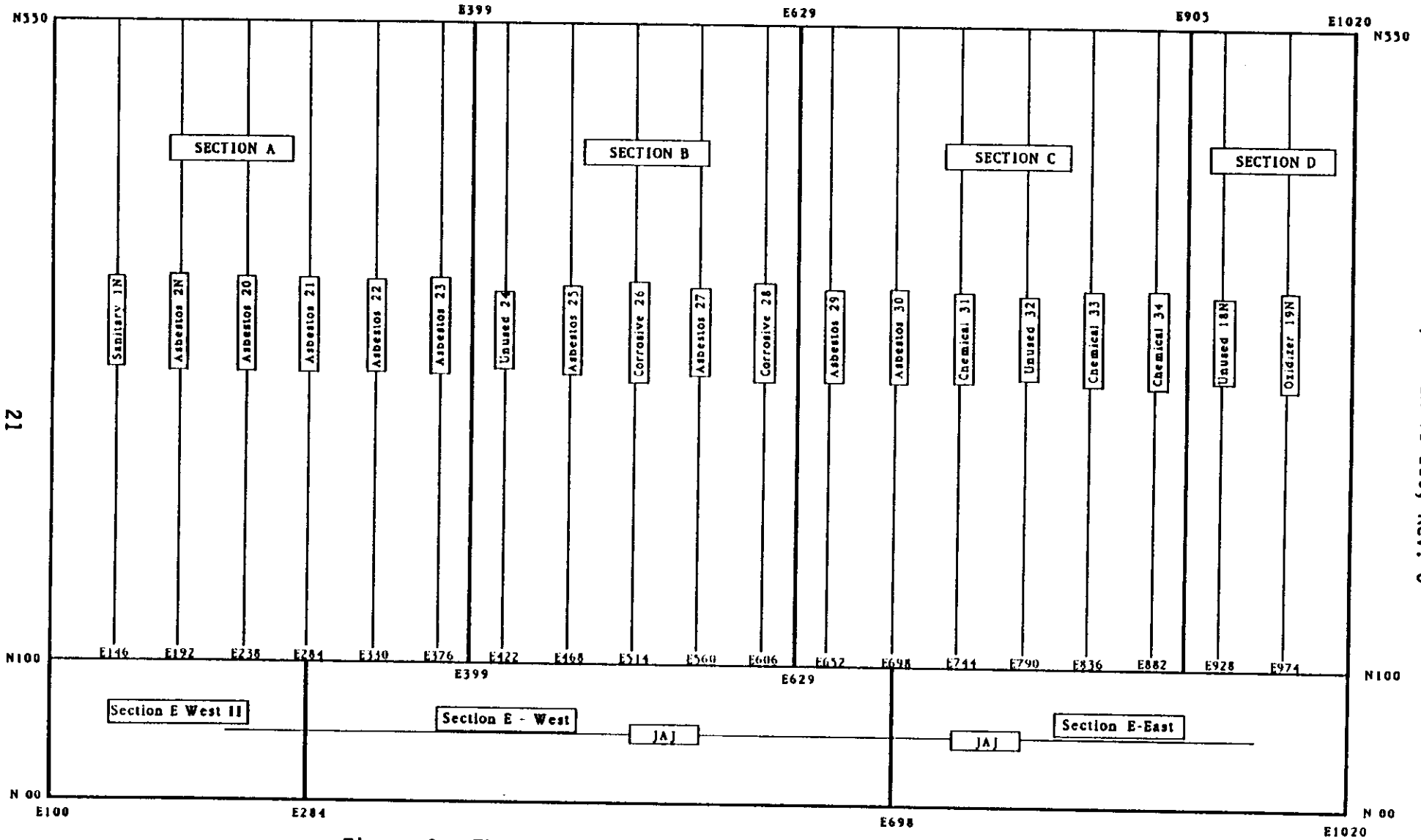



**Figure 6.** The NRDWL Study Area Divided into Seven Sections.
(The center of the trenches, as predicted from DOE-RL 1990, are shown in relationship to the survey grid.)

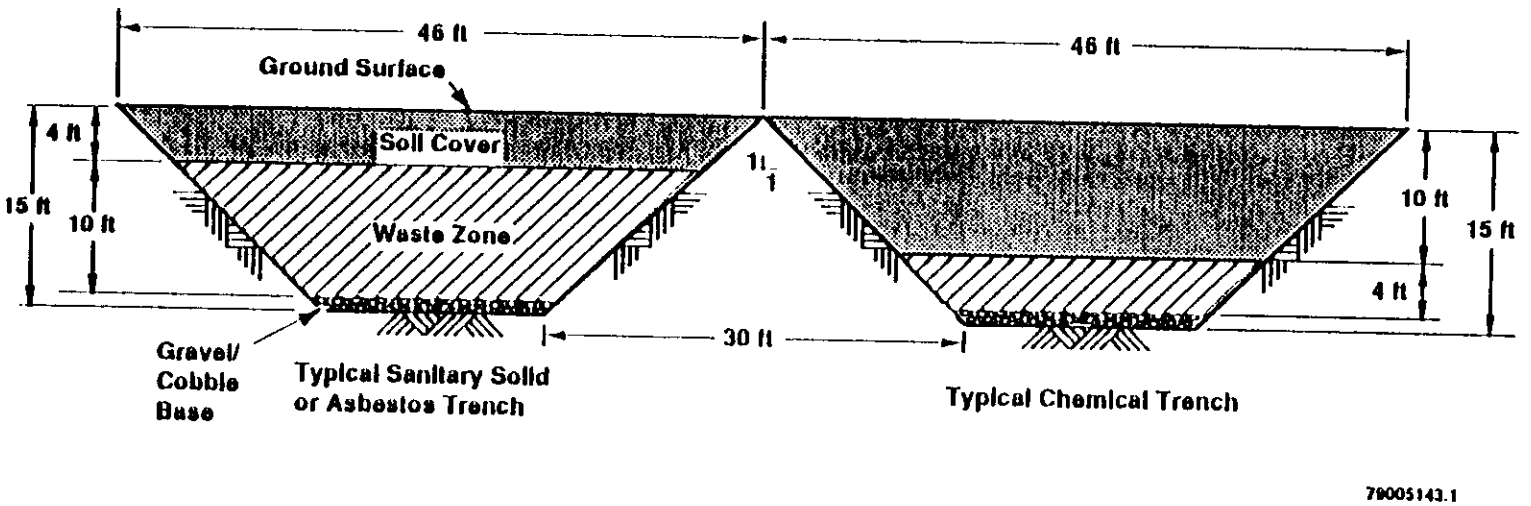



Figure 7. Documented Designs for "Typical" Asbestos and Chemical Trenches.

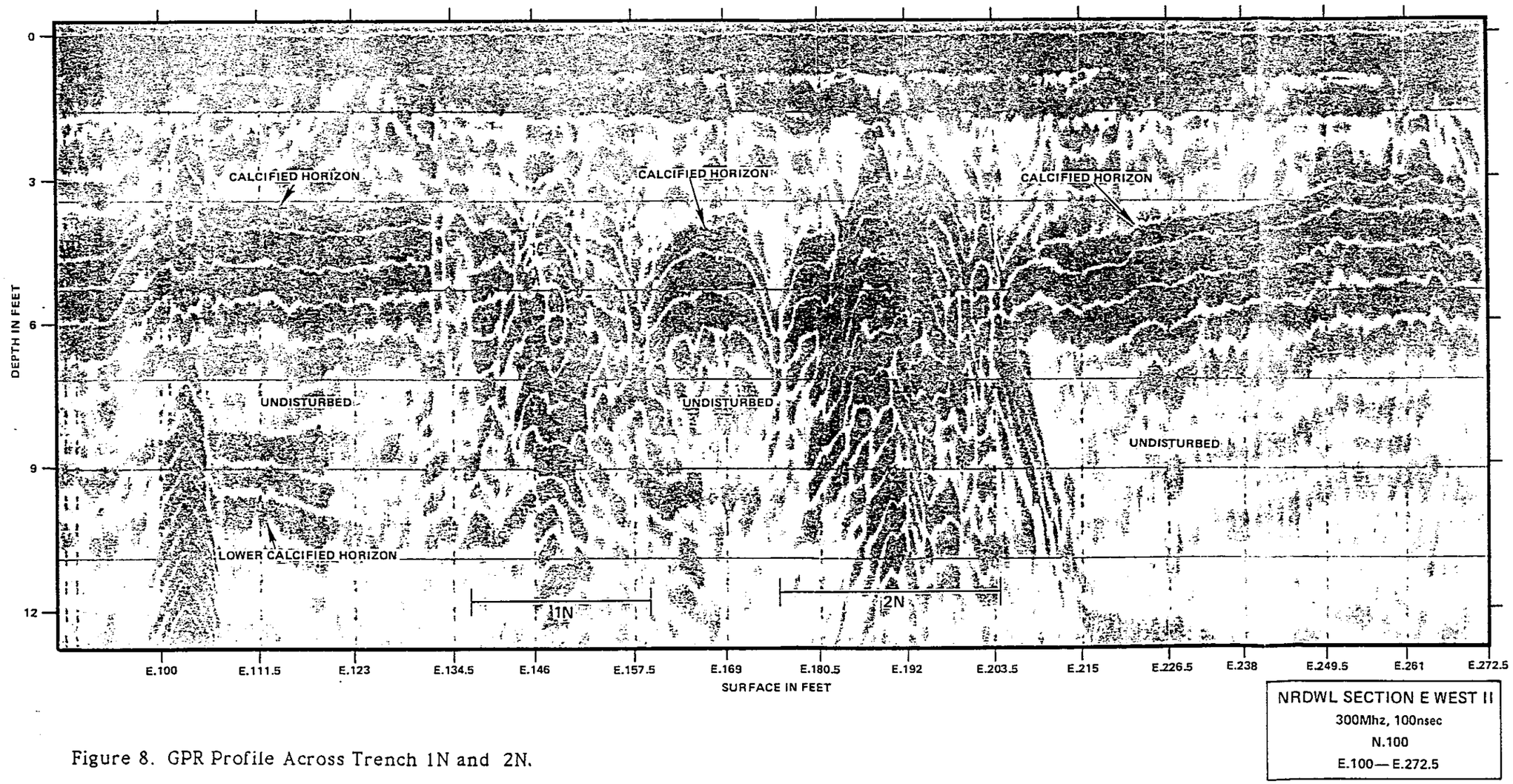



Figure 8. GPR Profile Across Trench 1N and 2N.

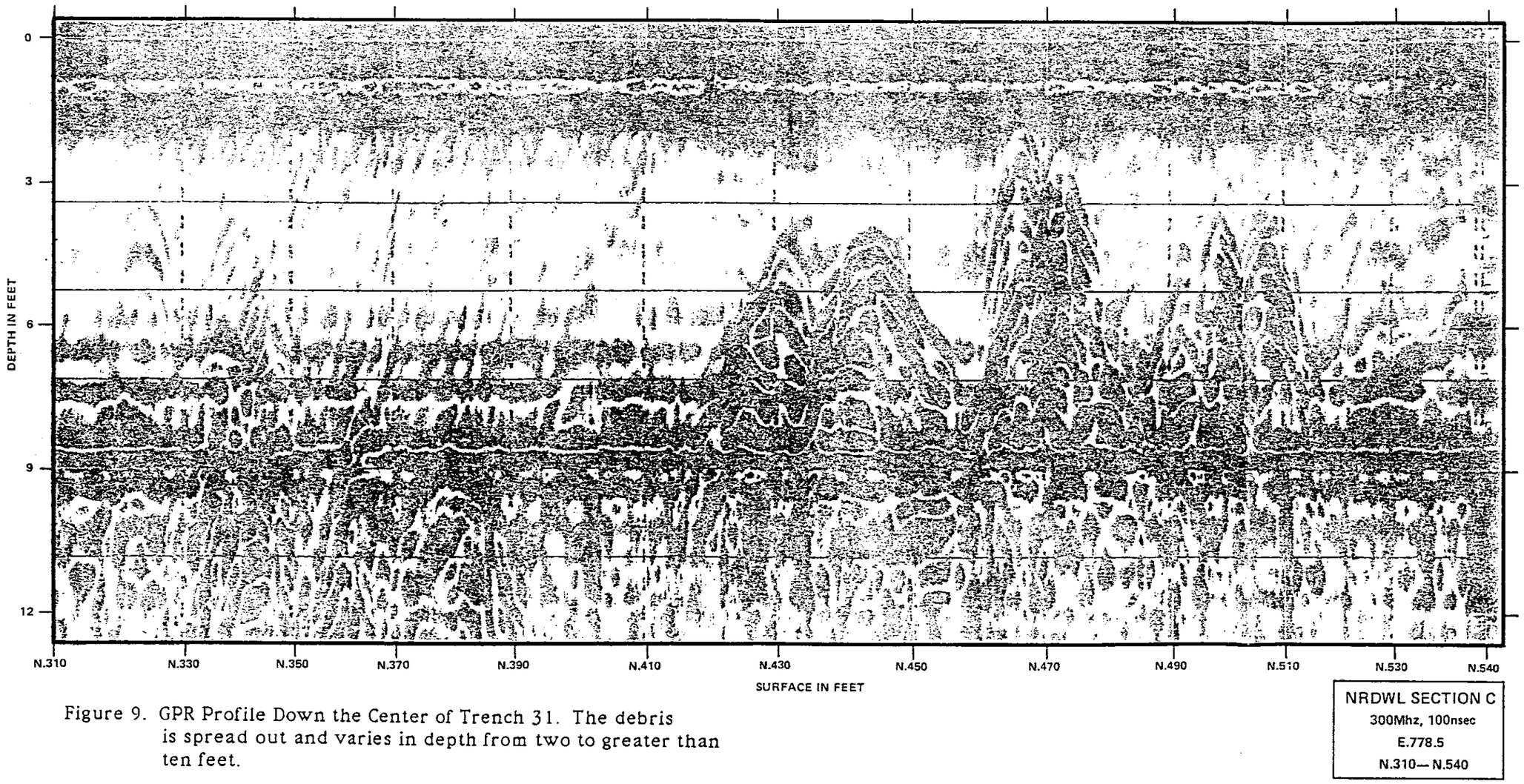



Figure 9. GPR Profile Down the Center of Trench 31. The debris is spread out and varies in depth from two to greater than ten feet.

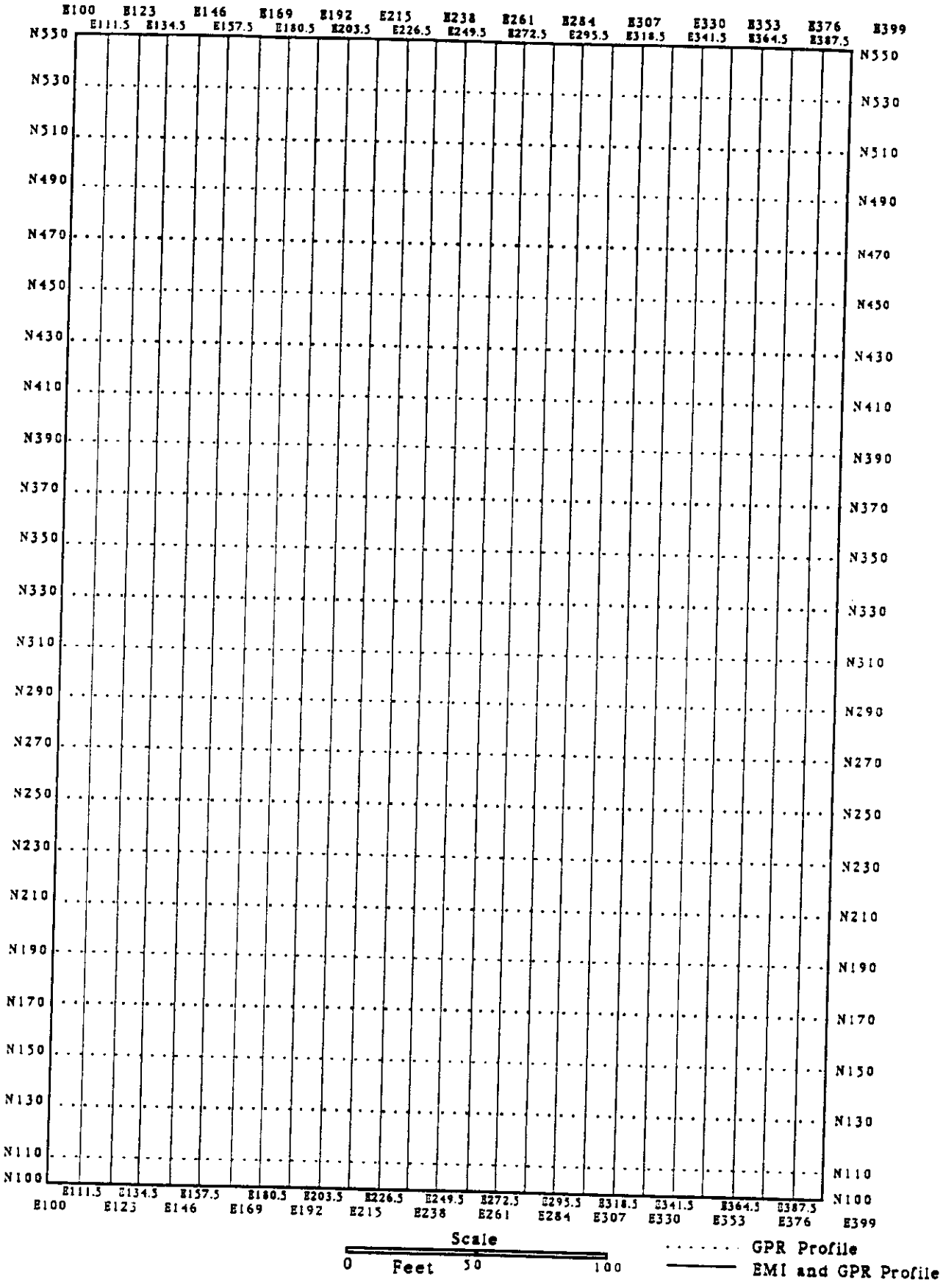



Figure 10. Section A Survey Grid with Locations of EMI and GPR Profiles.

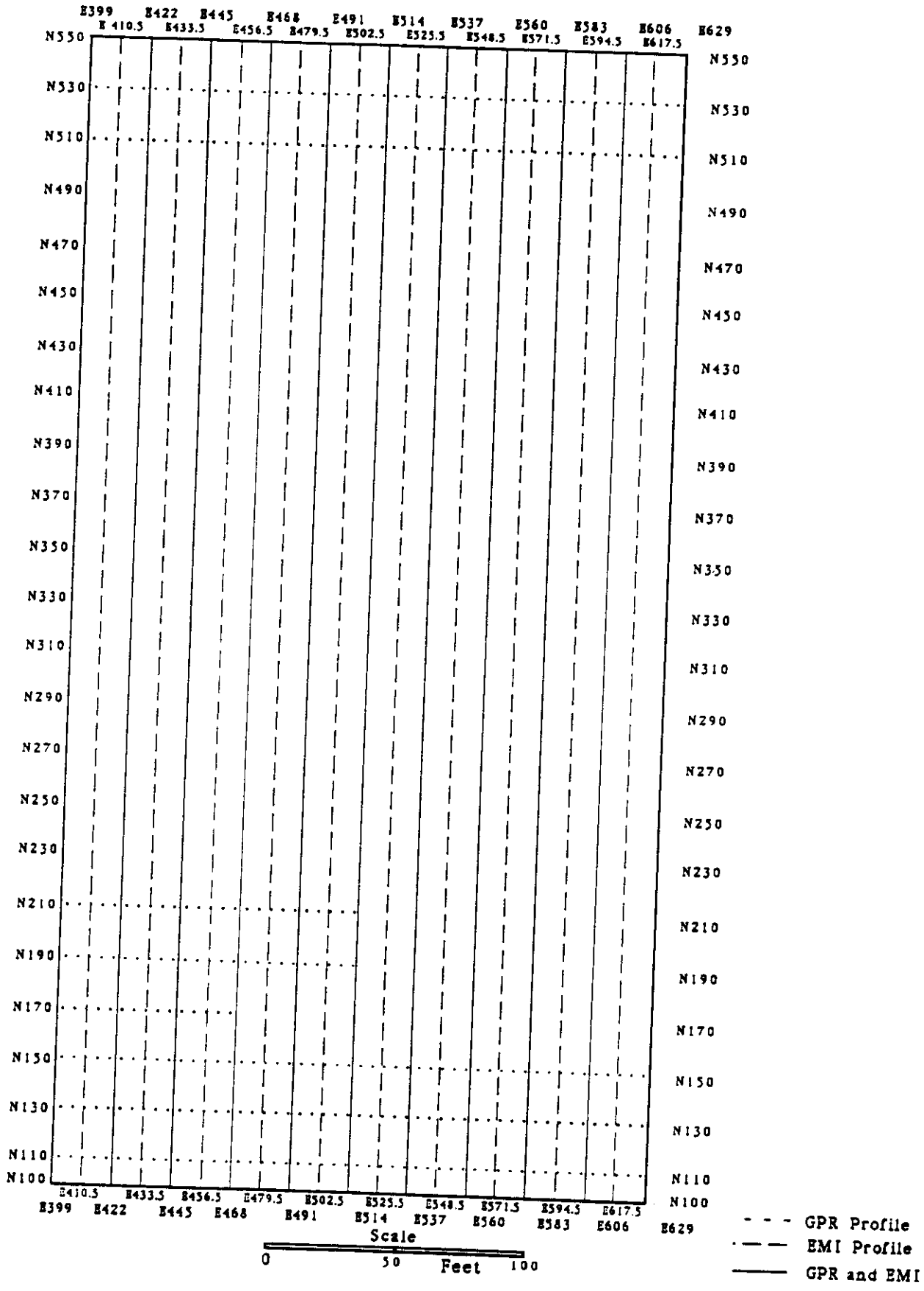



Figure 11. Section B Survey Grid with Locations of EMI and GPR Profiles.

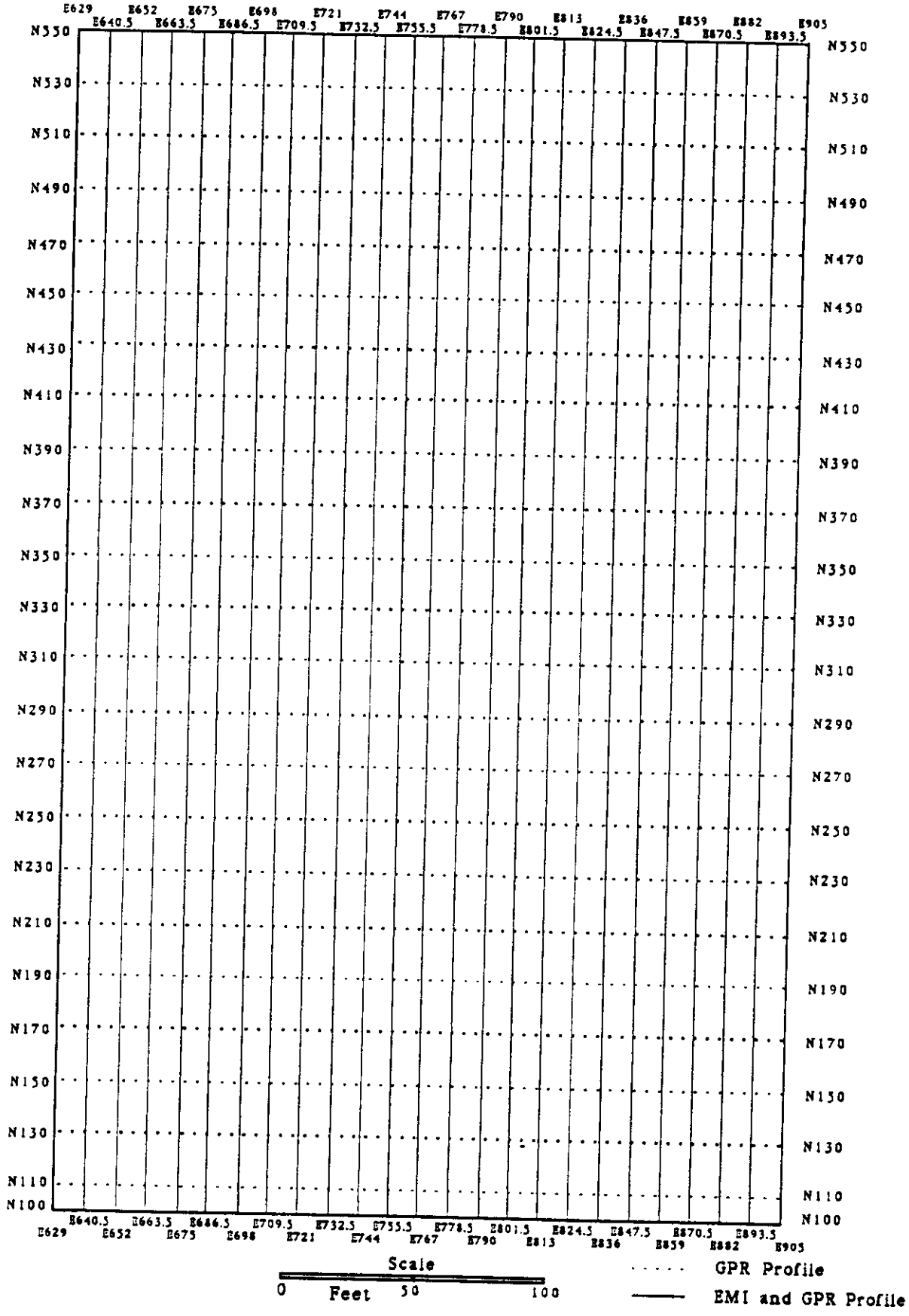



Figure 12. Section C Survey Grid with Locations of EMI and GPR Profiles.

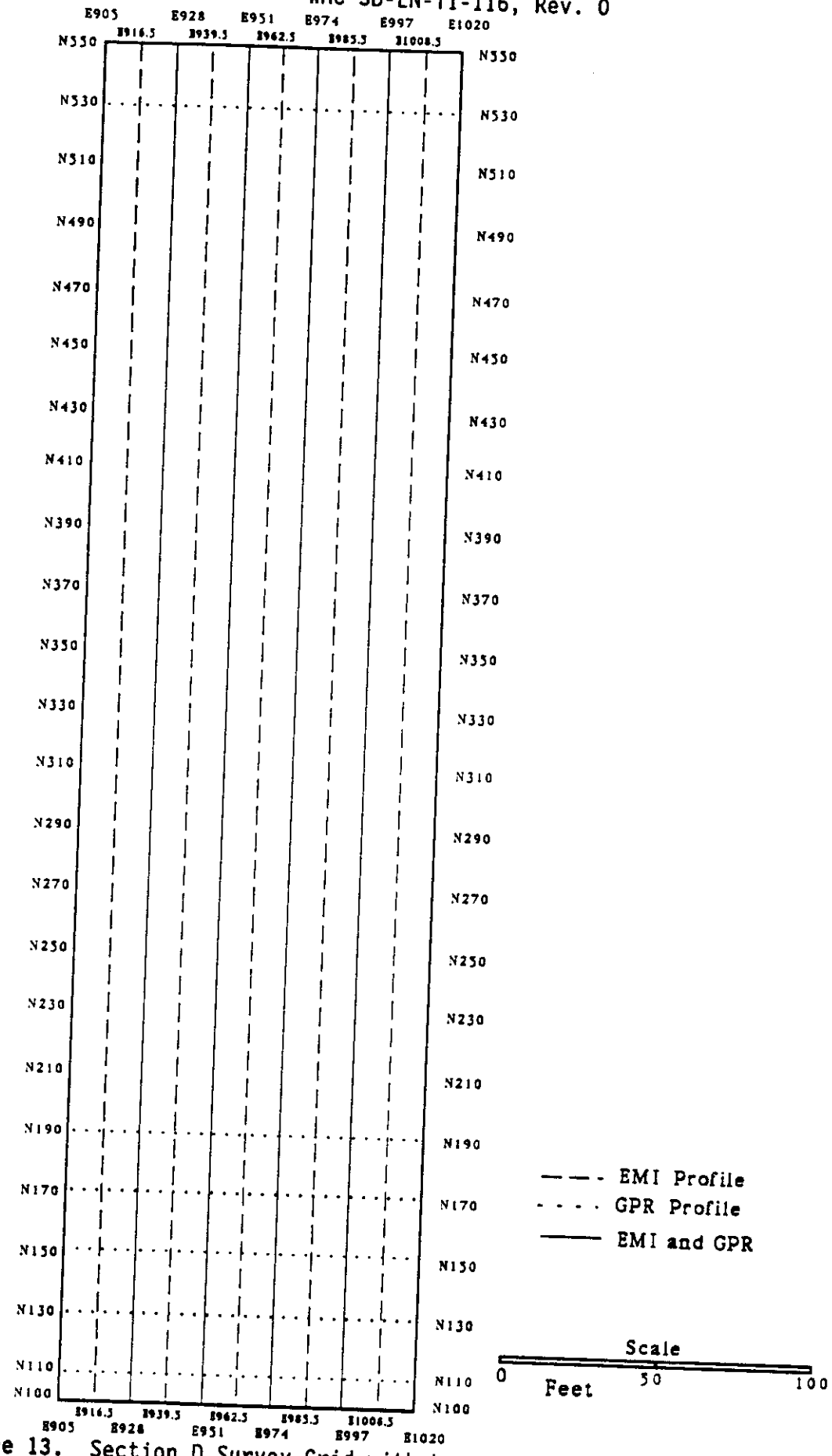



Figure 13. Section D Survey Grid with Locations of EMI and GPR Profiles.

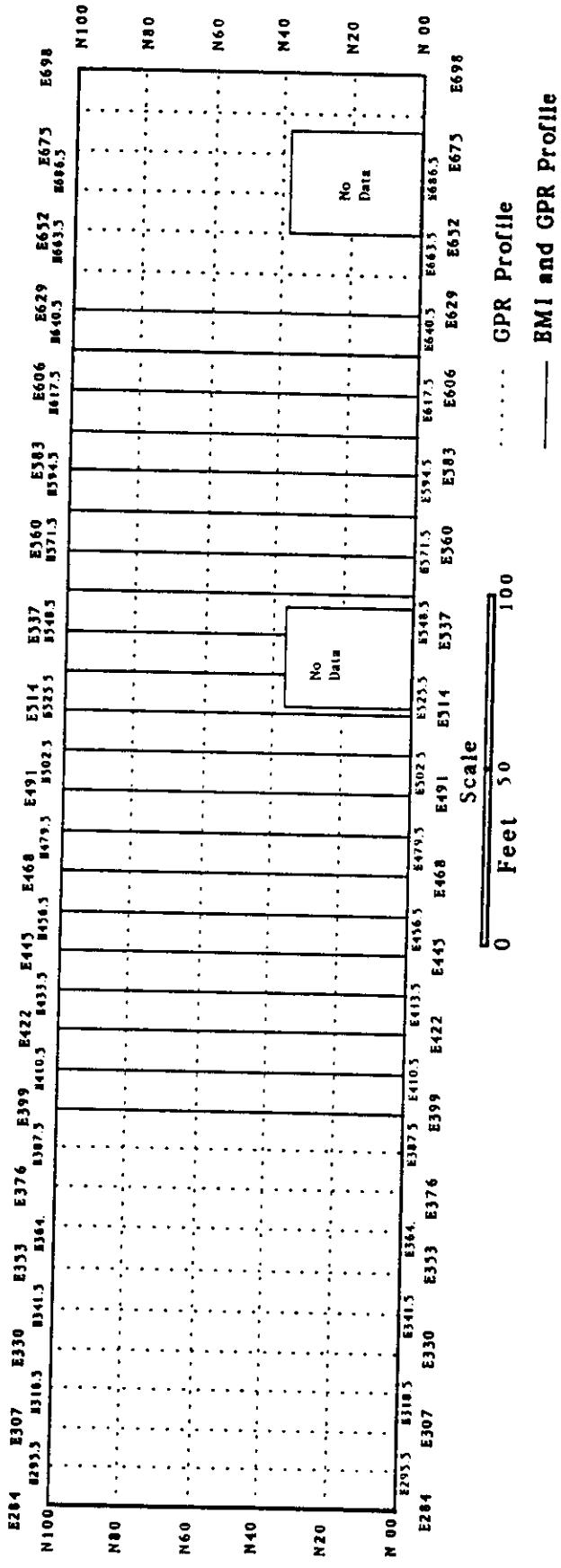



Figure 14. Section E West Survey Grid with Locations of EMI and GPR Profiles.

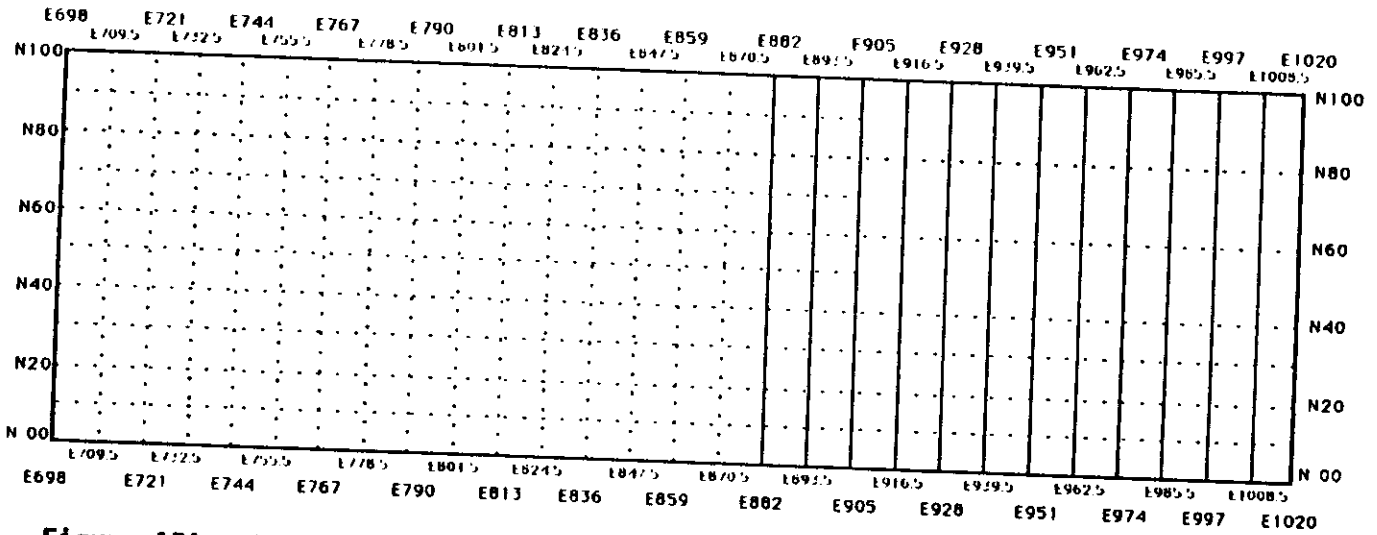



Figure 15A. Section E East Survey Grid with Locations of EMI and GPR Profiles.

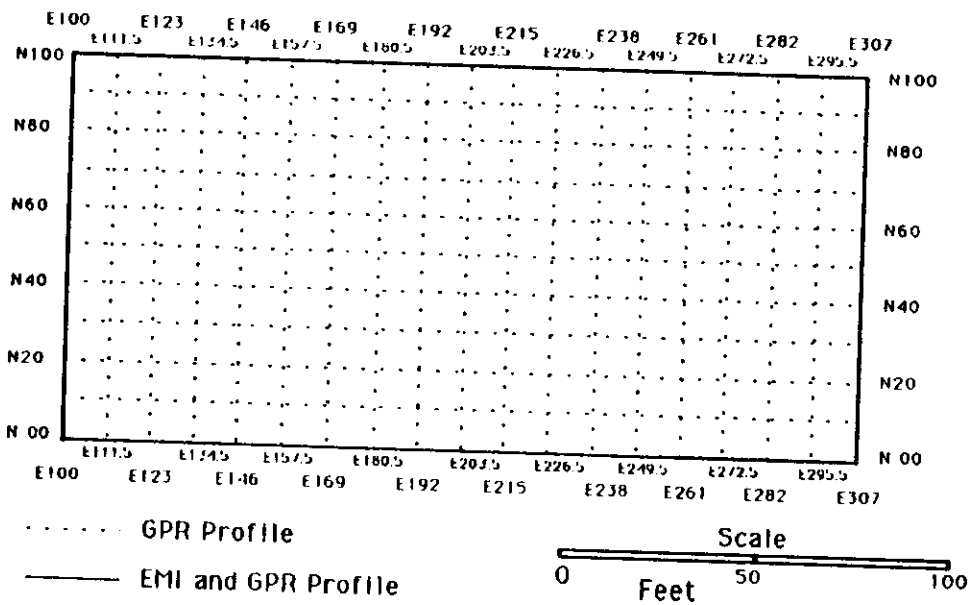
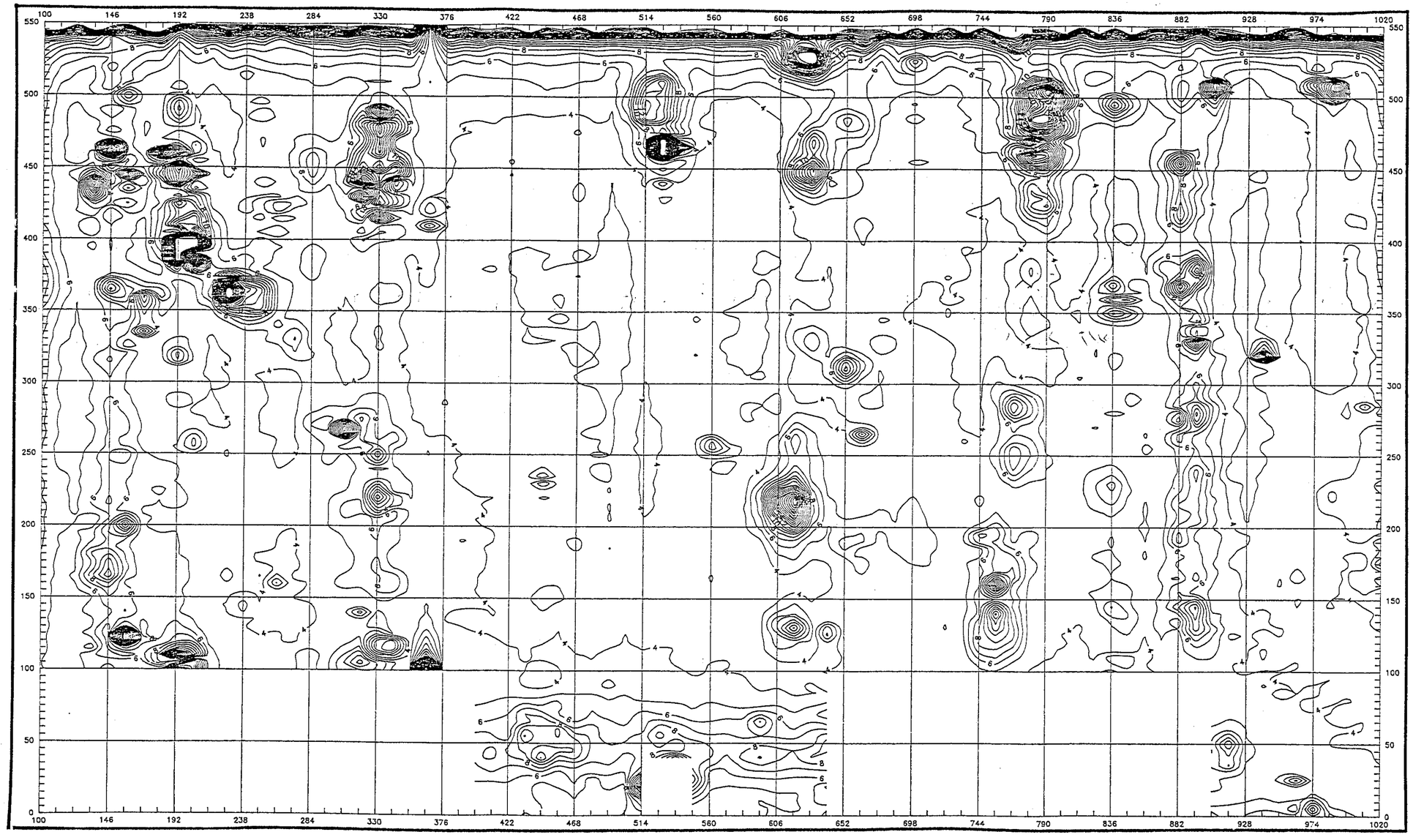
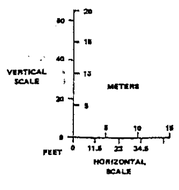



Figure 15B. Section E West II Survey Grid with Locations of EMI and GPR Profiles.

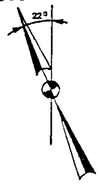


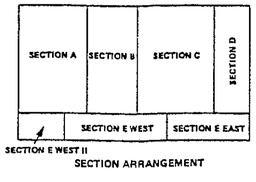

**NONRADIOACTIVE DANGEROUSE WASTE LANDFILL**
**(NRDWL)**
**ELECTROMAGNETIC INDUCTION**




GEOPHYSICS BY:
T.H.MITCHELL AND K.A.BERGSTROM
DRAWN BY:
W.H CROWLEY JR.

CONTOUR INTERVAL:
1 MILLIMHO/METER
(MMHOS)




SECTION ARRANGEMENT

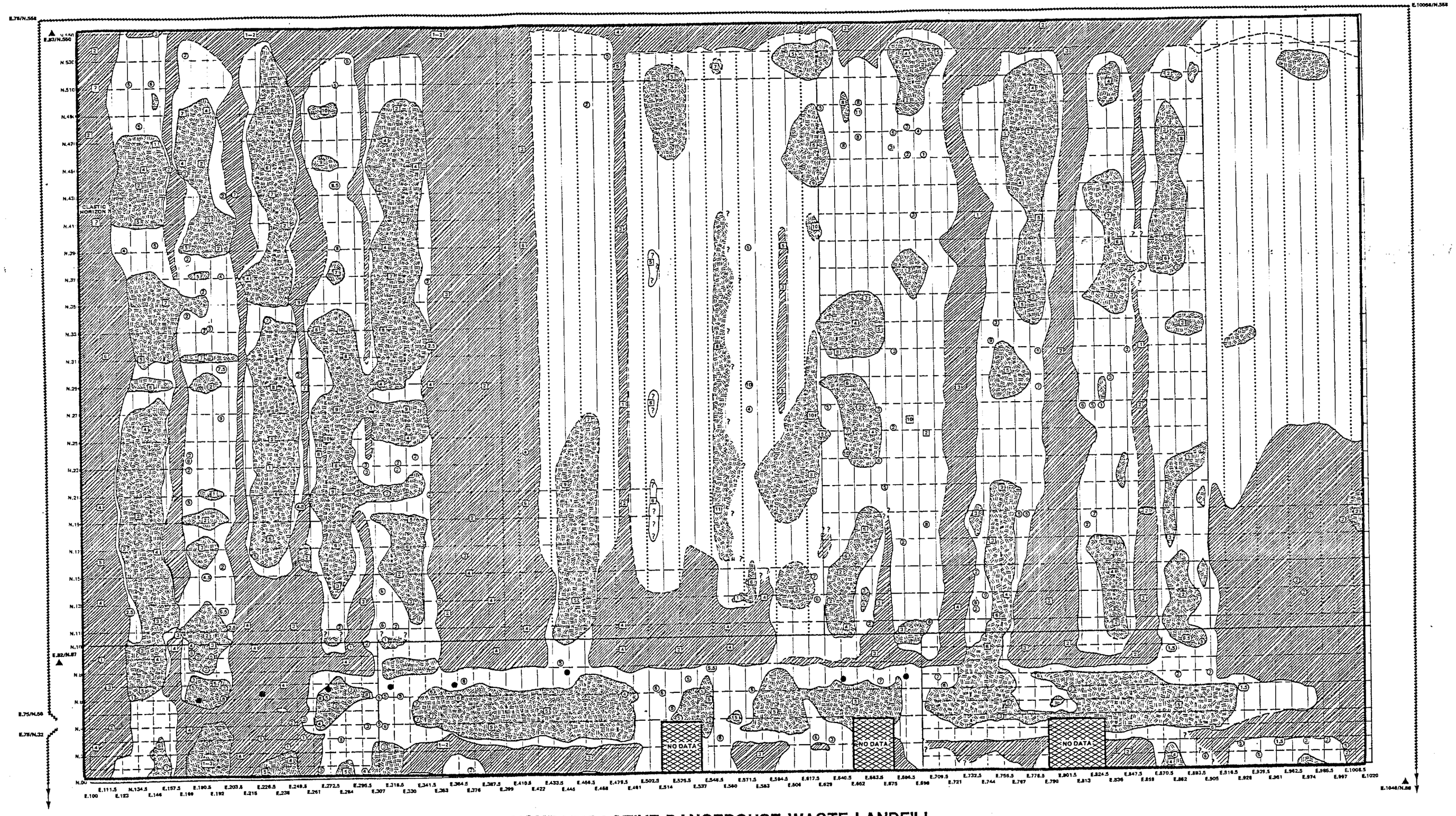
HANFORD SITE

WASHINGTON STATE

**PLATE 1**



31




# NONRADIOACTIVE DANGEROUSE WASTE LANDFILL (NRDWL)

GEOPHYSICS BY
T.H.MITCHELL AND K.A.BERGSTROM
DRAWN BY
W.H.CROWLEY JR.

LEGEND

- AREA OUTSIDE OF TRENCH BOUNDARIES. GENERALY UNDISTURBED BELOW DEPTH OF A FEW FEET.
- CONCENTRATIONS OF ANOMALIES WITHIN INTERPRETED TRENCH BOUNDARIES.
- SCATTERED ANOMALIES WITHIN TRENCH BOUNDARIES.
- AVERAGE DEPTH OF FILL OVER BURIED ANOMALIES (HIGHLY VARIABLE).
- DEPTH TO CALICHE HORIZON OUTSIDE OF TRENCH BOUNDARIES WHERE PRESENT.
- EMI PROFILE
- GPR PROFILE
- EMI AND GPR PROFILE
- ASBESTOS SIGN POSTS
- SURVEY HUB
- FENCE

VERTICAL SCALE — METERS — FEET — HORIZONTAL SCALE

SECTION A | SECTION B | SECTION C | SECTION D
SECTION E WEST II | SECTION E WEST | SECTION E EAST
SECTION ARRANGEMENT

HANFORD SITE

WASHINGTON STATE

**PLATE 2**

# APPENDIX A

# GPR PROFILES IN SUPPORT OF SOIL-GAS SURVEYS

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# APPENDIX A

North-south trending Solid Waste Landfill trenches lie immediately south of the JAJ trench. The northern-most end of several of these trenches were detected during the initial NRDWL investigation (Plate 2). Six east-west GPR profiles and 10 north-south GPR profiles were collected over several of these trenches in support of soil-gas surveys (Figure A-1). The intersections of the north-south and east-west profiles were tentative locations for soil-gas probes. The objective of the surveys were to locate areas where probes could be inserted without undue risk of penetrating buried waste material. These data were not used to characterize the trench locations or their contents. Data is included in Mitchell and Bergstrom (1993).

Status of the southern soil-gas probe locations and recommended location changes, where appropriate, are listed below.

| Location | Status |
|---|---|
| E146/S50 | Buried debris 5+ ft below the surface |
| E238/S50 | Buried debris 5+ ft below the surface |
| E330/S50 | Move to E330/S55. Buried debris 5+ ft below the surface |
| E442/S50 | Location is between trenches |
| E514/S50 | Move ~20 ft to the west |
| E606/S50 | No soil probe. The site is in an open trench |
| E698/S50 | Move to E698/S45 |
| E790/S50 | Move 10 to 15 ft to the east |
| E882/S50 | Site ok |
| E974/S50 | Site ok |
| E146/S50 | Site ok |
| E238/S150 | Move west ~10 ft |
| E330/S150 | Move site to E330/S145. Buried debris 6 ft below the surface |
| E442/S150 | Site is between trenches |
| E514/S150 | Buried debris 5+ ft below the surface |
| E606/S150 | Site ok |

| Location | Status |
|---|---|
| E698/S150 | Buried debris 5+ ft below the surface |
| E790/S150 | Move 10 to 15 ft to the west |
| E882/S150 | Buried debris 6+ ft below the surface |
| E974/S150 | Buried debris 6+ ft below the surface |

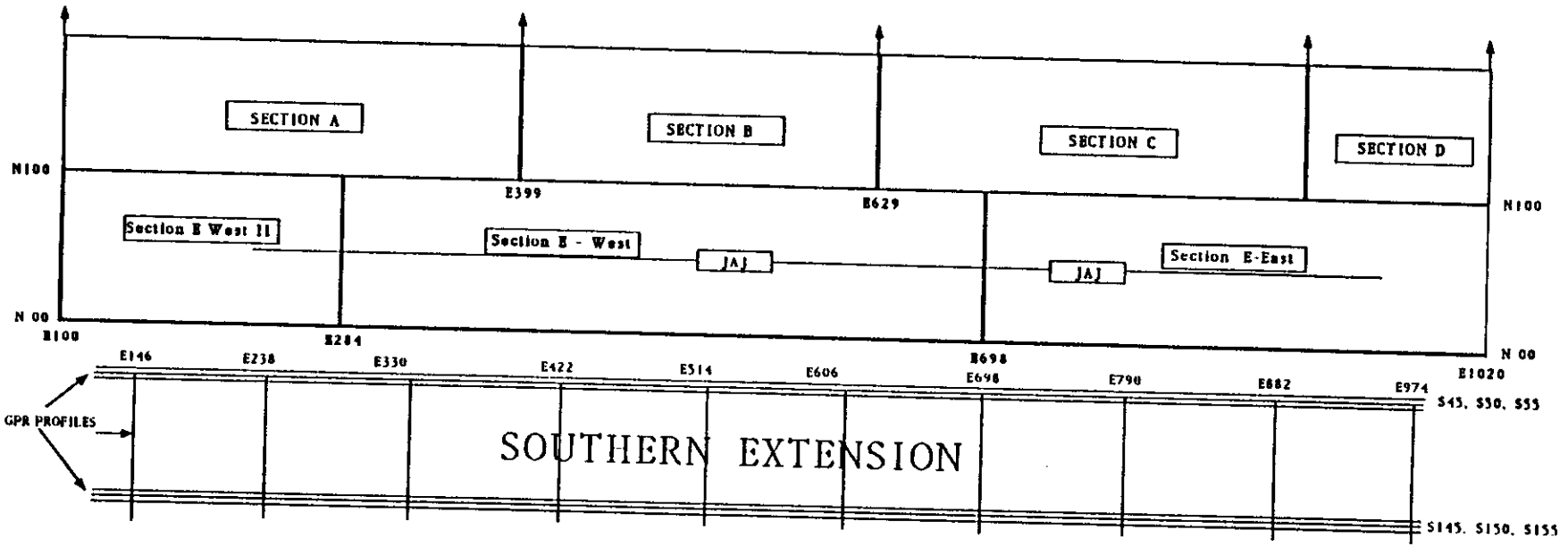


**Figure A-1.** The Southern Extension of the NRDWL Geophysical Survey.

(The southern extension consisted of several east-west GPR profiles and isolated north-south profiles to assist in locating soil-gas probes).

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EXHIBIT G:

Remote Sensing-LIDAR Survey Drawings
- Local Quadrant Area

-NRDWL/SWD Area

*Prepared for:*
*US DEPARTMENT OF ENERGY*
*RICHLAND OPERATIONS OFFICE*

*Created by:*
*Facilities and Land Management*
*Fluor Hanford, Richland, WA*

*INTENDED USE: REFERENCE ONLY*
*Projection: Lambert Conformal Conic*
*Coordinate Reference Grids:*
*Geographic Latitude/Longitude, Decimal Degrees*
*Washington State Plane, South Zone, Meters*
*Horizontal Datum: NAD83*
*Vertical Datum: NAVD88*

Named Areas

1 Meter Contour (Cartographic Smoothed)

Terrain Features Source is 2008 Bare Earth LiDAR Data

# Hanford

## Shaded Relief at

## NRDWL / Central Landfill

Intended Scale 1:1,000

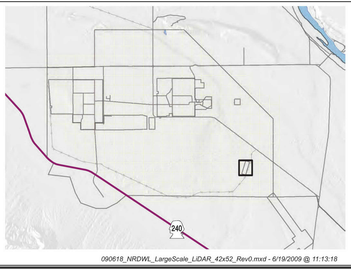
Feet: 0 100 200 300

N W E S

Meters: 0 10 20 30 40 50 60 70 80 90 100

Groundwater Sample Wells

BWIP Seismic Station Points

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*Prepared for:*
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*Projection: Lambert Conformal Conic*
*Coordinate Reference Grids:*
*Geographic Latitude/Longitude, Decimal Degrees*
*Washington State Plane, South Zone, Meters*
*Horizontal Datum: NAD83*
*Vertical Datum: NAVD88*

# Hanford
# Shaded Relief of the
# NRDWL / Central Landfill Vicinity

Named Areas

5 Meter Contour (Cartographic Smoothed)

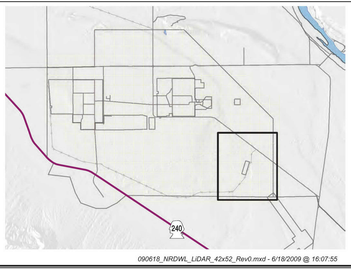
Terrain Features Source is 2008 LiDAR Data

Feet: 0 500 1,000 1,500

Meters: 0 100 200 300 400 500

Groundwater Sample Wells

BWIP Seismic Station Points



*090618_NRDWL_LiDAR_42x52_Rev0.mxd - 6/18/2009 @ 16:07:55*

EXHIBIT H:

Report entitled *Groundwater Monitoring Plan for the Nonradioactive Dangerous Waste Landfill* PNNL-12227

PNNL-12227

# Groundwater Monitoring Plan for the Nonradioactive Dangerous Waste Landfill

J. W. Lindberg
M. J. Hartman

August 1999

Prepared for
the U.S. Department of Energy
under Contract DE-AC06-76RLO 1830

Pacific Northwest National Laboratory
Richland, Washington 99352

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# Summary

The Nonradioactive Dangerous Waste Landfill (NRDWL), which received nonradioactive hazardous waste between 1975 and 1985 is regulated under the *Resource Conservation and Recovery Act of 1976* (RCRA) and monitored by Pacific Northwest National Laboratory. Monitoring is done under interim-status, indicator-evaluation requirements (WAC 173-303 and by reference, 40 CFR 265.92). The well network includes three upgradient and 6 downgradient wells. The wells are sampled semiannually for contaminant indicator parameters and site-specific parameters and annually for groundwater quality parameters.

| | |
|---|---|
| Upgradient Wells | 699-26-34A<br>699-26-35A (shared with Solid Waste Landfill)<br>699-26-35C |
| Downgradient Wells | 699-25-33A<br>699-25-34A<br>699-25-34B<br>699-25-34D<br>699-26-33<br>699-26-34B |
| Groundwater Quality Parameters | Chloride<br>Iron<br>Manganese<br>Phenols<br>Sodium<br>Sulfate |
| Contaminant Indicator Parameters | pH<br>Specific Conductance<br>Total Organic Carbon<br>Total Organ Halogens |
| Site-Specific Parameters | Nitrate<br>Volatile Chlorinated Hydrocarbons |

The purpose of this plan is to describe an efficient groundwater monitoring program that is capable of determining whether waste disposal at NRDWL has impacted groundwater quality in the uppermost aquifer.

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# 1.0 Introduction

The Nonradioactive Dangerous Waste Landfill (NRDWL), which received nonradioactive hazardous waste between 1975 and 1985, is located in the central Hanford Site (Figure 1.1) in southeastern Washington State. The Solid Waste Landfill, which is regulated and monitored separately, is adjacent to the NRDWL. The NRDWL is regulated under the *Resource Conservation and Recovery Act of 1976* (RCRA) and monitored by Pacific Northwest National Laboratory.[a] Monitoring is done under interim-status, indicator-evaluation requirements (WAC 173-303 and by reference, 40 CFR 265.92). The well network includes three upgradient wells (one shared with the Solid Waste Landfill) and six downgradient wells. The wells are sampled semiannually for contaminant indicator parameters and site-specific parameters and annually for groundwater quality parameters.

## 1.1 Purpose

The purpose of this plan is to describe a streamlined groundwater monitoring program that is capable of determining whether waste disposal at NRDWL has impacted groundwater quality in the uppermost aquifer. This document supersedes all previous monitoring plans (Weekes et al. 1987; Hodges 1993a; Hodges 1995). A revision to Hodges 1993a (Hodges 1995) incorporated the new wells suggested in Hodges monitoring program into the monitoring network and proposed an additional, deep well. Subsequent evaluation indicates that an additional deep well is not needed. The monitoring program proposed in this document is based on current conceptualization of the site and is consistent with data collected during 12 years of monitoring the site.

## 1.2 Regulatory Status and History

In November 1980, an initial RCRA part A permit application for NRDWL was submitted to the U.S. Environmental Protection Agency. The application was most recently revised in 1990, when a closure/postclosure plan also was submitted (DOE 1990). However, that plan was never approved or implemented.

In 1986, a groundwater monitoring program compliant with WAC 173-303-400(3) and 40 CFR 265, Subpart F (interim status) was required by a consent agreement and compliance order from the Washington State Department of Ecology. These requirements did not change under the *Hanford Federal Facility Agreement and Consent Order* (Tri-Party Agreement; Ecology et al. 1989). Nine wells were installed, seven of which comprised the initial monitoring network (Weekes et al. 1987). In 1987, quarterly sampling to establish background levels began. Sampling was reduced to a semiannual schedule in 1989 following four quarters of background data collection. Two new wells were installed in 1992. Interim-status indicator evaluation has provided no indication of significant groundwater contamination from NRDWL.

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(a) Pacific Northwest National Laboratory is operated by Battelle for the U.S. Department of Energy.

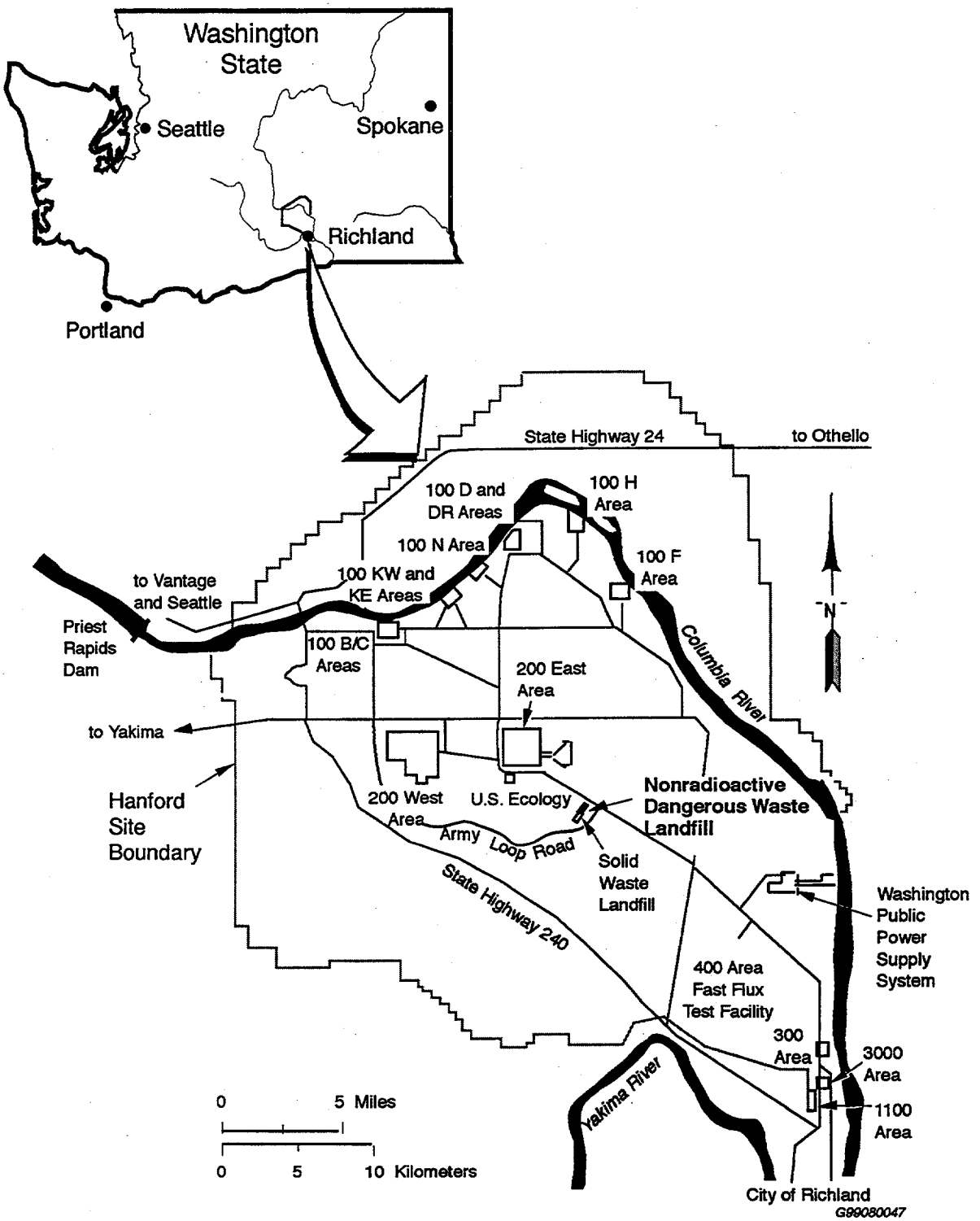


**Figure 1.1.** Location of the Nonradioactive Dangerous Waste Landfill

# 2.0 Description of the Nonradioactive Dangerous Waste Landfill

## 2.1 Physical Structure and Operational History

The NRDWL is located ~5.6-km southeast of the 200 East Area on the Hanford Site. The landfill has an area of 4.5 hectares and began operation in 1975. It consists of 19 parallel trenches, each ~122-m long, 4.9-m wide at the base, and 4.6-m deep. Beginning in 1975, chemical waste was disposed of in six trenches, asbestos in nine trenches, nonhazardous solid waste in one trench, and three were unused. The last receipt of dangerous waste was in May 1985, and the last receipt of asbestos occurred in May 1988. At the end of each operating day, the waste containers were covered with soil. This daily burial practice provided a temporary cover for the waste, but a permanent cover is planned for site closure.

The Solid Waste Landfill is adjacent to NRDWL on the south side. It is a larger facility (27 hectare) that received principally solid waste, including paper, construction debris, asbestos, and lunchroom waste. It also received sewage and bus garage wash water. Formerly both landfills were operated as a single landfill (Central Landfill).

## 2.2 Waste Types

The waste disposed of in NRDWL falls into the following categories (Hodges 1993b):

- Bulk organic waste: solvent waste, paints, paint thinners, and waste oils.
- Metal cleaner waste: primarily a mixture of sulfamic acid and sodium bisulfate.
- Small-quantity laboratory chemicals: used and unused reagents and various laboratory formulations, primarily metallic salts, acids, bases, oxidizers, and organic chemicals.
- Asbestos: primarily building demolition material, which accounts for more than 50% by volume of all waste disposed in the landfill.
- Nonhazardous solid waste: office and lunchroom waste, construction and demolition debris, and septic tank sludge.

Most of the chemical waste was placed in metal drums before disposal. Containers of small-quantity laboratory chemicals were placed in lab-packs and surrounded with sorbing material. Nonhazardous waste and asbestos were generally not placed in containers. In addition, some of the bulk organic wastes that were sorbed onto soil and other sorbents may not have been placed in containers.

# 3.0 Hydrogeology

The geology and hydrology of the NRDWL site are described in detail by Weekes et al. (1987) and Hodges (1993a). The following summary is taken largely from those documents unless indicated otherwise.

## 3.1 Physical Hydrogeology

The NRDWL is underlain by sands and gravels of the Hanford and Ringold formations (Figure 3.1). The vadose zone is ~40-m thick and consists of sand, silty sandy gravel, and gravel. The water table is near the top of a silty sand unit of the Hanford formation. Saturated sediments are composed of the following units:

- Saturated Hanford sediments: gravelly sand to sandy gravel, ~18-m thick; estimated horizontal hydraulic conductivity from field aquifer tests is approximately 1,000 m/d.

- Upper Ringold and Ringold Formation unit E, divided into three units based on lithology and hydraulic conductivity (40 to 45-m thick):
  - Slightly silty gravelly sand to sand, ~4-m thick; estimated horizontal hydraulic conductivity from field aquifer tests is 60 m/d.
  - Hard, clayey silt (low permeability) 1 to 4-m thick; estimated vertical hydraulic conductivity from field aquifer tests ranges from 0.006 to 3 m/d.
  - Silty sand to sandy gravel, unknown thickness; estimated horizontal hydraulic conductivity from field aquifer tests ranges from 0.3 to 15 m/d. This unit is probably unit E, but there are no wells in the vicinity that fully penetrate this unit. Approximately 2-km east at well 699-25-26, the Ringold Formation unit E is 40 m thick (Lindsey 1991).

- Ringold Formation unit C, unit B, the lower mud unit, and unit A are described as follows:
  - Unit C, 10 m, gravel and sandy gravel
  - Overbank deposit, 20 m, sandy silt and silty sand
  - Unit B, 10 m, gravel and sandy gravel
  - Lower mud unit, 17 m, silt and sandy silt
  - Unit A, 28 m, gravel and sandy gravel

- Top of basalt at ~185-m depth

The uppermost aquifer is unconfined and is part of the saturated Hanford sediments and probably the upper portion of the Upper Ringold unit. A low-permeability unit perhaps in the lower portion of the Upper Ringold unit or in unit E is believed to form the base of the uppermost aquifer because the hydraulic conductivity of the aquifer base is orders of magnitude lower than the overlying sediments.

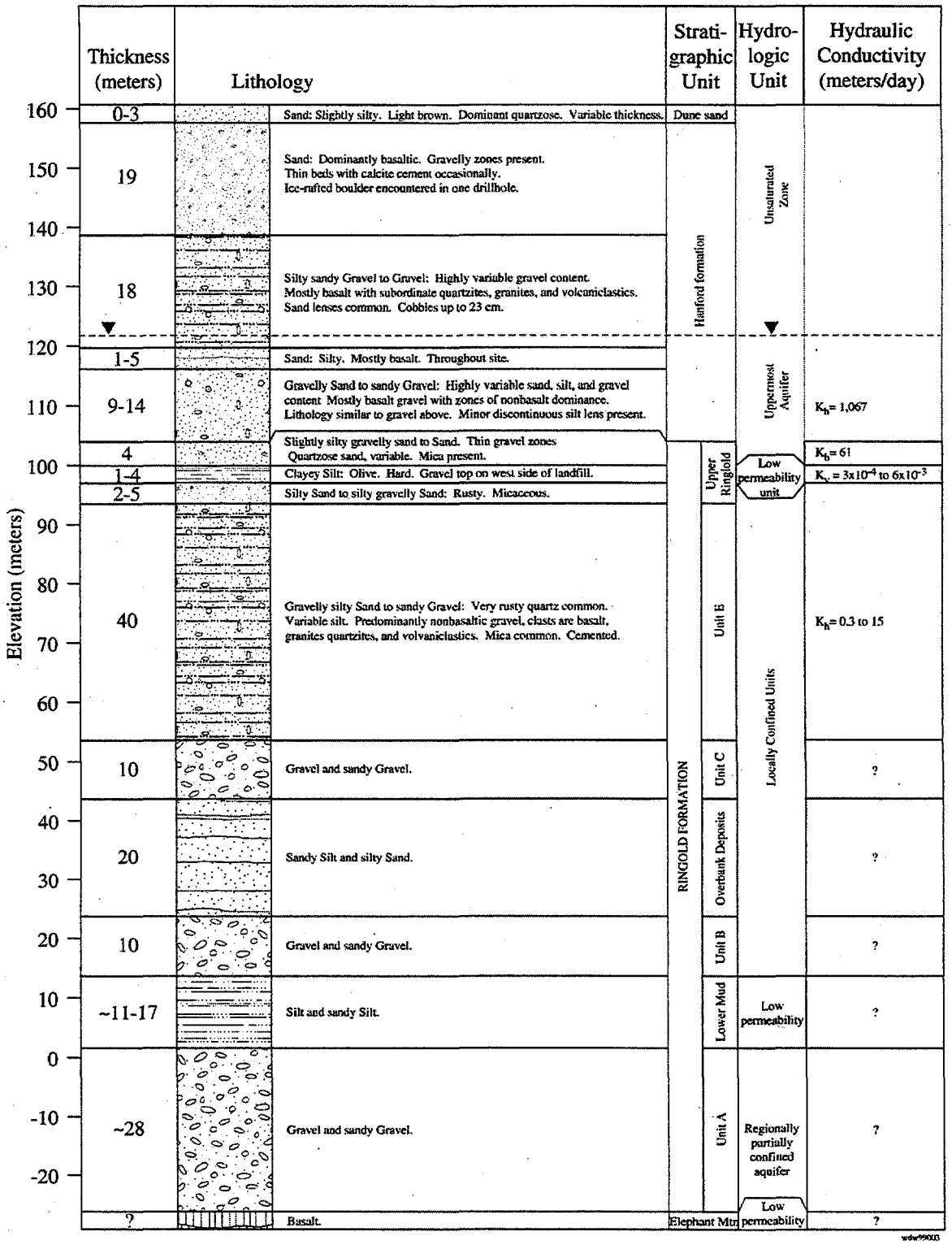


**Figure 3.1**. Stratigraphic Column at the NRDWL and Associated Hydrogeology

The hydraulic gradient beneath NRDWL is very low (0.00005; Weekes et al. 1987) because the aquifer is very transmissive. Previous estimates based on data from the nearby wells indicate that flow is generally west to east (Weekes et al. 1987, p. 43). A water-table map of the region around the landfill is shown in Figure 3.2. Assuming groundwater flows perpendicular to the equipotential lines, flow converges from the north-northeast and the southwest, and moves toward the southeast. Contaminant plumes originating in the 200 East Area move through the area from northwest to southeast, corroborate this interpretation.

Two wells at NRDWL sample the bottom of the uppermost aquifer, i.e., just above the low-permeability unit. Heads in these wells are virtually the same as in adjacent wells completed at the top of the aquifer, indicating no significant vertical gradient (Lindberg 1999, Section 3.7).

Water-levels beneath NRDWL declined nearly 2 m since 1988 because lower volumes of liquid waste are being discharged to the ground in the 200 Areas (Figure 3.3) (Lindberg 1999, Section 3.7). Based on a comparison of present levels of the water table with a hindcast water-table map (estimating water-table elevations in 1944, ERDA 1975) the water table could decline as much as 4.6 m before returning to pre-Hanford Site levels.

## 3.2 Summary of Groundwater Monitoring Results

Monitoring began at NRDWL and adjacent Solid Waste Landfill in 1987. Wells were sampled quarterly in 1987 through 1989, and semiannually thereafter. Some of the wells are co-sampled with Hanford environmental surveillance monitoring.

Concentrations of RCRA indicator parameters (specific conductance, pH, total organic carbon, and total organic halogens) have not significantly increased (or pH decreased) over background (upgradient) concentrations. Some chlorinated hydrocarbons were detected in the NRDWL monitoring wells in concentrations below their maximum contaminant levels (Table 3.1). One potential source of these low levels of chlorinated hydrocarbons is vadose-zone transport from the adjacent Solid Waste Landfill. Chlorinated hydrocarbons were disposed at the Solid Waste Landfill and are detected in groundwater downgradient of the Solid Waste Landfill. Soil gas surveys at NRDWL have detected several volatile organic compounds including chlorinated hydrocarbons. However, the shallow nature of soil gas surveys to date makes it inappropriate to link chlorinated hydrocarbons disposed at the Solid Waste Landfill with the low levels of chlorinated hydrocarbons detected in the groundwater (Jacques and Kerkow 1993).

Vadose zone gases were sampled during installation of wells 699-26-33 and 699-25-34A in 1992 (Hodges 1993a). A chlorinated hydrocarbon, probably carbon tetrachloride, was detected as deep as 37 m, near the water table (a malfunctioning gas chromatograph prevented unique identification of the compound). A shallow vadose zone soil gas survey was conducted in 1993 (Hodges 1994). The survey found widespread acetone and several chlorinated hydrocarbons, most notably tetrachloroethylene and trichloroethylene. The highest concentrations were detected over the older chemical trenches near the east end of NRDWL. Carbon tetrachloride, 1,1,1-trichloroethane, and chloroform were also detected locally. The presence of chlorinated hydrocarbons in the vadose zone suggests the possibility of their migration from the NRDWL to groundwater, and in fact most of them have been detected in groundwater.

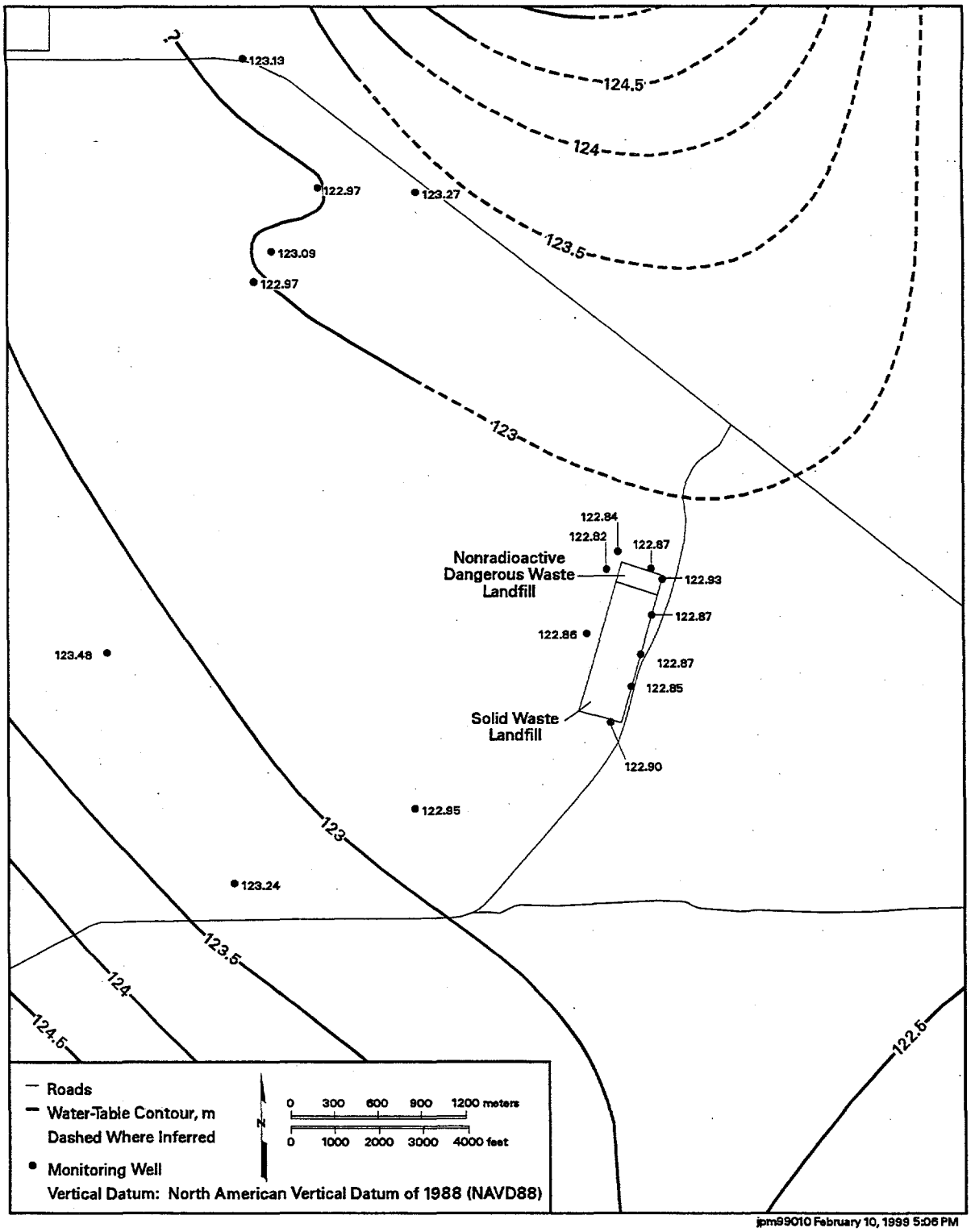


**Figure 3.2.** Water-Table Map for Nonradioactive Dangerous Waste Landfill and Solid Waste Landfill, June 1998

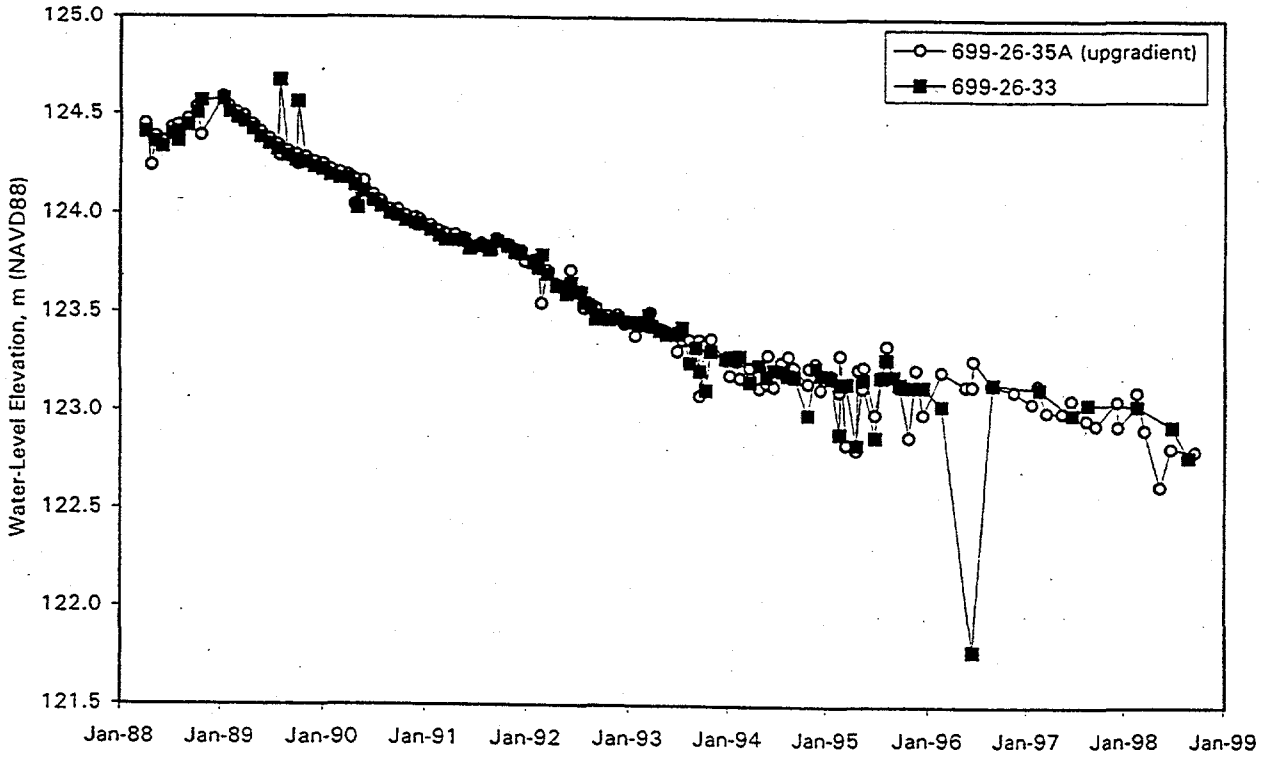


**Figure 3.3.** Water-Table Elevations in Wells Monitoring Nonradioactive Dangerous Waste Landfill

Tetrachloroethylene concentrations are higher in downgradient wells 699-25-34A and 699-25-34B than in upgradient wells (Figure 3.4). Downgradient concentrations are fairly steady at 1 to 2 µg/L. Trichloroethylene concentrations are also slightly higher in downgradient wells (Figure 3.5), but concentrations are less than or equal to 1 µg/L.

Carbon tetrachloride and 1,1,1-trichloroethane were detected in upgradient and downgradient NRDWL wells. All of the concentrations were less than or equal to 2 µg/L, and most are less than 1 µg/L (Figures 3.6 and 3.7). Concentrations in the early 1990s were greater in downgradient wells 699-25-34A and 699-25-34B than in upgradient wells. Since then, concentrations have decreased and are approximately the same as in upgradient wells.

Chloroform was detected in downgradient wells. Recently concentrations have increased from below detection limits to 1 µg/L in upgradient wells, which is greater than in downgradient wells (Figure 3.8). The cause of this change in upgradient concentrations is not known.

As mentioned previously in this section, acetone was also detected in shallow vadose zone gases. One set of samples from the NRDWL wells was analyzed for acetone in 1990. All results were below detection limits.

Groundwater beneath the NRDWL is contaminated with tritium, iodine-129, and nitrate from the 200 Areas. The plume boundaries bisect the Central Landfill, with low concentrations to the southwest and high concentrations to the northeast. Concentrations of these constituents in groundwater are decreasing gradually with time in all of the shallow NRDWL wells.

**Table 3.1.** Range and Average Concentration of Detected Chlorinated Hydrocarbons in NRDWL Wells, 1987-1998[a]

| Well | Constituent | Minimum µg/L | Maximum µg/L | Average[b] µg/L | Number of Sample Dates |
|---|---|---|---|---|---|
| 699-26-34A upgradient | 1,1,1-Trichloroethane | <DL | 2.10 | 0.85 | 20 |
| | 1,1-Dichloroethane | <DL | 0.14 | 0.01 | 20 |
| | 1,4-Dichlorobenzene | <DL | 0.09 | 0.01 | 20 |
| | Carbon tetrachloride | <DL | 0.91 | 0.12 | 20 |
| | Chloroform | <DL | 1.0 | 0.07 | 20 |
| | Tetrachloroethylene | <DL | 0.70 | 0.26 | 20 |
| | Trichloroethylene | <DL | 0.46 | 0.11 | 19 |
| | TOC | <DL | 635.85 | 169.11 | 14 |
| | TOX | <DL | 3.75 | 0.83 | 22 |
| 699-26-35A upgradient | 1,1,1-Trichloroethane | <DL | 4.0 | 1.25 | 36 |
| | 1,1-Dichloroethane | <DL | 0.30 | 0.02 | 36 |
| | 1,4-Dichlorobenzene | <DL | 0.05 | <DL | 32 |
| | Carbon tetrachloride | <DL | 2.0 | 0.19 | 37 |
| | Chloroform | <DL | 1.0 | 0.06 | 37 |
| | Tetrachloroethylene | <DL | 3.0 | 0.46 | 36 |
| | Trichloroethylene | <DL | 1.0 | 0.16 | 35 |
| | TOC | <DL | 933 | 95 | 43 |
| | TOX | <DL | 9.8 | 2.1 | 32 |
| 699-25-34A downgradient | 1,1,1-Trichloroethane | <DL | 6.1 | 2.04 | 21 |
| | 1,1-Dichloroethane | <DL | 0.3 | 0.05 | 21 |
| | 1,4-Dichlorobenzene | <DL | 0.06 | <DL | 17 |
| | Carbon tetrachloride | <DL | 1.6 | 0.25 | 22 |
| | Chloroform | <DL | 0.5 | 0.15 | 22 |
| | Tetrachloroethylene | <DL | 1.5 | 0.77 | 21 |
| | Trichloroethylene | <DL | 0.7 | 0.28 | 20 |
| | TOC | <DL | 770 | 90 | 28 |
| | TOX | <DL | 10.7 | 2.4 | 23 |
| 699-25-34B downgradient | 1,1,1-Trichloroethane | <DL | 7.0 | 1.72 | 21 |
| | 1,1-Dichloroethane | <DL | 0.3 | 0.06 | 21 |
| | 1,4-Dichlorobenzene | <DL | 0.28 | 0.03 | 17 |
| | Carbon tetrachloride | <DL | 0.89 | 0.14 | 22 |
| | Chloroform | <DL | 1.1 | 0.16 | 22 |
| | Tetrachloroethylene | <DL | 1.75 | 0.69 | 21 |
| | Trichloroethylene | <DL | 1.1 | 0.3 | 20 |
| | TOC | <DL | 800 | 89 | 28 |
| | TOX | <DL | 16.2 | 3.6 | 23 |
| 699-25-34D downgradient | 1,1,1-Trichloroethane | 0.7 | 6.0 | 2.1 | 13 |
| | 1,1-Dichloroethane | <DL | 2.0 | 0.22 | 13 |
| | 1,4-Dichlorobenzene | <DL | 0.4 | 0.03 | 13 |
| | Carbon tetrachloride | <DL | 0.89 | 0.26 | 14 |

**Table 3.1.** (contd)

| Well | Constituent | Minimum µg/L | Maximum µg/L | Average[b] µg/L | Number of Sample Dates |
|---|---|---|---|---|---|
| | Chloroform | <DL | 0.33 | 0.13 | 14 |
| | Tetrachloroethylene | <DL | 2.0 | 0.87 | 13 |
| | Trichloroethylene | <DL | 0.90 | 0.48 | 12 |
| | TOC | <DL | 575 | 131 | 14 |
| | TOX | <DL | 11.6 | 4.8 | 9 |
| 699-26-33 downgradient | 1,1,1-Trichloroethane | <DL | 2.6 | 1.05 | 21 |
| | 1,1-Dichloroethane | <DL | 0.13 | 0.01 | 21 |
| | 1,4-Dichlorobenzene | <DL | <DL | <DL | 17 |
| | Carbon tetrachloride | <DL | 1.9 | 0.22 | 21 |
| | Chloroform | <DL | 0.30 | 0.06 | 21 |
| | Tetrachloroethylene | <DL | 0.92 | 0.40 | 21 |
| | Trichloroethylene | <DL | 0.52 | 0.14 | 20 |
| | TOC | <DL | 1470 | 160 | 28 |
| | TOX | <DL | 13 | 2.2 | 23 |
| 699-26-34B downgradient | 1,1,1-Trichloroethane | 0.24 | 1.4 | 0.99 | 13 |
| | 1,1-Dichloroethane | <DL | 0.07 | 0.01 | 13 |
| | 1,4-Dichlorobenzene | <DL | <DL | <DL | 13 |
| | Carbon tetrachloride | <DL | 0.60 | 0.18 | 13 |
| | Chloroform | <DL | 0.20 | 0.05 | 13 |
| | Tetrachloroethylene | <DL | 0.82 | 0.35 | 13 |
| | Trichloroethylene | <DL | 0.34 | 0.13 | 12 |
| | TOC | <DL | 636 | 169 | 14 |
| | TOX | <DL | 8.0 | 3.3 | 9 |
| 699-26-35C upgradient, deep | 1,1,1-Trichloroethane | <DL | <DL | <DL | 21 |
| | 1,1-Dichloroethane | <DL | <DL | <DL | 21 |
| | 1,4-Dichlorobenzene | <DL | <DL | <DL | 17 |
| | Carbon tetrachloride | <DL | <DL | <DL | 21 |
| | Chloroform | <DL | 0.20 | 0.02 | 21 |
| | Tetrachloroethylene | <DL | <DL | <DL | 21 |
| | Trichloroethylene | <DL | 0.07 | <DL | 20 |
| | TOC | <DL | 203 | 32 | 27 |
| | TOX | <DL | 9.8 | 1.2 | 21 |
| 699-25-33A downgradient, deep | 1,1,1-Trichloroethane | <DL | 0.25 | 0.02 | 21 |
| | 1,1-Dichloroethane | <DL | <DL | <DL | 21 |
| | 1,4-Dichlorobenzene | <DL | <DL | <DL | 17 |
| | Carbon tetrachloride | <DL | <DL | <DL | 22 |
| | Chloroform | <DL | <DL | <DL | 22 |
| | Tetrachloroethylene | <DL | 0.06 | <DL | 21 |
| | Trichloroethylene | <DL | <DL | <DL | 20 |
| | TOC | <DL | 1320 | 126 | 27 |
| | TOX | <DL | 6.4 | 0.87 | 22 |

(a) Excluded data flagged as suspect or rejected; averaged replicates by date.
(b) Changed less-than detection values to zero to calculate average.
DL = detection level
TOC = total organic carbon.
TOX = total organic halogen.

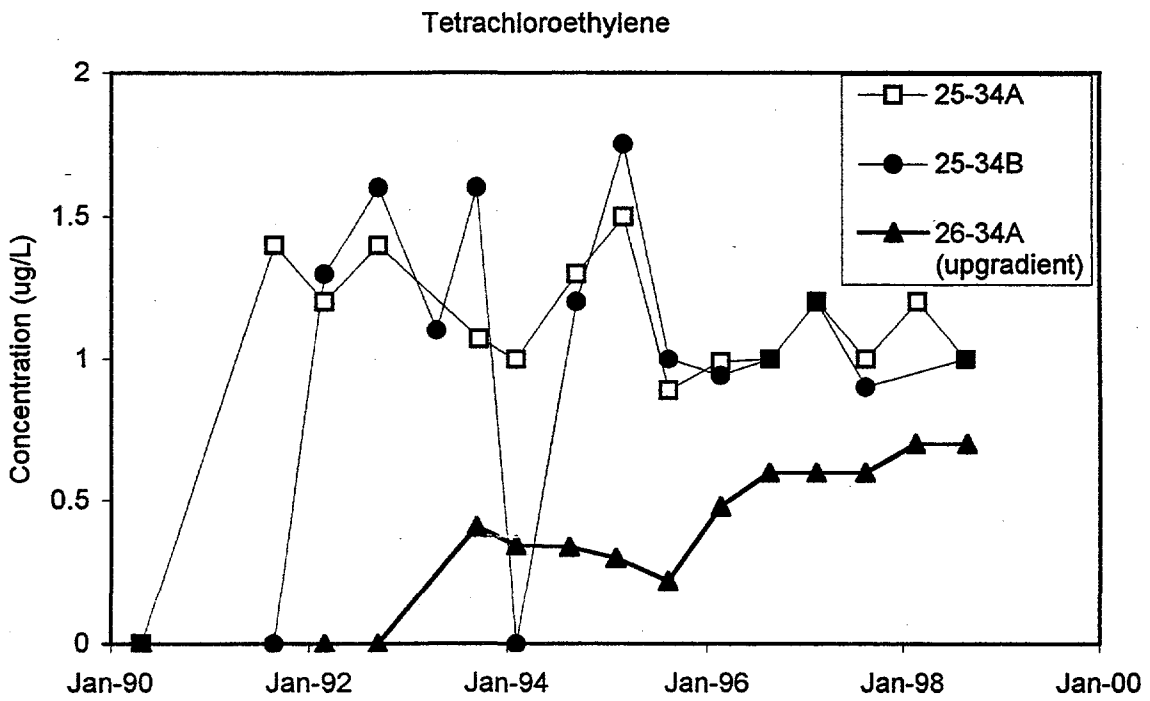


**Figure 3.4.** Tetrachloroethene Concentrations in NRDWL Wells

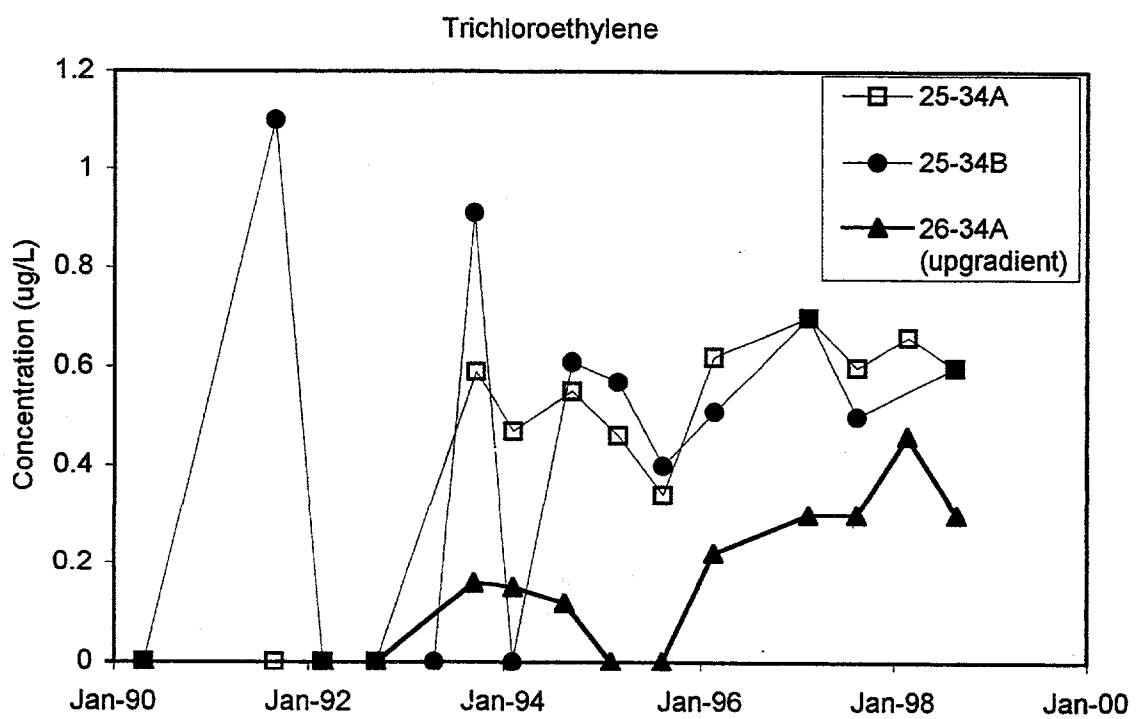


**Figure 3.5.** Trichloroethene Concentrations in NRDWL Wells

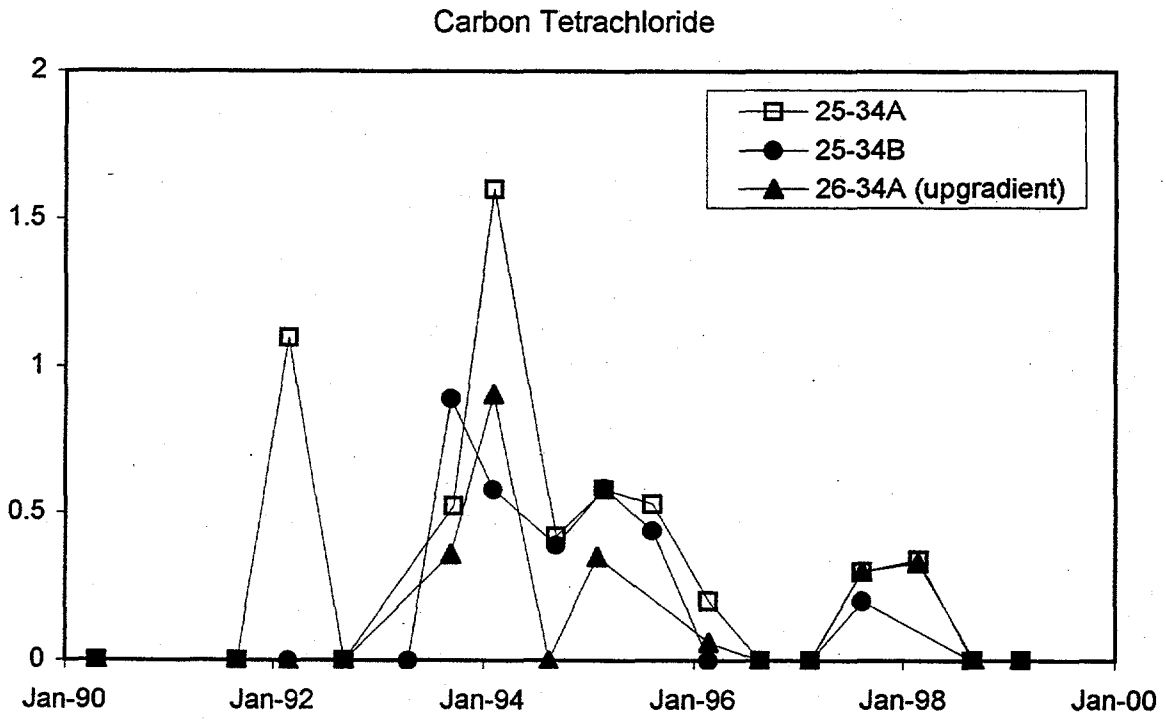


**Figure 3.6.** Carbon Tetrachloride Concentrations at NRDWL Wells

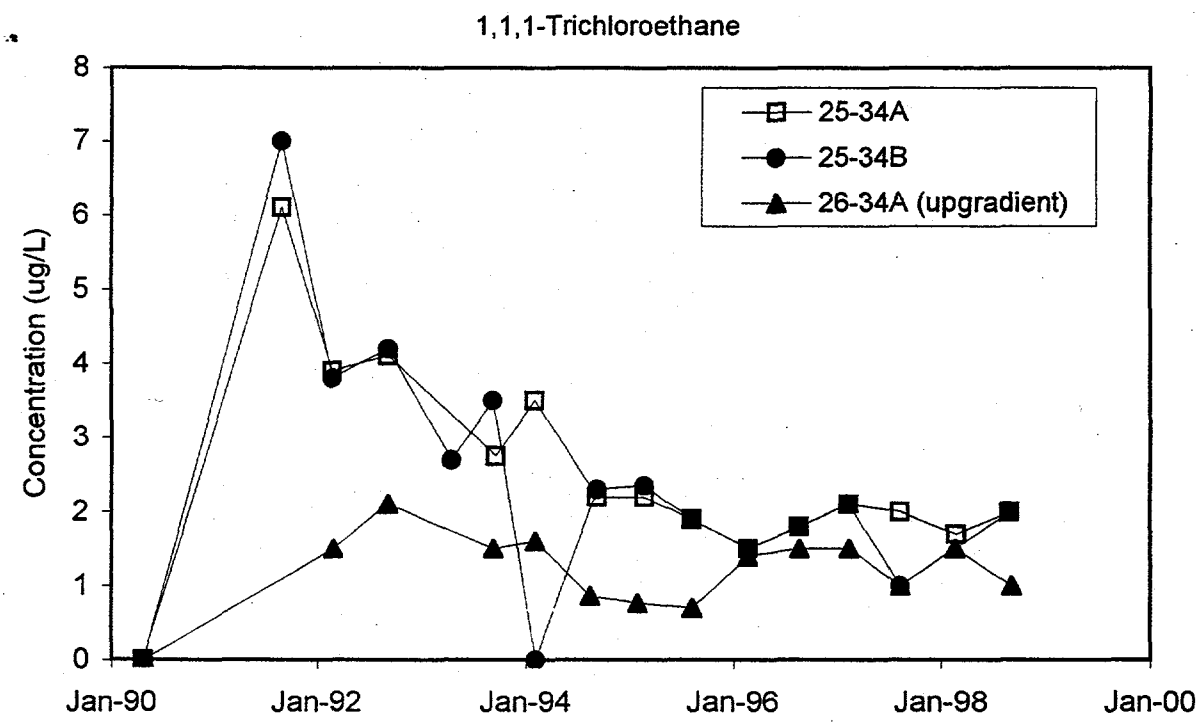


**Figure 3.7.** 1,1,1-Trichloroethane Concentrations at NRDWL Wells

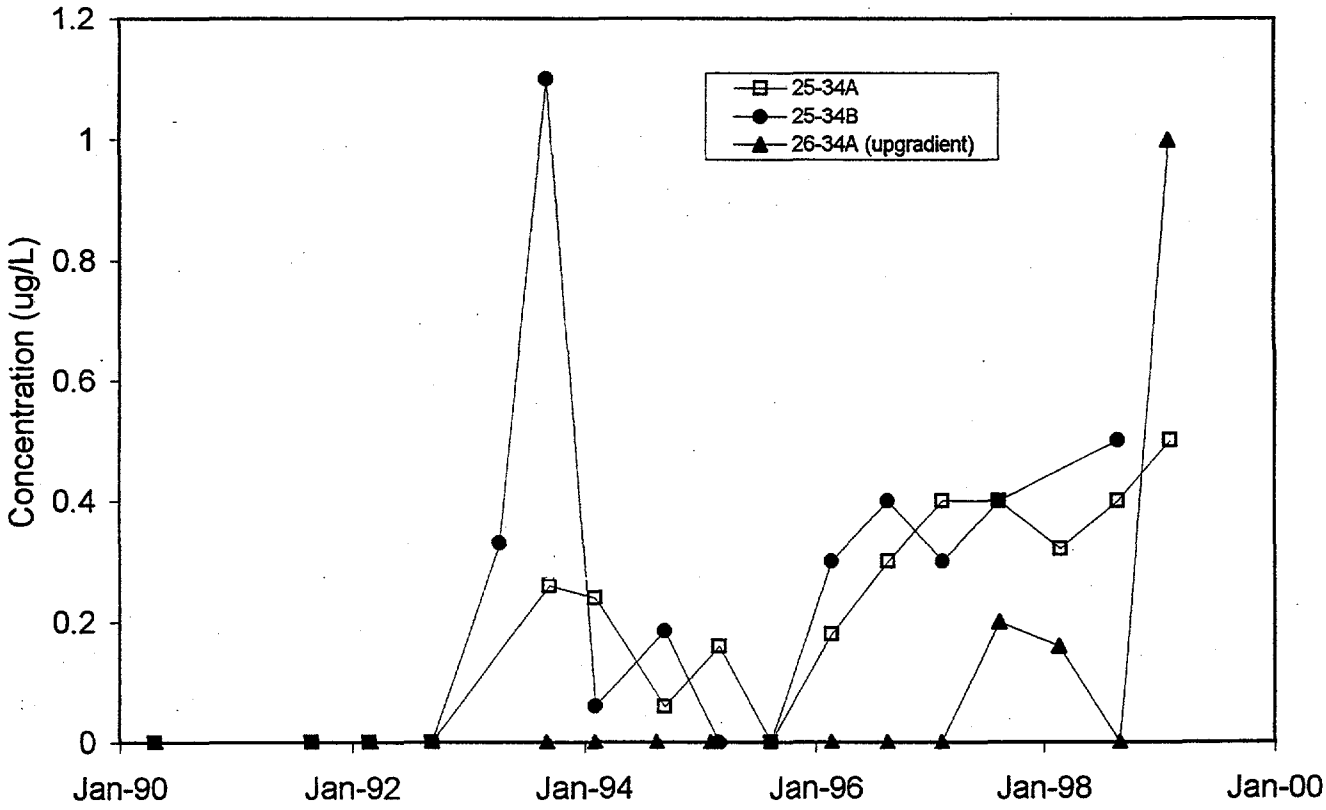


**Figure 3.8.** Chloroform Concentrations in NRDWL Wells

# 4.0 Conceptual Model

The following characteristics constitute key portions of the NRDWL conceptual model:

- Relatively small quantities of dangerous waste liquids were disposed of in NRDWL; most were placed in sorbing material so not much free liquid remained. It is unlikely that dense, nonaqueous phase liquids are present.

- Chlorinated hydrocarbons are present in vadose vapors and are the primary contaminant of concern for groundwater.

- Natural precipitation may carry some contaminants through the vadose zone to groundwater.

- Dangerous waste materials remain in the landfill; therefore, contamination from the landfill may still impact groundwater.

- Contaminants may move laterally within the vadose zone via vapor transport, perhaps from the adjacent solid waste landfill. However, soil gas studies to date have failed to prove this.

- Contaminants remain in the uppermost aquifer above the low-permeability unit. To date, indicator parameters measured in downgradient wells at the water table are lower in concentration than critical means or are within critical ranges, and contaminant concentrations are below respective MCLs. Similarly, the downgradient well sampling groundwater at the top of the low-permeability unit (well 699-25-33A) has very low concentrations of constituents monitored.

- The zone below the low-permeability unit has not been impacted by NRDWL because the saturated zone above the unit has not been impacted adversely by the NRDWL. That is, in order for the lower zone to be affected, the upper one must be affected first.

- Regionally, groundwater flows toward the southeast; however, flow directly beneath to the landfill may be toward the east or even northeast. The hydraulic gradient in the immediate vicinity of NRDWL is extremely low.

# 5.0 Groundwater Monitoring Program

## 5.1 Objectives of RCRA Monitoring

The overall objectives of the Groundwater Monitoring Program at the Hanford Site are to (a) protect human health and the environment; (b) comply with governmental regulations; and (c) contribute to groundwater investigation or remediation. Specifically, the objective of the groundwater monitoring at NRDWL is to detect adverse impact from the facility on the groundwater quality.

## 5.2 Special Conditions

Two hydrogeological conditions at NRDWL are of special concern to the development of this groundwater monitoring plan. The first is the low-permeability unit within Upper Ringold unit or Ringold Formation unit E. This low-permeability layer limits the thickness of the uppermost aquifer locally to about 22 m. It also limits the depth of contaminant sinkers (e.g., dense, nonaqueous phase liquids). A groundwater monitoring plan must account for this low-permeability zone and provide assurance that groundwater contamination from NRDWL has not reached the top of the low-permeability unit, as well as more shallow depths of the uppermost aquifer. (See also Section 4.0, "Conceptual Model.")

The second special condition is the extremely low hydraulic gradient and the difficulty in determining an accurate direction of groundwater flow in the uppermost aquifer. Water-table maps (like in Weekes et al. 1987, p. 43) indicate the flow should be generally from west to east in the immediate vicinity of the NRDWL. However, contaminate plumes like tritium from the 200 East Area are moving from the north-west to the southeast. (See also Section 4.0, "Conceptual Model.")

## 5.3 Sampling and Analysis Plan

### 5.3.1 Monitoring Well Network

The six downgradient wells and three upgradient wells (Table 5.1) of the monitoring well network are designed to

- detect groundwater contamination (from NRDWL) before it moves downgradient of the network wells
- compare upgradient and downgradient concentrations of indicator parameters
- determine if groundwater contamination has migrated vertically and impacted groundwater at the base of the uppermost aquifer (immediately above the low-permeability unit).

**Table 5.1.** Monitoring Well Network

| Well | Year Installed | Hydrogeologic Unit Monitored | Well Construction Standard | Upgradient/ Downgradient |
|---|---|---|---|---|
| 699-25-33A | 1987 | Top of LPU[a] | WAC 173-160 | Downgradient |
| 699-25-34A | 1986 | Top of Unconfined Aquifer | WAC 173-160 | Downgradient |
| 699-25-34B | 1986 | Top of Unconfined Aquifer | WAC 173-160 | Downgradient |
| 699-25-34D | 1992 | Top of Unconfined Aquifer | WAC 173-160 | Downgradient |
| 699-26-33 | 1986 | Top of Unconfined Aquifer | WAC 173-160 | Downgradient |
| 699-26-34A | 1986 | Top of Unconfined Aquifer | WAC 173-160 | Upgradient |
| 699-26-34B | 1992 | Top of Unconfined Aquifer | WAC 173-160 | Downgradient |
| 699-26-35A[b] | 1986 | Top of Unconfined Aquifer | WAC 173-160 | Upgradient |
| 699-26-35C | 1987 | Top of LPU[a] | WAC 173-160 | Upgradient |

(a) Low-permeability unit in Upper Ringold Formation.
(b) Well shared with Solid Waste Landfill Network.

The six downgradient wells are located (Figure 5.1) around the northern, eastern, and southern boundaries of NRDWL to detect potentially contaminated groundwater in response to groundwater flowing either eastward (interpreted from water table contours) or southeastward (interpreted from plume maps). Monitoring Efficiency Model (MEMO) results demonstrate that the downgradient wells have a monitoring efficiency of more than 90% for flow directions from 80 degrees to 140 degrees clockwise from north (DOE 1990). Results for a flow direction of 125 degrees clockwise from due north (southeast—the most likely flow direction) indicate a model efficiency of 99.8%. One downgradient well (699-25-33A) was installed at the top of the low-permeability unit to detect potentially contaminated groundwater at the base of the uppermost aquifer.

The three upgradient wells (Figure 5.1) are located northwestward to determine background water quality. Wells 699-26-34A and 699-26-35A are screened near the water table and are compared with downgradient water quality (from five downgradient wells) to determine if NRDWL has adversely affected groundwater quality. (See Sections 6.2 and 6.3 for an explanation of the methods used to compare background and downgradient water quality. Well 699-26-35A is shared with the Solid Waste Landfill.) Well 699-26-35C is screened immediately above the low-permeability zone, and results are used for information purposes only. Results from this well cannot be used for background statistics because the well monitors a different portion of the aquifer.

To determine whether groundwater contamination can be detected lower in the aquifer (lower than near the water table), two deeper wells sample groundwater at the top of the low-permeability zone. One of the deeper wells is located upgradient of NRDWL and the other is downgradient to examine upgradient and downgradient concentrations of chlorinated hydrocarbons over time (Figure 5.1). Some chlorinated hydrocarbons have a dense nonaqueous phase that could migrate downward to the top of the low-permeability zone.

Appendix A contains construction details for each well in the groundwater monitoring network at NRDWL.

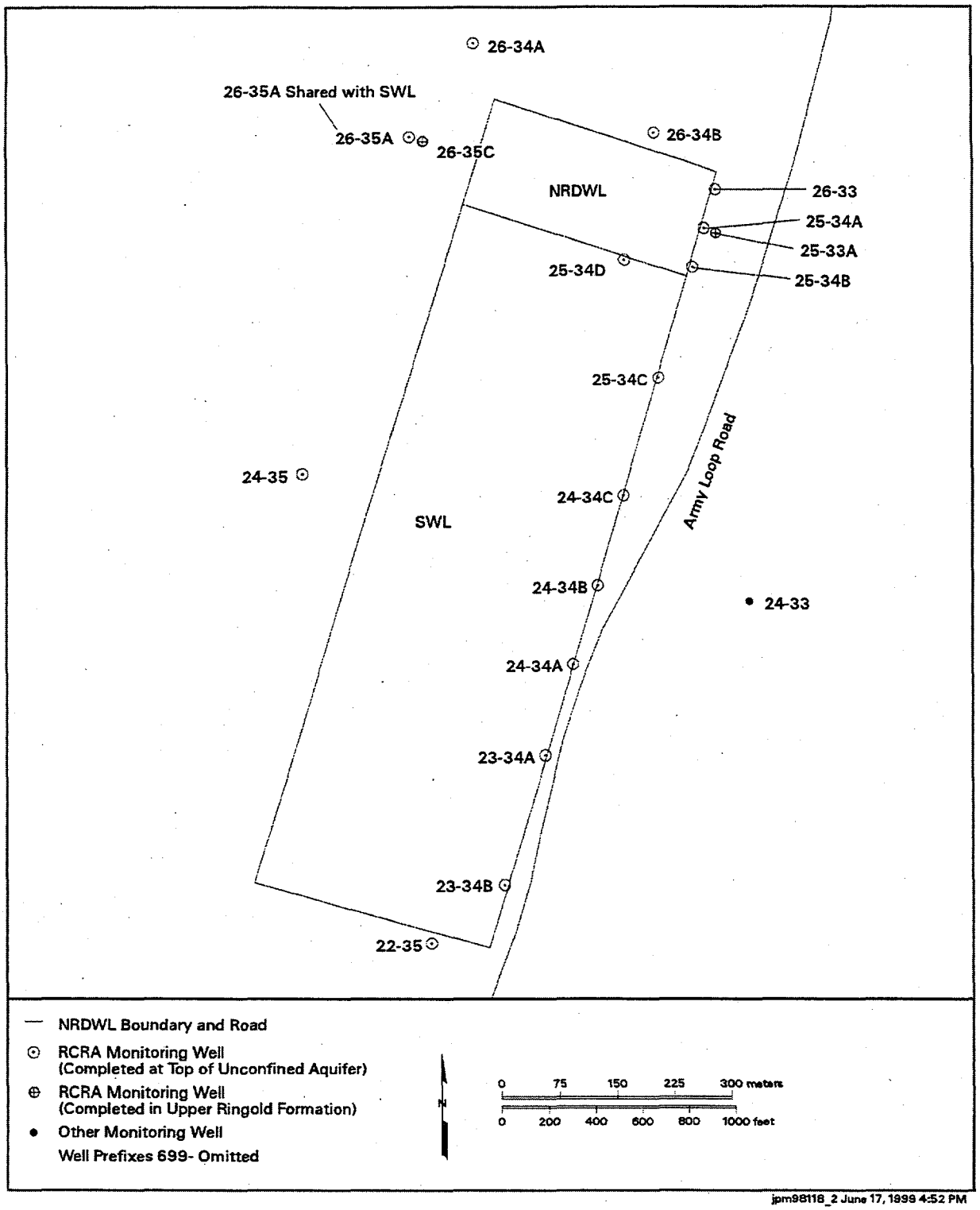


**Figure 5.1.** Monitoring Well Locations for Solid Waste Landfill and Nonradioactive Dangerous Waste Landfill

### 5.3.2 Constituent List and Sampling Frequency

After the first year, groundwater beneath RCRA treatment, storage, and disposal units in an interim status/indicator-evaluation program (WAC 173-303 and by reference, 40 CFR 265) must be monitored for groundwater quality parameters and contaminant indicator parameters. If appropriate, site-specific parameters may be added (Table 5.2 lists the monitored constituents and frequencies appropriate for NRDWL). The groundwater quality parameters are to be monitored annually, the contaminant indicator parameters semiannually, and the site-specific parameters semiannually. Groundwater quality parameters include chloride, iron, manganese, phenols, sodium, and sulfate. Contaminant indicator parameters include specific conductance, pH, total organic carbon, and total organic halogens. Appropriate site-specific parameters are nitrate and volatile chlorinated hydrocarbons. Nitrate is monitored semiannually because it is a significant upgradient groundwater contaminant that may affect an indicator parameter (specific conductance). Volatile chlorinated hydrocarbons are monitored semiannually because they have been detected in the 12 years of groundwater monitoring at NRDWL.

### 5.3.3 Determination of Groundwater Flow

Depth-to-water measurements will continue to be collected from each monitoring well when each is sampled. Therefore, depth-to-water will be measured at least semiannually at all network wells. These depth-to-water measurements will be used to construct water-table maps which, in turn, will be reevaluated annually to determine the direction of groundwater flow beneath NRDWL. In addition, depth-to-water will be measured at approximately six of the NRDWL monitoring wells during the month of March to support the efforts to make a water-table map of the entire Hanford Site for *Hanford Site Groundwater Monitoring* (Hartman 1999) each year. (Initially, the six wells measured will include 699-22-35, -23-34A, -25-34C, -26-34A, -26-34B, and –26-35A, but these may change as the needs of the Hanford Site map change.)

**Table 5.2.** Constituent List and Sampling Frequency

| |
|---|
| **Contamination Indicator Parameters (Quadruplicate Samples) (Sampled Semiannually)** |
| pH |
| Specific Conductance |
| Total Organic Carbon |
| Total Organic Halides |
| **Groundwater Quality Parameters (Sampled Annually)** |
| Chloride |
| Iron |
| Manganese |
| Phenols |
| Sodium |
| Sulfate |
| **Site-Specific Parameters (Sampled Semiannually)** |
| Volatile Chlorinated Hydrocarbons |
| Nitrate |

The water table at NRDWL has a very low gradient. Water-table maps constructed previously from the depth-to-water measurements (and surveyed elevation of the ground surface and casing top at each well) show that the gradient across the site is approximately 0.00005 (Weekes et al. 1987). Determining groundwater flow direction in an area the size of the NRDWL when the gradient is 0.00005 is very difficult. Very small errors in depth-to-water measurements or in surveyed casing elevations are significantly large compared to the low gradient. Therefore, maps showing the major plumes of tritium, nitrate, and iodine-129 will be used to corroborate flow directions based on water-table maps.

Using the Darcy equation,

$$v = \frac{K(i)}{n_{(e)}} \tag{1}$$

average groundwater flow rate (v) will be estimated from known estimates of hydraulic conductivity (K), the water-table gradient (i), and effective porosity ($n_{(e)}$).

### 5.3.4 Sampling and Analysis Protocol

Monitoring at NRDWL is part of the Hanford Groundwater Monitoring Project. Procedures for groundwater sampling, documentation, sample preservation, shipment, and chain-of-custody requirements are described in Pacific Northwest National Laboratory or subcontractor manuals (currently, Waste Management Northwest procedures manual ES-SSPM-001, Waste Management Federal Services, 1998) and in the groundwater monitoring quality assurance (QA) plan (PNNL 1998). Samples generally are collected after three casing volumes of water have been purged from the well or after field parameters (pH, temperature, specific conductance, and turbidity) have stabilized. For routine groundwater samples, preservatives are added to the collection bottles before their use in the field. Samples to be analyzed for metals are usually filtered in the field so that results represent dissolved metals.

Procedures for field measurements are specified in the subcontractor's or manufacturer's manuals. Analytical methods are specified in contracts with laboratories, and most are standard methods from *Test Methods for Evaluating Solid Wastes, Physical/Chemical Methods* (EPA 1986b). Analytical methods are described in Gillespie (1999). Alternative procedures meet the guidelines of SW-846, Chapter 10 (EPA 1979).

### 5.3.5 Quality Assurance and Quality Control

The QA and quality control (QC) program for groundwater monitoring is designed to assess and enhance the reliability and validity of groundwater data. The primary quantitative measures or parameters used to assess data quality are accuracy, precision, completeness, and the method detection limit. Qualitative measures include representativeness and comparability. Goals for data representativeness for groundwater monitoring projects are addressed qualitatively by the specification of well locations, well construction, sampling intervals, and sampling and analysis techniques in the groundwater monitoring plan for each RCRA facility. Comparability is the confidence with which one data set can be compared

to another. The QC parameters are evaluated through laboratory checks (e.g., matrix spikes, laboratory blanks), replicate sampling and analysis, analysis of blind standards and blanks, and interlaboratory comparisons. Acceptance criteria have been established for each of these parameters (PNNL 1998), based on guidance from the U.S. Environmental Protection Agency (EPA 1986b). When a parameter is outside the criteria, corrective actions are taken to prevent a future occurrence and affected data are flagged in the database.

# 6.0 Data Management, Evaluation, and Reporting

This section describes how groundwater data are stored, retrieved, evaluated, and interpreted. Statistical evaluation methods and reporting requirements are also described.

## 6.1 Data Management

The contract laboratories report analytical results electronically. The results are loaded into the Hanford Environmental Information System (HEIS) database. Field-measured parameters are entered manually or through electronic transfer. Data from HEIS may be downloaded to smaller databases, such as the Geosciences Data Analysis Toolkit (GeoDAT) for data validation, reduction, and trend analysis. Paper data reports and field records are considered to be the record copies and are stored at Pacific Northwest National Laboratory.

The data undergo a validation and verification process according to a documented procedure, as described in the project QA plan. QC data are evaluated against the criteria listed in the project QA plan and data flags are assigned when appropriate. In addition, data are screened by scientists familiar with the hydrogeology of the unit, compared to historical trends or spatial patterns, and flagged if they are not representative. Other checks on data may include comparison of general parameters to their specific counterparts (e.g., conductivity to ions; gross alpha to uranium), calculation of charge balances, and comparison of calculated versus measured conductivity. If necessary, the laboratory may be asked to check calculations or reanalyze the sample, or the well may be resampled.

## 6.2 Interpretation

After 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 man-made 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 chemical or radiological constituents versus time to determine fluctuations and trends. These plots 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 or radiological constituents areally in the aquifer to determine extent of contamination. Changes in plume distribution over time aid in determining movement of plumes and direction of flow.

## 6.3 Statistical Evaluation

The goal of RCRA detection monitoring is to determine if NRDWL has affected groundwater quality. This is determined based on the results of a statistical test. According to 40 CFR 265.92 [and by reference of WAC 173-303-400(3)], the owner/operator of an interim-status hazardous waste facility must establish initial background concentrations for the contamination indicator parameters: specific conductance, pH, total organic carbon, and total organic halogen. Four replicate measurements for each parameter from each well were collected at NRDWL quarterly for 1 year. Data from the upgradient wells were used to determine the initial background arithmetic mean and variance.

Monitoring data collected after the first year are compared with the initial background data to determine if there is an indication that contamination may have occurred. A t-test is required to make this determination [40 CFR 265.93(b)]. A recommended method is the averaged replicate t-test method described in Appendix B of the *RCRA Groundwater Monitoring Technical Enforcement Guidance Document* (EPA 1986a). The averaged replicate t-test method for each contamination indicator parameter is calculated as:

$$t = \left(\bar{x}_i - \bar{x}_b\right) / S_b * \sqrt{1 + 1/n_b}$$

where $t$ = test statistic
$\bar{x}_i$ = average of replicates from the $i^{th}$ monitoring well
$\bar{x}_b$ = background average
$S_b$ = background standard deviation
$n_b$ = number of background replicate averages.

A test statistic larger than the Bonferroni critical value, $t_c$, (i.e., $t > t_c$) indicates a statistically significant probability of contamination. These Bonferroni critical values depend on the overall false-positive rate required for each sampling period (i.e., 1% for interim status), the total number of wells in the monitoring network, and the number of degrees of freedom ($n_b$ - 1) associated with the background standard deviation. Because of the nature of the test statistic in the above equation, results to be compared to background do not contribute to the estimate of the variance. The test can be reformulated, without prior knowledge of the results of the sample to be compared to background (i.e., $\bar{x}_i$), in such a way that a critical mean, CM, can be obtained:

$$CM = \bar{x}_b + t_c * S_b * \sqrt{(1 + 1/n_b)} \quad \text{(one tailed)}$$

$$CM = \bar{x}_b \pm t_c * S_b * \sqrt{(1 + 1/n_b)} \quad \text{(two tailed)}$$

If downgradient data exceed the CM, the data are determined to be statistically different from background. For pH, a two-tailed CM (or critical range) is calculated and downgradient data beyond the range are considered to be statistically different from background. If a statistical exceedance is detected, the well will be resampled to determine if the originally detected increase (or pH decrease) was a result of laboratory or measurement error (verification sampling). If verification sampling confirms the exceedance, the owner/operator must notify the Washington State Department of Ecology within 7 days and submit a groundwater quality assessment plan within 15 days following the notification [40 CFR 265.93(d)]. The assessment monitoring program determines if dangerous waste or dangerous waste constituents from the facility have entered the groundwater, their concentration, and their rate and extent of migration [40 CFR 265.93(d)]. Critical mean values for the NRDWL are presented in Table 6.1.

## 6.4 Reporting

Chemistry and water-level data are reviewed at least quarterly and are available in HEIS. Interpretive reports are issued annually in March (e.g., Hartman 1999). Reporting requirements are listed in Table 6.2.

**Table 6.1.** Critical Means for 28 Comparisons—Background Contamination Indicator Parameter Data for Nonradioactive Dangerous Waste Landfill[a]

| Constituent | n | df | $t_c$ | Average Background | Standard Deviation | Critical Mean | Upgradient/ Downgradient Comparison Value |
|---|---|---|---|---|---|---|---|
| Specific conductance, µS/cm | 10 | 9 | 5.0255 | 461.65 | 4.845 | 487.2 | 487.2 |
| Field pH | 11 | 10 | 5.2814 | 7.45 | 0.164 | [6.55, 8.35] | [6.55, 8.35] |
| Total organic carbon,[b] µg/L | 11 | 10 | 4.8092 | 380.68 | 242.28 | 1,597.7 | 1,597.7 |
| Total organic halides,[b,c] µg/L | 11 | 10 | 4.8092 | 4.28 | 2.05 | 14.6 | 22.4 |

(a) Data collected from August 1997 to February 1999 for upgradient wells 699-26-34A and 699-26-35A.
(b) Critical means calculated from values reported below the contractually required detection limit.
(c) The upgradient/downgradient comparison value is the limit of quantitation.
df = Degrees of freedom (n-1).
n = Number of background replicate averages.
$t_c$ = Bonferroni critical t-value for appropriate df and 28 comparisons.

**Table 6.2.** Reports Required for Compliance with 40 CFR 265, Subpart F, for Groundwater Monitoring

| Submittal | Submittal Period | Reporting Vehicle | Regulatory Requirement[a] |
|---|---|---|---|
| First year of sampling: concentrations of interim primary drinking water constituents, identifying those that exceed limits. | Quarterly | Complete[b] | 40 CFR 265.94(a)(2)(i) |
| Concentration and statistical analyses of groundwater contamination indicator parameters, noting significant differences in upgradient wells. | Annually, by March 1 of following year. | Hanford Groundwater Monitoring Report (e.g., Hartman 1999[c]) | 40 CFR 265.94(a)(2)(ii) |
| Results of groundwater surface elevation evaluation and description of response if appropriate. | Annually, by March 1 of following year. | Hanford Groundwater Monitoring Report | 40 CFR 265.94(a)(2)(iii) |
| Outline for groundwater quality assessment program | Within 1 year after effective date of regulations | Chapter 7 of this document | 40 CFR 265.93(a) |
| Notification of statistical exceedance[d] | Within 7 days of verification | Letter to Ecology | 40 CFR 265.93(c) |
| Assessment Plan[d] | Within 15 days of notification | PNNL document or letter | 40 CFR 265.93(d) |
| Determinations under assessment program[d] | As soon as technically feasible; annually thereafter | PNNL document, letter, or Hanford Groundwater Monitoring Report | 40 CFR 265.93(d)(5) and 265.94(b) |

(a) 40 CFR 265, U.S. Environmental Protection Agency. "Interim status standards for owners and operators of hazardous waste treatment, storage, and disposal facilities."
(b) Requirement was fulfilled during first year of sampling via published reports. Quarterly submittal of data continues via HEIS.
(c) Hartman MJ, ed. 1999. *Hanford Site groundwater monitoring for fiscal year 1998*. PNNL-12086, Pacific Northwest National Laboratory, Richland, Washington.
(d) Required if exceedance occurs and is verified.

# 7.0 Assessment Monitoring

This section outlines the assessment monitoring plan for NRDWL, as required by 40 CFR 265.93(a). The assessment program must be capable of determining whether dangerous waste or dangerous waste constituents have entered the groundwater, their concentration, and the rate and extent of migration.

If an indicator parameter at a downgradient well significantly exceeds the background value, an assessment plan will be prepared and submitted to the Washington State Department of Ecology (see Section 6.3). The plan will include the following:

- the approach to determine if dangerous waste or dangerous waste constituents from the facility have entered the groundwater or if the exceedance was caused by other sources (false-positive rationale)
- the investigative approach to fully characterize the rate and extent of contaminant migration
- number, locations, and depths of wells in the monitoring network
- sampling and analytical methods used
- data evaluation procedures
- an implementation schedule.

An outline for the assessment plan is presented in Table 7.1.

As the assessment determinations are made, a report of the findings will be sent to the Washington State Department of Ecology. The determinations will then be updated annually as required by 40 CFR 265.94(b).

**Table 7.1.** Outline for Groundwater Quality Assessment Monitoring Plan

| |
|---|
| Introduction |
| Existing Data and Evaluation |
| Groundwater Quality Assessment Program |
| Approach |
| Assessment Monitoring Network |
| Constituents |
| Sampling and Analysis |
| Data Evaluation |
| Schedule |
| References |

# 8.0 References


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# Appendix A

# Construction Details of the Wells in the Monitoring Network

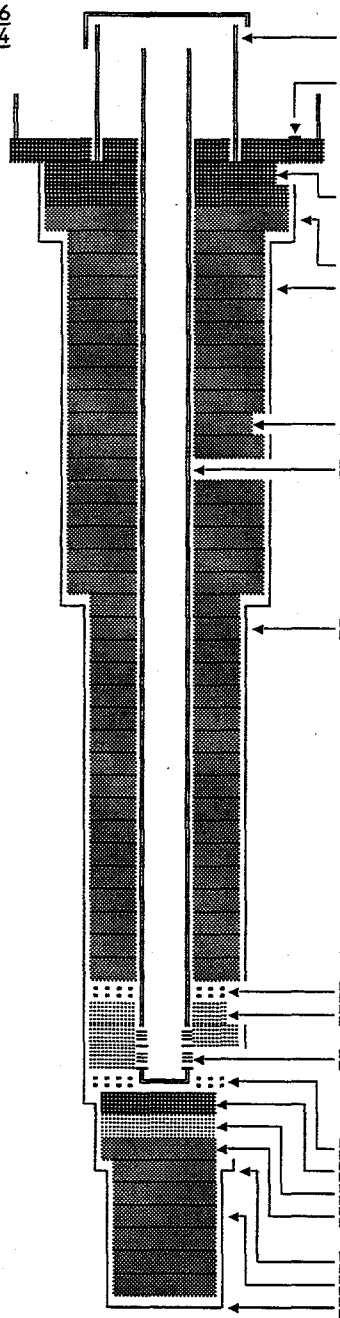
## WELL CONSTRUCTION AND COMPLETION SUMMARY

| | | |
|---|---|---|
| Drilling Method: Cable tool | Sample Drive barrel Method: Hard tool | WELL NUMBER: 699-25-33A A5094 / TEMPORARY WELL NO: DM-2 |
| Drilling Fluid Used: Water | Additives Used: None | Hanford Coordinates: N/S N 25,364.2 E/W W 33,444.8 |
| Driller's Name: Ludtke Olson/Bigham/Garcia/Joy | WA State Lic Nr: Not documented | State Coordinates: N 430,580.28 E 2,261,815.21 |
| Drilling Company: Onwego Drilling Co | Company Location: Kennewick WA | Start Card #: Not documented T___ R___ S___ |
| Date Started: 01Dec86 | Date Complete: 03Jan87 | Elevation Ground surface: 526.81-ft Brass cap |

Depth to water: 125.0-ft 13Dec86
(Ground surface) 126.1-ft 20Jun94

GENERALIZED Driller's STRATIGRAPHY Log

0↔15: Not documented
15↔30: Brown SAND, SILT & GRAVEL
30↔65: Black [SAND?]
65↔78: Med SAND, some GRAVEL
78↔80: COBBLES
80↔100: GRAVEL & COBBLES
100↔108: GRAVEL, fine SAND
108↔125: SAND, GRAVEL, COBBLES
125↔145: Fine SAND, GRAVEL
145↔155: SAND, GRAVEL, COBBLES
155↔172: SAND, SILT, fine GRAVEL
172↔200: Gravelly SAND
200↔210: CLAY
210↔223: Not documented
223↔239: Cemented SAND & GRAVEL
239↔240: GRAVEL
240↔245: Silty SAND
245↔255: Silty SAND, trace CLAY



Elevation of reference point: [528.97-ft] (top of casing)
Height of reference point above ground surface [2.16-ft]
Depth of surface seal [0.0↔10.2-ft]
Type of surface seal: Cement grout to 10.2-ft 4x4-ft x 6-in concrete pad
17-in nominal hole, 0↔20-ft
13-in nominal hole, 20↔100-ft
8↔20-mesh bentonite crumbles, 10.2↔88.7-ft
4-in T304 stainless steel casing, +1.8↔191.0-ft
11-in nominal hole, 100↔201.5-ft
Bentonite pellets, 184.0↔186.0-ft
Sand pack, 186.0↔201.0-ft
4-in T304 stainless steel screen, 191.0↔201.0-ft, #20-slot
201.0↔203.0-ft, 2-ft blank
Bentonite pellets, 201.0↔207.0-ft
Cement grout, 207.0↔210.0-ft
Sand pack, 210.0↔216.0-ft
Bentonite slurry, 216.0↔255.0-ft
9-in nominal hole, 201.5↔225.0-ft
8-in nominal hole, 225.0↔255.0-ft
Borehole drilled depth: [255.0-ft]

Drawing By: RKL/6N25W33A.ASB
Date : 14Sep94
Reference : HANFORD WELLS

## WELL CONSTRUCTION AND COMPLETION SUMMARY

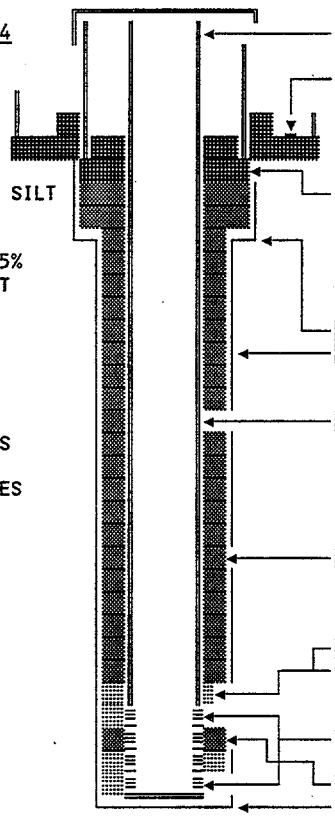
| | | |
|---|---|---|
| Drilling Method: Cable tool | Sample Drive barrel Method: Hard tool | WELL NUMBER: 699-25-34A A5045 TEMPORARY WELL NO: SM-3 |
| Drilling Fluid Used: Water | Additives Used: None documented | Hanford Coordinates: N/S N 25,384.01 E/W W 33,500.86 |
| Driller's Name: Evans/Myrick | WA State Lic Nr: Not documented | State Coordinates: N 430,599.95 E 2,261,759.09 |
| Drilling Company: Myrick's Well Drill. | Company Location: Not documented | Start Card #: Not documented T___ R___ S___ |
| Date Started: 20May86 | Date Complete: 14Jul86 | Elevation Ground surface: 528.23-ft Brass cap |

Depth to water: 125.3-ft Jun86
(Ground surface) 127.2-ft 20Jun94

GENERALIZED STRATIGRAPHY Log

Driller's

0↔10: Not documented
10↔21: 90% coarse↔fine SAND, 10% SILT
21↔30: Not documented
30↔70: Black SAND
70↔85: 40% coarse↔medium SAND, 45% PEBBLES & COBBLES, 5% SILT
85↔95: 45% coarse↔fine SAND, 45% COBBLES, 10% SILT
95↔100: Coarse↔fine SAND, SILT, PEBBLES & COBBLES
100↔105: Coarse SAND, with large PEBBLES and COBBLES
105↔111: Coare↔fine SAND, PEBBLES COBBLES & SILT
111↔122: Coarse↔fine SAND, PEBBLES & COBBLES
122↔140: BOULDERS & GRAVEL
140↔145: Black SAND, some GRAVEL



Elevation of reference point: [530.19-ft]
(top of 5-in casing)
Height of reference point above ground surface [ 2.0-ft ]

Depth of surface seal [0↔8.5-ft ]
Type of surface seal:
Cement grout with 5% bentonite
4-ft x 4-ft x 4-in concrete pad with 2-ft round pad suppporting 10-in ID carbon steel protective casing to 2-ft

11-in nominal hole, 0↔21-ft
9-in nominal hole, 21↔145-ft

5-in ID sch 40 carbon steel casing, +2.0↔117.9-ft

Granular bentonite, 8.5↔114.8-ft

Monterey crystal sand pack,
114.8↔118.6-ft, mesh not documented
119.6↔145.0-ft, mesh not documented

5-in ID stainless steel screen,
117.9↔127.9-ft, #20-slot
127.9↔137.9-ft, #25-slot

Bentonite, 118.6↔119.6-ft

Borehole drilled depth: [ 145.0-ft]

Drawing By: RKL/6N25W34A.ASB
Date : 14Sep94
Reference : HANFORD WELLS

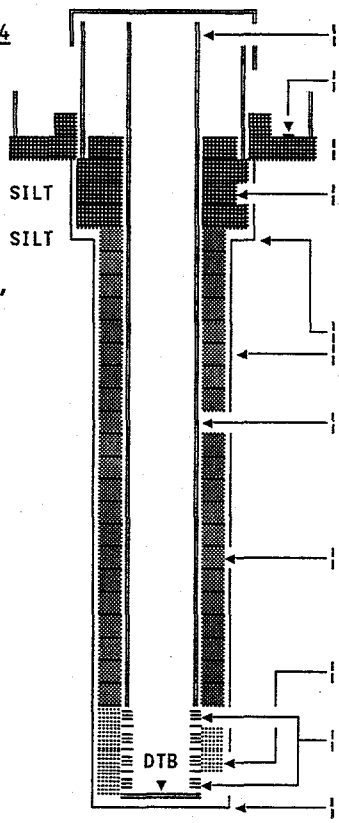
## WELL CONSTRUCTION AND COMPLETION SUMMARY

| | | |
|---|---|---|
| Drilling Method: Cable tool | Sample Drive barrel Method: Hard tool | WELL NUMBER: 699-25-34B A5096 TEMPORARY WELL NO: SM-5 |
| Drilling Fluid Used: Water | Additives Used: None documented | Hanford Coordinates: N/S N 25,221.61 E/W W 33,551.98 |
| Driller's Name: Evans/Myrick | WA State Lic Nr: Not documented | State Coordinates: N 430,437.42 E 2,261,708.39 |
| Drilling Company: Myrick's Well Drill. | Company Location: Not documented | Start Card #: Not documented T___ R___ S___ |
| Date Started: 30Jul86 | Date Complete: 05Sep86 | Elevation Ground surface: 526.92-ft Brass cap |

Depth to water: 123.3-ft Aug86
(Ground surface) 126.4-ft 20Jun94

GENERALIZED Driller's STRATIGRAPHY Log

0↔35: Not documented
35↔50: 90% fine↔coarse SAND, 10% SILT
50↔58: 60% SILT, 40% SAND
58↔63: 90% coarse↔fine SAND, 10% SILT
63↔67.5: Very fine↔coarse SAND
67.5↔75: 90% fine↔very fine SAND, 10% SILT
75↔85: GRAVEL, PEBBLES, COBBLES SAND & SILT
85↔139.3: Not documented




Elevation of reference point: [529.31-ft]
(top of 5-in casing)
Height of reference point above ground surface [2.4-ft]

Depth of surface seal [0↔20-ft]
Type of surface seal:
Cement grout with 5% bentonite
4-ft x 4-ft x 4-in concrete pad with 2-ft round pad supporting 10-in ID carbon steel protective casing to 2-ft

11-in nominal hole, 0↔20-ft
9-in nominal hole, 20↔139.3-ft

5-in ID sch 40 carbon steel casing, +2.4↔118.2-ft

Granular bentonite, 20↔120.5-ft

Monterey crystal sand pack, 120.5↔139.3-ft, mesh not documented

5-in stainless steel screen,
118.2↔138.2-ft, #20-slot
128.2↔138.2-ft, #25-slot

Borehole drilled depth: [139.3-ft]

DTB=Depth to bottom, 136.8-ft, 25Jun91

Drawing By: RKL/6N25W34B.ASB
Date : 14Sep94
Reference : HANFORD WELLS

## WELL CONSTRUCTION AND COMPLETION SUMMARY

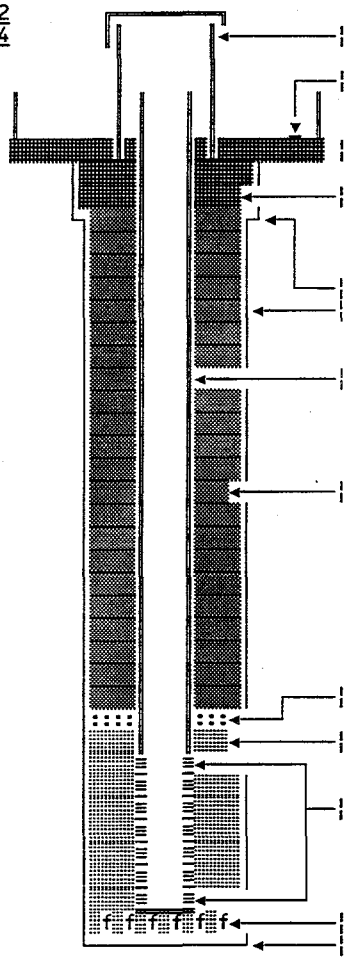
| | |
|---|---|
| Drilling Method: ODEX air rotary | Sample Method: Air returns |
| Drilling Fluid Used: None | Additives Used: None |
| Driller's Name: S. McKinnon/D. Mingo | WA State Lic Nr: Not documented |
| Drilling Company: Jensen Drilling Co | Company Location: Not documented |
| Date Started: 09Sep92 | Date Complete: 22Oct92 |

| | |
|---|---|
| WELL NUMBER: 699-25-34D A5419 | TEMPORARY WELL NO: |
| Hanford Coordinates: N/S N 25,253.6 | E/W W 33,847.9 |
| State NAD83 N 131,191.16m | E 579,589.97m |
| Coordinates: N 430,469 | E 2,261,412 |
| Start Card #: Not documented | T R S |
| Elevation Ground surface: 534.47-ft (Brass cap) | |

Depth to water: 132.4-ft 22Oct92
(Ground surface) 133.3-ft 20Jun94

GENERALIZED STRATIGRAPHY Log
Geologist's
Sl=slightly

0↔84: SAND
84↔101: GRAVEL
101↔103: SAND
103↔126: GRAVEL
126↔126.5: Silty sandy GRAVEL
126.5↔161: Sandy GRAVEL
161↔173: Silty sandy GRAVEL



Elevation of reference point: [537.91-ft]
(top of casing)
Height of reference point above ground surface [3.44-ft]
Depth of surface seal [2.0↔8.6-ft]
Type of surface seal:
Cement grout to 8.6-ft
4-ft x 4-ft concrete pad
extending 2.0-ft into annulus
13-in nominal hole, 0↔9.8-ft
11-in nominal hole, 9.8↔173-ft
4-in ID T304 stainless steel casing, +1.0↔126.8-ft
Bentonite crumbles, 8.6↔119.4-ft
Enviroplug coarse chunk bentonite seal, 119.4↔123.1-ft
Silica sand pack: 123.1↔266.2-ft, 20↔40-mesh
4-in, T304 stainless steel screen, 126.8↔162.0-ft, #10-slot
Fill, 166.1↔173.0-ft
Borehole drilled depth: [173.0-ft]

Drawing By: RKL/6N25W34D.ASB
Date : 14Sep94
Reference : WHC-SD-EN-DP-055

## WELL CONSTRUCTION AND COMPLETION SUMMARY

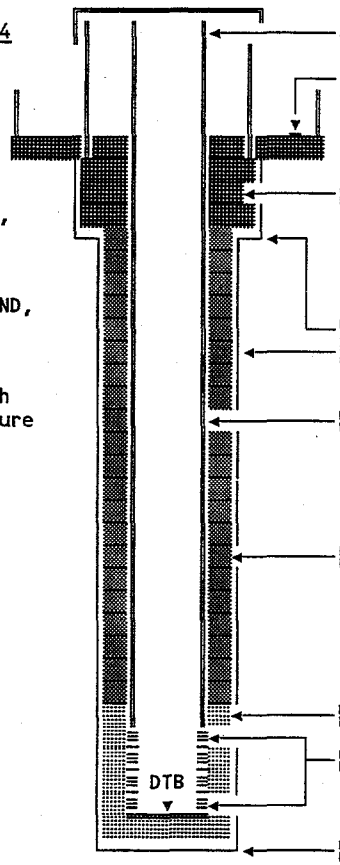
| | | |
|---|---|---|
| Drilling Method: Cable tool | Sample Drive barrel Method: Hard tool | WELL NUMBER: 699-26-33 A5101 |
| Drilling Fluid Used: Water | Additives Used: Bentonite | TEMPORARY WELL NO: SM-4 |
| Driller's Name: Myrick | WA State Lic Nr: Not documented | Hanford Coordinates: N/S N 25,545.85 E/W W 33,451.61 |
| Drilling Company: Myrick's Well Drill. | Company Location: Not documented | State Coordinates: N 430,761.92 E 2,261,807.92 |
| Date Started: 01Aug86 | Date Complete: 04Sep86 | Start Card #: Not documented T___ R___ S___ |
| | | Elevation Ground surface: 533.75-ft Brass cap |

Depth to water: 128.5-ft Aug86
(Ground surface) 132.9-ft 20Jun94

GENERALIZED STRATIGRAPHY Log

Driller's

0↔2: River run
2↔20: Fine brown SAND, damp
20↔25: Coarse black SAND, GRAVEL, PEBBLES, damp
25↔28: Fine brown SAND, damp
28↔30: SAND, dark, coarse
30↔37.5: Coarse brown & black SAND, 1/4-in GRAVEL
37.5↔45: BOULDER
45↔45.5: Compact SAND
45.5↔100: No record, drilled with drive barrel for moisture samples
100↔108: Large GRAVEL
108↔112: BOULDER
112↔130: Large GRAVEL
130↔135: SAND and GRAVEL
135↔145: Very fine brown SAND
145↔147: Fine SAND




Elevation of reference point: [535.66-ft] (top of 5-in casing)

Height of reference point above ground surface [1.9-ft]

Depth of surface seal [0↔20-ft]
Type of surface seal:
Cement grout with 5% bentonite to 20-ft
4-ft x 4-ft x 4-in concrete pad with 2-ft round pad supporting 10-in ID carbon steel protective casing to 2-ft

11-in nominal hole, 0↔20-ft

9-in nominal hole, 20↔147-ft

5-in ID sch 40 carbon steel casing, +1.9↔123.5-ft

Granular bentonite, 20↔120.5-ft

Monterey crystal sand pack, 120.5↔147.0-ft mesh not documented

5-in stainless steel screen, 123.5↔143.5-ft, #25-slot

Borehole drilled depth: [147.0-ft]

DTB=Depth to bottom, 143.7-ft, 25Jun91

Drawing By: RKL/6N26W33.ASB
Date : 14Sep94
Reference : HANFORD WELLS

## WELL CONSTRUCTION AND COMPLETION SUMMARY

| | |
|---|---|
| Drilling Method: Cable tool | Sample Method: Drive barrel |
| Drilling Fluid Used: Water | Additives Used: None documented |
| Driller's Name: Evans/Myrick(s) | WA State Lic Nr: Not documented |
| Drilling Company: Myrick's Well Drill. | Company Location: Not documented |
| Date Started: 22May86 | Date Complete: 03Jul86 |

WELL NUMBER: 699-26-34A A5102 TEMPORARY WELL NO: SM-2

Hanford Coordinates: N/S N 26,162.95 E/W W 34,483.26

State Coordinates: N 431,376.37 E 2,260,774.69

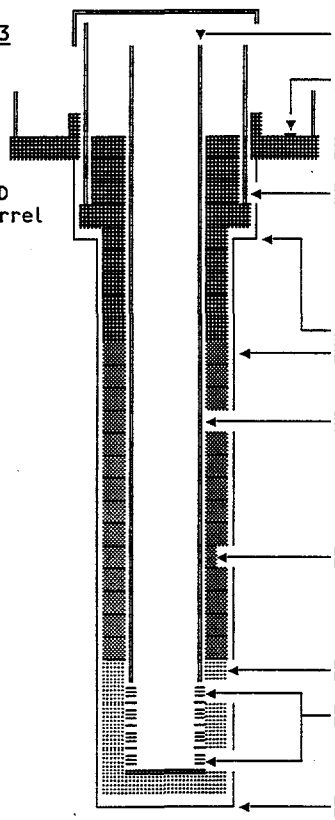
Start Card #: Not documented T____ R____ S____

Elevation Ground surface: 526.43 Brass cap

Depth to water: 121.5-ft Jun86
(Ground surface) 125.0-ft 27Dec93

GENERALIZED Driller's STRATIGRAPHY Log

0↔75: Not documented
75↔81: Large GRAVEL and fine SAND
81↔120: Not documented, drive barrel
120↔136: BOULDER or BOULDERS
136↔143: SAND (heaving)



Elevation of reference point: [528.11-ft]
(top of 5-in casing)

Height of reference point above ground surface [ 1.7-ft ]

Depth of surface seal [0↔20-ft ]
Type of surface seal:
Cement grout w/5% bentonite to 20-ft
4-ft x 4-ft x 4-in concrete pad
with 2-ft round pad supporting
10-in ID carbon steel protective
casing to 17-ft

11-in nominal hole, 0↔20-ft
9-in nominal hole, 20↔143-ft

5-in ID sch 40 carbon steel casing,
+1.7↔117.2-ft

Granular bentonite, 20↔114.2-ft

Monterey crystal sand pack,
114.2↔143.0-ft, mesh not documented

5-in stainless steel screen,
117.2↔127.2-ft, #20-slot
127.2↔137.2-ft, #25 slot

Borehole drilled depth: [ 143.0-ft]

Drawing By: RKL/6N26W34A.ASB
Date : 14Sep94
Reference : HANFORD WELLS

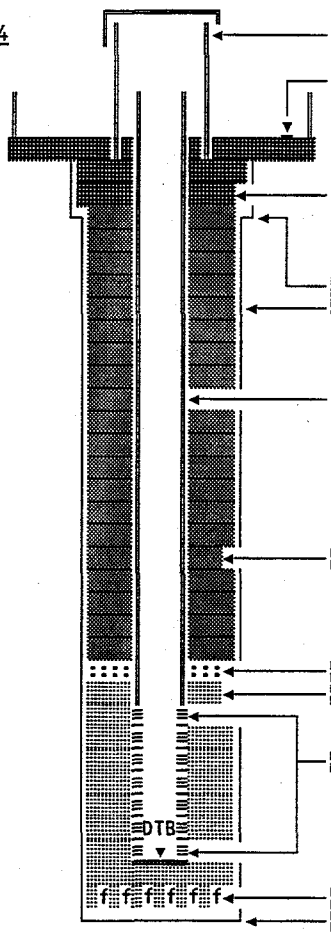
## WELL CONSTRUCTION AND COMPLETION SUMMARY

| | | |
|---|---|---|
| Drilling Method: Air rotary | Sample Method: Air returns | WELL NUMBER: 699-26-34B A5420 |
| Drilling Fluid Used: Not applicable | Additives Used: None | TEMPORARY WELL NO: |
| Driller's Name: S. McKennon/D. Mingo | WA State Lic Nr: Not documented | Hanford Coordinates: N/S N 25,782 6 E/W W 33,716.8 |
| Drilling Company: Jensen | Company Location: Not documented | State NAD83 N 131,352.50m E 579,629.52m |
| Date Started: 09Sep92 | Date Complete: 22Oct92 | Coordinates: N 430,998 E 2,261,542 |
| | | Start Card #: Not documented T___ R___ S___ |
| | | Elevation Ground surface: 526.47 Brass cap |

Depth to water: 124.1-ft Oct92
(Ground surface) 125.3-ft 20Jun94

GENERALIZED STRATIGRAPHY Geologist's Log

0↔74: SAND
74↔82: GRAVEL
82↔85: Sandy GRAVEL
85↔87: GRAVEL
87↔99: Gravelly SAND
99↔102: GRAVEL
102↔108: Sandy GRAVEL
108↔119: SAND
119↔122: Gravelly SAND
122↔124: SAND
124↔127: Sandy GRAVEL
127↔139: Silty sandy GRAVEL
139↔164.9: Pebble cobble GRAVEL




Elevation of reference point: [530.27-ft]
(top of casing)
Height of reference point above ground surface [3.80-ft]

Depth of surface seal [1.5↔8.2-ft]
Type of surface seal
Cement grout to 8.2-ft
4 x 4-ft x 4-in concrete pad extends 1.5-ft into annulus

13-in nominal hole, 0↔8.5-ft
11-in nominal hole, 8.5↔164.9-ft

4-in ID T304 stainless steel casing, +0.7↔118.4-ft

Bentonite crumbles, 8.2↔111-ft

Enviroplug bentonite chunks, 111.0↔115.2-ft
Silica sand pack, 115.2↔161.6-ft, 20↔40-mesh

4-in T304 stainless steel screen, 118.4↔153.6-ft, #10-slot

Fill, 161.6↔164.9-ft
Borehole drilled depth: [164.9-ft]

DTB=Depth to bottom, 154.4-ft, 18Dec92

Drawing By: RKL/6N26W34B.ASB
Date : 14Sep94
Reference : WHC-SD-EN-DP-055

## WELL CONSTRUCTION AND COMPLETION SUMMARY

Drilling Method: Cable tool
Drilling Fluid Used: Water
Driller's Name: Myricks(s)
Drilling Company: Myrick's Well Drill.
Date Started: 20May86

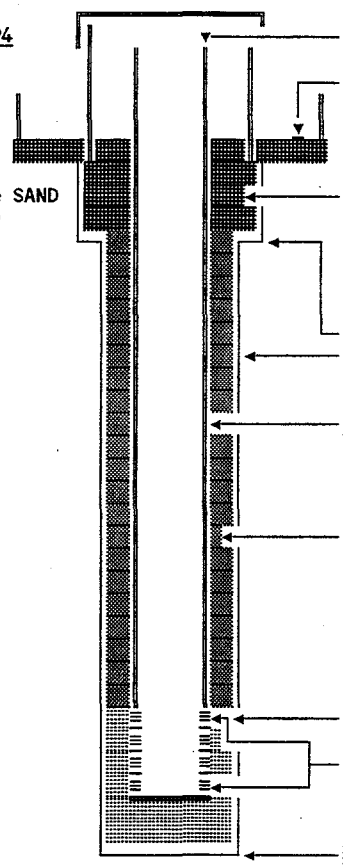
Sample Drive barrel Method: Hard tool
Additives Used: Bentonite
WA State Lic Nr: Not documented
Company Location: Not documented
Date Complete: 14Jul86

WELL NUMBER: 699-26-35A A5103
TEMPORARY WELL NO: SM-1
Hanford Coordinates: N/S N 25,768.80 E/W W 34,748.81
State Coordinates: N 430,981.54 E 2,260,510.15
Start Card #: Not documented T___ R___ S___
Elevation Ground surface: 530.38 Brass cap

Depth to water: 126.5-ft Jun86
(Ground surface) 129.7-ft 20Jun94

GENERALIZED Driller's STRATIGRAPHY Log

0↔38: Not documented
38↔69: 90% coarse SAND, 10% fine SAND
69↔70: 20% GRAVEL, 80% fine SAND
70↔95: Not documented
95↔114: BOULDERS
114↔120: GRAVEL
120↔130: GRAVEL & SAND
130↔152.5: SAND & GRAVEL



Elevation of reference point: [532.38-ft]
(top of 5-in casing)
Height of reference point above ground surface [2.0-ft]

Depth of surface seal [0↔20-ft]
Type of surface seal:
Cement grout w/5% bentonite to 20-ft
4-ft x 4-ft x 4-in concrete pad
with 2-ft round pad supporting
10-in ID carbon steel protective
casing to 2-ft

11-in nominal hole, 0↔20-ft
9-in nominal hole, 20↔152.5-ft

5-in ID sch 40 carbon steel casing,
+2.0↔120.4-ft

Granular bentonite, 20↔120.5-ft

Monterey crystal sand pack,
120.5↔152.5-ft, mesh not documented

5-in stainless steel screen,
120.4↔130.4-ft, #20-slot
130.4↔140.4-ft, #25-slot

Borehole drilled depth: [152.5-ft]

Drawing By: RKL/6N26W35A.ASB
Date : 14Sep94
Reference : HANFORD WELLS

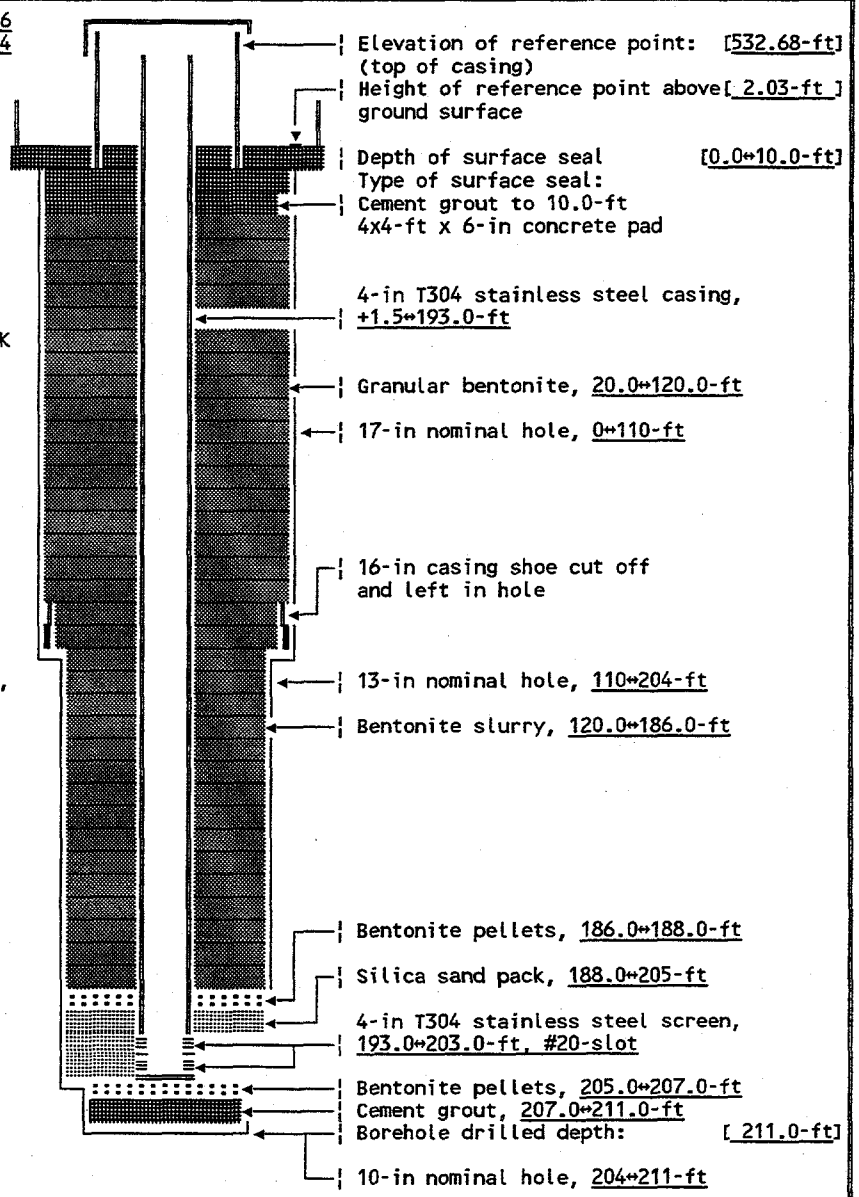
## WELL CONSTRUCTION AND COMPLETION SUMMARY

| | | |
|---|---|---|
| Drilling Method: Cable tool | Sample Drive barrel Method: Hard tool | WELL NUMBER: 699-26-35C A5104 / TEMPORARY WELL NO: DM-1 |
| Drilling Fluid Used: Water | Additives Used: None | Hanford Coordinates: N/S N 25,751.10 E/W W 34,688.94 |
| Driller L Myrick/R Myrick Name: L Bultena | WA State Lic Nr: Not documented | State Coordinates: N 430,981.54 E 2,260,510.15 |
| Drilling Myrick Drilling Co Company: Onwego Drilling Co | Company Not documented Location: Kennewick WA | Start Card #: Not documented T___ R___ S___ |
| Date Started: 23Jun86 | Date Complete: 05Jan87 | Elevation Ground surface: 530.65-ft Brass cap |

Depth to water: 127.0-ft 15Jul86
(Ground surface) 129.5-ft 20Jun94

GENERALIZED Driller's STRATIGRAPHY Log

0↔4: Very cse b&w SAND
15↔20: Fine brown SAND
20↔30: Cse black SAND
30↔40: Fine brown & black SAND
40↔50: Black cse SAND
50↔55: Fine grey SAND
55↔65: Fine brown SAND
65↔75: Black & brown SAND, w/ROCK
75↔80: Brown SAND
80↔85: Large ROCK, some SAND
85↔90: Round river run ROCK
90↔100: BOULDERS, GRAVEL, SAND
100↔110: Round ROCK
110↔115: ROCK, GRAVEL & SAND
115↔125: BOULDERS
125↔135: Not documented
135↔140: Fine SAND
140↔145: Fine compacted SAND
145↔155: Fine SAND, heaving
155↔170: Cse GRAVEL-SAND
170↔172: Loose COBBLES
172↔203: GRAVEL, SAND, some SILT
203↔204: GRAVEL, SAND, some SILT, CLAY
204↔211: Not documented (Attempted to sample w/drive sampler and split spoon)




Drawing By: RKL/6N26W35C.ASB
Date : 14Sep94
Reference : HANFORD WELLS

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EXHIBIT I:

Excavation and Inventory of Trench 19N at NRDWL (91-EAB-078) and Trench 19N, 26, 28,31,33,34 Disposal records

**DOE 91-EAB-078, *REPORT ON THE EXCAVATION AND INVENTORY OF TRENCH 19N AT THE NONRADIOACTIVE DANGEROUS WASTE LANDFILL, HANFORD SITE***

0013661

9101752

**Department of Energy**
Richland Operations Office
P.O. Box 550
Richland, Washington 99352

91-EAB-078

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CORRESPONDENCE CONTROL

Mr. Paul T. Day
Hanford Project Manager
U.S. Environmental Protection Agency
Region 10
712 Swift Boulevard, Suite 5
MSIN: B5-01
Richland, Washington 99352

Mr. Timothy L. Nord
Hanford Project Manager
State of Washington
Department of Ecology
Mail Stop PV-11
Olympia, Washington 98504-8711

Dear Messrs. Day and Nord:

REPORT ON THE EXCAVATION AND INVENTORY OF TRENCH 19N AT THE NONRADIOACTIVE DANGEROUS WASTE LANDFILL, HANFORD SITE

The enclosed report and Chemical Waste Inventory are being forwarded to the U.S. Environmental Protection Agency and the State of Washington Department of Ecology, in accordance with agreements made at the February 14, 1991, Unit Managers' Meeting.

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Enclosure:
Excavation Report/Chemical Waste Inventory

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# REPORT ON THE EXCAVATION AND INVENTORY OF TRENCH 19N AT THE NONRADIOACTIVE DANGEROUS WASTE LANDFILL, HANFORD SITE

## INTRODUCTION

The Nonradioactive Dangerous Waste Landfill (NRDWL) is an isolated, operationally closed, land disposal unit located near the geographic center of the Hanford Site in the 600 Area. The landfill received nonradioactive dangerous chemicals regulated under WAC 173-303 in six trenches from 1975 through May 1985. On November 8, 1985, one of the six chemical trenches (Figure 1), designated 19N, was excavated to retrieve several drums containing regulated dangerous waste.

The purpose of this paper is to document the November 8, 1985 Trench 19N excavation activity in response to an action item identified during the January 15, 1991 Unit Managers Meeting for the NRDWL. Specifically, this paper describes the excavation process and conditions encountered during the retrieval process, and reconciles pre- and post-excavation inventories. Information concerning the excavation process was acquired from interviews with Hanford Site personnel that were directly involved with the activity.

## DESCRIPTION OF THE TRENCH 19N EXCAVATION ACTIVITY

### Background Information

A 150-foot section of Trench 19N was opened in March 1984 to dispose of oxidizer chemicals. The trench was approximately 14 feet deep and 16 feet wide at the base. An access ramp on the south end of the trench allowed transfer vehicles to access the working face. An 8- to 12-inch layer of cobble/gravel was placed over the bottom of the trench to form a temporary roadbed. A representative cross section of the trench is shown in Figure 2.

Trench 19N received its first shipment of waste in April 1984 consisting of nonregulated empty containers. The first receipt of chemical waste occurred in June 1984. A total of 4 shipments of chemical waste where placed in Trench 19N, the last of which was received in May 1985. The trench also received 7 shipments of empty containers not regulated under WAC 173-303. Each shipment of waste was catalogued using a disposal request number. All containers disposed of in Trench 19N were covered by an approximately 10-foot thick operational cover consisting of local sand.

On November 8, 1985, Trench 19N was excavated to retrieve drums containing sodium nitrite which had been mistakenly disposed of in the trench. Sodium nitrite which is designated as an extremely hazardous waste was prohibited from being disposed of in the NRDWL. In the process of retrieving the sodium nitrite drums, all other waste containers that were disposed of in Trench 19N also were removed. Approximately 120 feet of available trench space had been filled prior to the Trench 19N excavation activity.

| | | | |
|---|---|---|---|
| OPEN 1-76 | SANITARY TRASH | CLOSED 9-76 | 1N |
| OPEN 5-85 | ASBESTOS | CLOSED 10-86 | 2N |
| OPEN 7-79 | ASBESTOS | CLOSED 7-81 | 20 |
| OPEN 1-84 | ASBESTOS | CLOSED 5-85 | 21 |
| OPEN 10-86 | ASBESTOS | CLOSED 5-88 | 22 |
| OPEN 7-81 | ASBESTOS | CLOSED 9-82 | 23 |
| | UNUSED | | 24 |
| OPEN 9-82 | ASBESTOS | CLOSED 3-84 | 25 |
| OPEN 1-85 | CORROSIVES | OPEN | 26 |
| OPEN 1-75 | ASBESTOS | CLOSED 7-76 | 27 |
| OPEN 2-84 | CORROSIVES | CLOSED 1-85 | 28 |
| OPEN 9-76 | ASBESTOS | CLOSED 6-79 | 29 |
| OPEN 8-76 | ASBESTOS | CLOSED 9-76 | 30 |
| OPEN 9-82 | CHEMICAL | CLOSED 4-84 | 31 |
| | UNUSED | | 32 |
| OPEN 11-80 | CHEMICAL | CLOSED 9-82 | 33 |
| OPEN 1-75 | CHEMICAL | CLOSED 11-80 | 34 |
| | UNUSED | | 18N |
| OPEN 3-84 | OXIDIZERS | OPEN | 19N |

Figure 1. Nonradioactive Dangerous Waste Landfill Trench Plan.

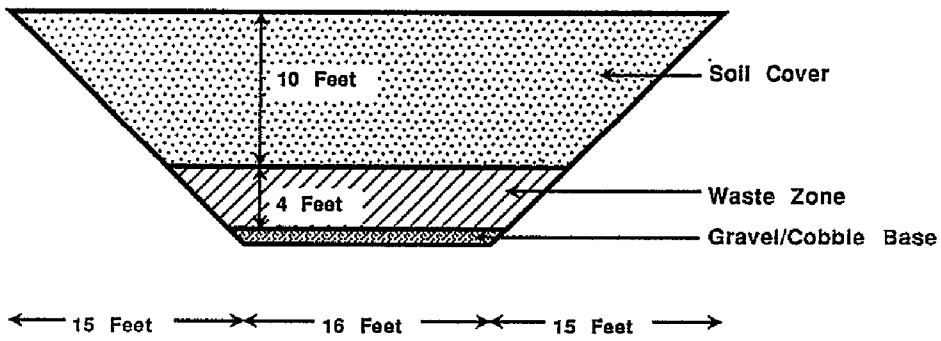


Figure 2. Representative Cross Section of a Nonradioactive Dangerous Waste Landfill Chemical Trench.

**Excavation Methodology**

The excavation of Trench 19N and retrieval of drums was performed by NRDWL landfill operating personnel including a work supervisor, a heavy equipment operator, and two laborers. Equipment used included a front end wheel loader and hand shovels. No written work plan was prepared.

The excavation activity began by scraping off a portion of the operational cover using a front wheel loader to decrease the amount of overburden. The depth of material removed in this manner was limited to a few feet to prevent damaging the underlying containers. Cover material that was removed was piled along the sides of the trench.

After the upper portion of the cover was removed, the front end loader was then used to locate the buried containers. Working in the bottom of the trench, the loader operator carefully exposed containers by driving the loader bucket into the base of the waste layer and then tilting or lifting the bucket. By following the coarse gravel/cobble layer (Figure 2), which defined the base of the waste layer, the operator was successful in positioning the bucket beneath the containers. Excavated soil was piled along the edges of the trench.

After a container was located with the front end loader, laborers would complete the excavation using hand shovels and place the container in the loader bucket. The container would then be transported out of the trench. Retrieved containers were segregated by shipment (i.e. disposal request number) and staged along the east side of the trench. The method of excavation was considered to be effective in finding and retrieving containers without damage.

The retrieval process started on the south side (open side) of the Trench 19N and progressed in manner opposite to the original disposal sequence. The activity took two days to complete at a cost of approximately $2,000. Thirty metal drums containing regulated waste, and numerous empty containers were retrieved. No leaking containers or evidence of soil contamination was observed. The metal drums containing regulated waste were found to be in good shape with no damage from the excavation process. Container labels; however, were often illegible, which added some uncertainty to the identification process. This was further complicated by the finding that a number of shipments, which were thought to have been placed in Trench 19N were actually not present. The matching of containers to a particular disposal request number was often based on the arrangement in which they were found in the trench.

On November 11, 1985 containers with regulated waste were either loaded onto a flat-bed for transportation to the 2727S Nonradioactive Dangerous Waste Storage Facility or returned back to Trench 19N and covered. No attempt was made to open retrieved containers at the NRDWL to verify their contents. No waste or soil sampling was performed. Empty containers which were not regulated under WAC 173-303 were transferred to the adjacent Solid Waste Landfill for disposal as sanitary waste.

## WASTE DESCRIPTION AND INVENTORY

Three distinct inventory lists for Trench 19N have been provided in RCRA regulatory documents. The first inventory list was provided in Appendix D-1 of the 1985 Part B Permit Application for the Nonradioactive Dangerous Landfill and Storage Facility. In August 1990, a closure and postclosure plan was prepared for the NRDWL (DOE/RL-90-17) that contained two other lists including a revision of 1985 inventory (Appendix 4C) and a post-excavation inventory (Appendix 4A). The following discussion explains the differences between these three inventory lists.

Appendix D-1 contained in the 1985 Part B permit Application was compiled before November 1985, and did not take into account the findings and results of the November 8, 1985 excavation activity. During the excavation of Trench 19N, several shipments that were thought to have been placed in Trench 19N were not found. It was deduced that the missing containers had actually been disposed of in another NRDWL trench (28 or 26) which happened to be open at the same time as Trench 19N. Appendix D-1 was revised accordingly and issued as an appendix (4C) in the closure/postclosure plan. Several discrepancies with the original records were also corrected in Appendix 4C. The inventory for Trench 19N was then revised a second time (Appendix 4A) to reflect the containers that where removed during the excavation activity and transferred elsewhere (e.g. 2727S Facility).

Table 1 summarizes the differences in the three inventory lists, and provides specific comments governing why changes were made to the inventory. In addition, Table 1 identifies several remaining errors. These errors have been corrected in the attached inventory lists for Trench 19N and 28. Effected inventory lists in the NRDWL Closure/Postclosure Plan will also be revised accordingly in the next revision of the document.

TABLE 1. CHEMICAL WASTE INVENTORIES FOR NONRADIOACTIVE DANGEROUS WASTE LANDFILL TRENCH 19N

| 1985 Part B Permit Application Inventory (Appendix D-1) | | | Disposal Request # | Comments/Disposition | 1990 Closure/PostClosure Plan (DOE/RL-90-17) | |
|---|---|---|---|---|---|---|
| Date | Quantity | Chemical | | | Pre-Excavation Inventory (Appendix 4C) | Post-Excavation Inventory (Appendix 4A) |
| 04-17-84 | 10 gal<br>20 gal<br>55 gal<br>55 gal<br>55 gal<br>30 gal<br>5 gal<br>5 gal<br>5 gal | Ferric nitrate<br>Lithium nitrate<br>Ferric phosphate<br>Neodymium nitrate<br>Aluminum nitrate<br>Rare earth nitrate<br>Magnesium nitrate<br>Kesel<br>Manganese nitrate | 5-17 | •Original record indicates that all containers were empty<br>•Empty containers were transferred to SWL | •Deleted | •Deleted |
| 06-13-84 | 2 lb<br>20 lb | Sodium nitrate<br>Sodium nitrate | 9-33 | •Original record indicates that the total quantity should read 20 lbs not 22 lbs<br>•Returned to Trench 19N following excavation | •Included | •Included |
| 07-05-84 | 100 lb<br>25 lb<br>13 gal<br>225 lb | Versene EDTA<br>Thiourea<br>Ethylene glycol<br>Ammonium persulfate | 9-41 | •Not found during excavation of Trench 19N<br>•Assumed to be disposed of in corrosive Trench 28 | •Deleted | •Deleted, but not added to Trench 28 inventory |
| 07-19-84 | 18 drums<br>10 drums | Sodium nitrite<br>Nickel, hydrated | 6-9 | •18 drums sodium nitrite transferred to 2727S<br>•1 drum nickel transferred to 2727S; 9 other drums nickel were not found during excavation of Trench 19N<br>•Assumed that 9 drums nickel are disposed of in corrosive Trench 28 | •Included; however quantity is incorrect | •Deleted and added to Trench 28 inventory, but quantity is incorrect |
| 09-05-84 | 400 lb | Metal alloy - 40% Al and 60% Ca | 10-9 | •Not found during excavation of Trench 19N<br>•Assumed to be disposed of in corrosive Trench 28 | •Deleted | •Deleted, but not added to Trench 28 inventory |
| 09-24-84 | 10 gal | Dioctyl sebacate | 10-43 | •Nonregulated Waste<br>•Not found during excavation of Trench 19N | •Deleted | •Deleted |
| 11-09-84 | 75 gal | Paint related material | 11-39B | •Original record indicates that waste was actually placed in corrosive Trench 28 | •Deleted | •Deleted, but not added to Trench 28 inventory |

TABLE 1. CHEMICAL WASTE INVENTORIES FOR NONRADIOACTIVE DANGEROUS WASTE LANDFILL TRENCH 19N

| 1985 Part B Permit Application Inventory (Appendix D-1) | | | Disposal Request # | Comments/Disposition | 1990 Closure/PostClosure Plan (DOE/RL-90-17) | |
|---|---|---|---|---|---|---|
| Date | Quantity | Chemical | | | Pre-Excavation Inventory (Appendix 4C) | Post-Excavation Inventory (Appendix 4A) |
| 12-05-84 | 1 lb<br>1 lb<br>1 lb<br>5 lb<br>1 pt<br>1 pt<br>1 qt<br>1 gal<br>1 lb<br>1 lb<br>1 qt<br>2 qt | Potassium permanganate<br>Sodium nitrate<br>Sodium chromate<br>Sodium hydroxide<br>Ethyl acetate<br>Methanol<br>Isopropanol<br>Naphtha<br>Ammonium nitrate<br>Ammonium chloride<br>Ammonium hydroxide<br>Ammonium oxalate | 12-15B | •Returned to Trench 19N following excavation | •Included | •Included; however several additional chemicals were mistakenly added |
| 12-20-84 | 69 mL<br>230 mL | Refill CQC for Fyrite Oxygen Indicator<br>Methanol | 10-23 | •Original record indicates that waste was actually placed in corrosive Trench 28 | •Deleted | •Deleted, but not added to Trench 28 inventory |
| 01-11-85 | 13 drums | Salt cake | 5-31 | •Not found during excavation of Trench 19N<br>•Assumed to be disposed of in corrosive Trench 26; however, corrosive Trench 28 may have been used, because it was also open during this period | •Included, but should have been deleted | •Deleted and added to Trench 26 inventory |
| 05-14-85 | 3 drums<br>1 drum | Calcium nitrate<br>Sodium nitrate | 7-23 | •Returned to Trench 19N following excavation | •Included | •Included |

**ATTACHMENT 1**

**REVISED INVENTORY LISTS FOR TRENCH 19N AND 28**

**APPENDIX 4A**
**CHEMICAL WASTE INVENTORY FOR THE NONRADIOACTIVE DANGEROUS WASTE LANDFILL**

**Trench #19N**

| Date | Quantity | Chemical |
|---|---|---|
| 11-08-85 | 3 drums, 55 gal | Waste calcium nitrate |
| 11-11-85 | 1 drum, 55 gal | Waste sodium nitrate |
| | ~~22~~ 20 lb | Sodium nitrate |
| | 1 pt | Ethyl acetate |
| | ~~8 pt~~ | ~~Toluene~~ |
| | ~~1 pt~~ | ~~Xylene~~ |
| | ~~3~~ 1 pt | Methyl alcohol |
| | ~~5 pt~~ | ~~Benzene~~ |
| | ~~2~~ 1 qt | Isopropanol |
| | 1 lb | Potassium permanganate |
| | 1 lb | Ammonium nitrate |
| | ~~3~~ 1 lb | Sodium nitrate |
| | 1 lb | Ammonium chloride |
| | 1 lb | Sodium chromate |
| | ~~1 qt~~ | ~~1 1 1 Trichloroethane~~ |
| | ~~2~~ 1 qt | Ammonium hydroxide |
| | ~~1 pt~~ | ~~37% Formaldehyde solution~~ |
| | 5 lb | Sodium hydroxide, dry solid |
| | 1 gal | Naphtha |
| | 2 qt | Ammonium oxalate (TURCO 4521*) |

ATT 1-1

**APPENDIX 4A**
**CHEMICAL WASTE INVENTORY FOR THE NONRADIOACTIVE DANGEROUS WASTE LANDFILL**

**Trench #28**

| Date | Quantity | Chemical |
|---|---|---|
| 02-03-84 | 6 lb | Sodium hydrogen sulfide |
| | 1 lb | Sodium chromate |
| | 1 lb | Sodium bichromate |
| | 0.5 lb | Potassium chromate |
| | 10 oz | 1-Ethylquinelinium iodide |
| | 1 lb | Sodium metabisulfite |
| | 1 lb | Ferrous sulfate |
| | 0.5 lb | Nickel chloride |
| | 1 kg | Calgon* |
| | 1 lb | Gelatine powder |
| | 1 pt | Flexible collodion |
| | 1 L | Polyelectrolytes |
| | 1 lb | Ammonium sulfate |
| | 1 lb | Aluminum oxide |
| | 32 oz | Glycenyl triacetate |
| | 800 g | Weldon 28 component C |
| | 32 oz | Ammonium sulfide |
| | 250 mL | Castor oil |
| | 1 pt | Photo-flo 200 |
| | 100 g | Creosote |
| 02-09-84 | 110 gal | Anhydrous borax |
| | 255 gal | Sodium nitrate |
| | 170 gal | Boric acid |
| | 240 gal | Sodium nitrite |
| | 145 gal | Sodium nitrite, borax, frit, sand, gravel |
| | 22 gal | Boric acid, frit, soda ash, silica, and warehouse sweepings |
| | 120 gal | Boric acid, anhydrous borax, brown sand |
| | 175 gal | Boric acid, borax, potassium nitrate |
| | 165 gal | Boric acid, sand, fine frit, borax, sodium nitrate |
| | 220 gal | Boric acid, frit, borax, sodium nitrate |
| | 195 gal | Borax, sand, frit, empty chemical bags |
| | 55 gal | Low sodium nitrate sludge |
| | 55 gal | Normal sodium nitrate sludge |
| | 275 gal | Sodium carbonate sludge spiked |
| 02-22-84 | 18 gal | Ammonium hydroxide |
| 03-16-84 | 200 mL | Butyl alcohol |
| | 1 pt | 2-Propanol |

ATT 1-2

**APPENDIX 4A**
**CHEMICAL WASTE INVENTORY FOR THE NONRADIOACTIVE DANGEROUS WASTE LANDFILL**

**Trench #28**

| Date | Quantity | Chemical |
|---|---|---|
| 03-16-84 (cont) | 0.5 pt | Butyl ether |
| | 1 L | Amyl alcohol |
| | 0.5 kg | n-Octylalcohol |
| | 0.5 pt | Normal paraffin hydrocarbon |
| | 1,000 mL | Plexiglass* cement |
| | 1 pt | Iodobenzene |
| | 2/3 pt | Combustible liquid, n.o.s. |
| | 0.5 L | Phosphenylchloride, dichlorophenyl phosphine |
| | 500 mL | Indene |
| | 1/8 pt | Diazald |
| | 1 L | Tris (hydroxymethyl) amino-methane |
| | 1 pt | Hypophosphorus acid |
| | 250 g | Antimonypentachloride |
| | 1 L | Bromine |
| | 1 pt | Hydriodic acid |
| | 1 pt | Dinoylnapthalenesulfonic acid |
| | 450 g | Benzoyl peroxide |
| | 1 L | 2,2-$A_2$O-bis-2-Methyl propionitrile |
| | 315 kg | Ceric oxide |
| | 54 $ft^3$ | Cerous oxalate |
| | 1 pt | Butyl ether |
| | 11 qt | Sulfurous acid |
| | 250 lb | Magnesium nitrate |
| | 100 lb | Bismuth nitrate |
| | 75 lb | Sodium nitrate |
| | 950 lb | Sodium nitrite |
| | 75 lb | Disodium phosphate |
| | 96 lb | Cesium carbonate |
| | 25 lb | Soda ash |
| | 5 gal | Kaowool* cement |
| | 100 lb | Activated aluminum |
| | 30 lb | Sodium fluoride |
| 05-01-84 | 2 gal | Urethane component A |
| | 1 pt | Urethane component B |
| | 2 gal | Concentrated chemical A/B |
| 05-23-84 | 20 gal | Waste corrosive liquid, n.o.s. (Picrolonic acid, formic acid, and vanadous formate all absorbed) |
| 06-13-84 | 10 lb | Sodium hydroxide |

ATT 1-3

**APPENDIX 4A**
**CHEMICAL WASTE INVENTORY FOR THE NONRADIOACTIVE DANGEROUS WASTE LANDFILL**

**Trench #28**

| Date | Quantity | Chemical |
|---|---|---|
| 06-14-84 | 17 gal | Ammonium hydroxide |
| 06-20-84 | 0.5 kg | Zirconium hydride |
| 06-22-84 | 1,140 gal | Lanthanum nitrate |
| | 825 gal | Trichloroethane |
| 07-05-84 | 100 lb | Versene EDTA |
| | 25 lb | Thiourea |
| | 13 gal | Ethylene glycol |
| | 225 lb | Ammonium persulfate |
| 07-19-84 | ~~90 lb~~ 9 drums, 55 gal | Nickel, hydrated |
| 08-23-84 | 1 pt | Ammonium sulfide |
| | 1 pt | Ethylacetate |
| | 0.5 gal | Hexone |
| | 6 pt | Butyl alcohol |
| | 1 qt | Hexone |
| | 1 qt | Collodion |
| | 1 pt | Amyl acetate |
| | 1 pt | Ethyl acetate |
| | 3 kg | Methyl ethyl ketone |
| | 1 pt | Hexone |
| | 1 qt | Tetrahydrofuran |
| | 1 pt | Perchloric acid (70%) |
| | 1 pt | Hydrogen peroxide (30%) |
| | 5 gal | Dichloromethane |
| | 1 qt | Bis(2-ethylhexyl)2-hexylphosphonate |
| | 1 qt | Mono-2-ethyl hexylacid orthophosphate |
| | 1 pt | Glycerine |
| | 1 kg | Octyl alcohol |
| | 5 L | Isopentyl alcohol |
| | 1 qt | Acetyl acetone |
| | 1 gal | Dimethyl formamide |
| | 1 L | Hexanol |
| | 5 lb | Lactic acid |
| | 1 qt | Diisopropyl ketone |
| | 1 gal | Sulfuric acid (93%) |
| 09-05-84 | 400 lb | Metal alloy - 40% Al and 60% Ca |

ATT 1-4

**APPENDIX 4A**
**CHEMICAL WASTE INVENTORY FOR THE NONRADIOACTIVE DANGEROUS WASTE LANDFILL**

**Trench #28**

| Date | Quantity | Chemical |
|---|---|---|
| 11-09-84 | 75 gal | Paint related material |
| 12-20-84 | 69 mL<br>230 mL | Refill for CQC for fyrite oxygen indicator<br>Methanol |
| 01-11-85 | 520 gal | Dry salt cake: $NaNO_3$, $NaNO_2$, NaOH |

ATT 1-5

**APPENDIX 4C**

**PRE-NOVEMBER 1985 CHEMICAL WASTE INVENTORY FOR THE NONRADIOACTIVE DANGEROUS WASTE LANDFILL**

**Trench #19N**

| Date | Quantity | Chemical |
|---|---|---|
| 06-13-84 | ~~2 lb~~ | ~~Sodium nitrate~~ |
| | 20 lb | Sodium nitrate |
| 07-19-84 | ~~990 gal~~ 18 drums, 55 gal | Sodium nitrite |
| | ~~550 gal~~ 1 drum, 55 gal | Nickel, hydrated |
| 12-05-84 | 1 lb | Potassium permanganate |
| | 1 lb | Sodium nitrate |
| | 1 lb | Sodium chromate |
| | 5 lb | Sodium hydroxide |
| | 1 pt | Ethyl acetate |
| | 1 pt | Methanol |
| | 1 qt | Isopropanol |
| | 1 gal | Naphtha |
| | 1 lb | Ammonium nitrate |
| | 1 lb | Ammonium chloride |
| | 1 qt | Ammonium hydroxide |
| | 2 qt | Ammonium oxalate |
| ~~01-11-85~~ | ~~13 drums, 55 gal~~ | ~~Salt cake~~ |
| 05-14-85 | 3 drums, 55 gal | Waste calcium nitrate |
| | 1 drum, 55 gal | Waste sodium nitrate |

ATT 1-6

EXHIBIT J:

NRDWL Soil-Gas Survey: Final Data Report (WHC-SD-EN-TI-1990) 1993

Evaluation of the Soil-Gas Survey at NRDWL (BHI-01115) 1997

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# Evaluation of the Soil-Gas Survey at the Nonradioactive Dangerous Waste Landfill

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# Evaluation of the Soil-Gas Survey at the Nonradioactive Dangerous Waste Landfill

Author
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Date Published
September 1997

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Prepared for the U.S. Department of Energy
Office of Environmental Restoration

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## EXECUTIVE SUMMARY

Soil-gas samples were collected from six shallow probes (1.8 m deep) and 33 deep probes (8.8 to 29.7 m deep) at the Nonradioactive Dangerous Waste Landfill (NRDWL) to (1) assess the current distribution and potential movement of volatile organic compounds (VOC) in the vadose zone and (2) reaffirm the current priority for closure of NRDWL. The sampling locations focused on the eastern half of NRDWL, where VOCs were detected in a 1993 soil-gas survey. Six VOCs were detected during the 1997 survey: 1,1,1-trichloroethane (TCA); 1,1-dichloroethane (DCA), tetrachloroethylene, trichloroethylene, carbon tetrachloride, and chloroform. Of these contaminants, TCA was the most widespread and detected in all but one of the samples from the deep probes at concentrations less than 1 part per million by volume (ppmv); however, TCA was not detected in the samples from the shallow probes. Carbon tetrachloride and chloroform were the only contaminants detected at concentrations exceeding 1 ppmv; in samples from two adjacent locations (one shallow and two deep probes), concentrations ranged from 20 to 46 ppmv. All of the same contaminants, except DCA, were detected in the 1993 survey. Evaluation of the 1997 soil-gas results indicates that the potential risk at NRDWL is low compared to the potential risks associated with other 200 Area waste sites and does not merit changing the current priorities for closure.

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# 1.0 INTRODUCTION

## 1.1 BACKGROUND

The Nonradioactive Dangerous Waste Landfill (NRDWL) is a *Resource Conservation and Recovery Act of 1976* (RCRA) land disposal unit assigned to the 200-IU-3 Operable Unit. The landfill was used to dispose nonradioactive dangerous waste and asbestos waste from 1975 to 1985. A closure and postclosure plan for NRDWL was submitted in August 1990 (DOE-RL 1990) that recommended that waste be left in place and that a final cover be placed for closure. Notice of deficiency comments from the Washington State Department of Ecology (Ecology) were provided in January 1994 and April 1997. In 1996, a 200 Area soil remediation strategy was developed that redefined and reprioritized operable units into waste site groups, integrated RCRA and *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* (CERCLA) activities, and defined an integrated assessment process within the U.S. Department of Energy, Richland Operations Office (RL) Environmental Restoration (ER) program (DOE-RL 1996, DOE-RL 1997). The NRDWL was assigned to the ER program's Nonradioactive Landfills Waste Group, which was considered low on the priorities list. However, the Ecology Unit Manager for NRDWL identified concerns that the potential for NRDWL being a source of groundwater contamination may require closure of NRDWL earlier than the priority for the Nonradioactive Landfills Waste Group. Ecology and RL agreed that the 1997 soil-gas survey was needed to confirm the closure priority assigned to NRDWL by providing an assessment of the current distribution and potential movement of the contaminants of concern.

## 1.2 PURPOSE

Volatile organic compounds (VOC) were detected primarily within and south of the eastern third of the NRDWL trenches during a 1993 shallow, (1.5 to 1.8 m deep) soil-gas survey and have been detected during groundwater monitoring of wells near NRDWL since 1987 (Jacques 1993, Hartman and Dresel 1997). The purpose of the 1997 soil-gas investigation was to (1) collect deep soil-gas data to assess the vertical extent of VOC contamination and the potential impacts to groundwater and (2) resample selected shallow gas probes to assess changes in contaminant distribution that may indicate contaminant movement.

## 1.3 SAMPLING AND ANALYSIS OBJECTIVE

The contaminants of concern (COC) for NRDWL are 1,1,1-trichloroethane (TCA), tetrachloroethylene (PCE), trichloroethylene (TCE), carbon tetrachloride, and chloroform based on previous soil-gas data from NRDWL (Jacques 1993). Using the data quality objectives (DQO) process, the Environmental Restoration Contractor (ERC), RL, and Ecology defined the following specific objectives for this investigation (Smith 1997):

1. Are the COCs within NRDWL moving? This question will be addressed by comparing the VOC concentrations measured in 1997 to those measured in 1993.

2. Where are the COCs now? This question will be addressed by determining the distribution of VOC contaminants in the subsurface focusing on the vertical extent of VOCs.

3. Do the results of this sampling effort merit changing NRDWL's priority for closure? This question will be addressed by evaluating the levels of VOC concentrations in the vadose zone and the potential impact of the detected VOC on the underlying groundwater.

## 1.4 VADOSE ZONE CHARACTERISTICS

The vadose zone underlying NRDWL is 38.4 to 40.8 m thick and consists of surficial dune sand overlying flood-deposited silts, sands, and gravels of the Hanford formation (Weekes et al. 1987). The surficial dune sand layer is 0.9 to 1.2 m thick. Beneath the surface sand is a narrow horizontal silt layer approximately 7.6 to 10 cm thick that marks the top of the sand subunit of the Hanford formation. This silt layer was evident in open trenches of NRDWL and was encountered in the undisturbed areas of the site in 1993 during the surface geophysical survey and while installing the shallow soil-gas probe network (Mitchell et al. 1993, Jacques 1993). In contrast to the undisturbed areas, the closed disposal trenches represent large disturbed areas containing reworked soil and waste. The disturbed portions of the site contain medium- to coarse-grained sand.

Based on drilling at NRDWL, the vadose zone consists of an upper, unconsolidated sand subunit with occasional thin silt layers underlain by a gravel subunit consisting of pebbles and cobbles with a variable matrix of silt and sand (Weekes et al. 1987). The contact between the sand and gravel subunits through NRDWL averages 19.2 m (63 ft) below ground surface; in wells 699-25-34B and 699-25-34D at the southeast corner of NRDWL, the contact is 25.9 m (85 ft) below ground surface (Weekes et al. 1987, WHC 1993).

# 2.0 SAMPLING AND ANALYSIS PLAN

The strategy and methods used to sample and analyze the soil gas within the subsurface at NRDWL are described in the *Nonradioactive Dangerous Waste Landfill Sampling and Analysis Plan and Data Quality Objectives Process Summary Report* (Smith 1997). The Sampling and Analysis Plan includes the Field Sampling Plan and the Quality Assurance Project Plan.

The sampling design was developed by the ERC, RL, and Ecology based on historical soil-gas data, site geohydrology, budget limitations, and professional judgement. The selection of horizontal locations was made based on the historical soil-gas data, which shows contaminants generally associated with the chemical trenches in the eastern half of NRDWL and with some apparent tendency to move southeast outside of NRDWL. The selection of deep vertical locations at 9.1, 18.3, 27.4, and 36.6 m were considered reasonably close to each other to establish vertical concentration profiles and sufficiently deep to assess potential impacts on

groundwater, but still cost-effective. A total of 27 existing shallow probes and 56 new deep probes (4 depths at each of 14 locations) were selected for sampling (Figures 1 and 2, respectively). The probes were prioritized into three phases: samples from Phase I and II probes had the highest priority and were considered necessary to delineate the extent of contamination to meet the DQOs; samples from Phase III probes had the lowest priority and were intended to supplement the coverage and density of the primary effort, as needed. In general, a higher priority was placed on deeper samples outside NRDWL and on shallower samples within NRDWL, based on the working model that any soil-gas migration from NRDWL would tend to occur vertically as well as horizontally.

## 3.0 RESULTS OF PROBE INSTALLATION

A total of 35 probes were installed from August 18, 1997, through August 27, 1997: 2 shallow probes and 33 deep probes. Probes were installed at all of the target depths at all of the Phase I and Phase II locations, except all 14 target depths of 36.6 m and two target depths of 27.4 m; installation of these probes was limited by resistance of the subsurface to further rod penetration, referred to as refusal. In addition, the final depths of four probes (three probes targeted for depths of 27.4 m and one probe targeted for a depth of 18.3 m) differ from their target depths by more than ± 3 m, the tolerance allowed in the Sampling and Analysis Plan. The actual depths achieved at each sampling location are compared to the target depths in Table 1.

Before probe installation, the 1993 geophysical survey data were reviewed to ensure that buried waste would not be encountered. Within the NRDWL trench area, horizontal probe locations were adjusted slightly (by 0 to 3 m) to locations where intersecting east-west and north-south geophysical survey lines indicated no disturbed soil that could potentially contain buried waste; intersections of perpendicular geophysical survey lines were considered to provide significantly more information for subsurface evaluation than single lines. The Sampling and Analysis Plan allowed horizontal adjustments of up to 15.2 m. No buried materials were encountered during probe installation.

Soil-gas probes were installed using a Geoprobe Model 5400™ hydraulic probe driver. Each sample point consists of a dedicated stainless steel screen implant connected to a length of 0.64 cm outside diameter polyethylene tubing (Figure 3).

Refusal was typically encountered at depths ranging from 19.5 to 29.7 m, which correspond to the average depth of the sand-gravel contact. The primary cause of refusal is believed to be pebbles or cobbles in the gravel subunit. However, refusal was encountered twice at 13.4 m and once at 3.7 m, presumably by the presence of cobbles within the sand subunit. As described in the Sampling and Analysis Plan, only one attempt was made to reach the target depth at each

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Geoprobe Model 5400 is a trademark of Geoprobe Systems, Salina, Kansas.

location, and no additional attempts were made to drive to that depth or deeper depths at that location. At each location, the deepest target depth was attempted first. In general, the resistance to probe installation increased at approximately 9 m below ground surface and again at 18 m.

During probe installation, eight initial attempts were abandoned (Table 2); at these locations, probes were successfully installed during later attempts. At one location, the installation was abandoned because of shallow refusal (3.7 m); at six locations, the installations were abandoned because of difficulties with the sample tip or screen placement. At three locations (D-8, D-9, and D-10), the rods broke in the subsurface and could be not be retrieved (at D-8, however, the sample probe was tested and found to be usable). The rod breakage was attributed primarily to metal fatigue, combined with installation at undisturbed locations. A total of 26.7 m of rod was left in place. New rods that were delayed in transit were received on the following workday and used for the remaining field work; no additional rod breakage was encountered.

## 4.0 RESULTS OF SOIL-GAS SAMPLING AND ANALYSIS

Soil-gas samples were collected and analyzed on September 2, 1997, and September 4, 1997, from all of the Phase I and II probes that were installed. The existing, shallow Phase III probes were not sampled due to the emphasis on analysis of samples from the deeper probes. Six VOCs were detected: TCA, 1,1-dichloroethane (DCA), PCE, TCE, carbon tetrachloride, and chloroform (Jacques 1997). Of these contaminants, TCA was the most widespread, detected in all but one of the samples from deep probes at concentrations less than 1 ppmv, but in none of the samples from the shallow probes. Carbon tetrachloride and chloroform were the only contaminants detected at concentrations exceeding 1 ppmv. In samples from three probes at two locations (two samples from S-4/1.8 m, one from D-3/8.8 m, and one from D-3/23.2 m), carbon tetrachloride concentrations ranged from 20 to 45 ppmv; concentrations exceeded the calibration range (0 to 23 ppmv) in samples from probes S-4/1.8 m and D-3/23.2 m. In the same samples from these probes, chloroform concentrations ranged from 22 to 46 ppmv; concentrations exceeded the calibration range (0 to 23 ppmv) in one sample from each probe. The actual values for concentrations that exceeded the calibration range are likely to be slightly higher (5 to 10%) because the slopes of the calibration curves decrease as the detector becomes more saturated with the contaminant. The VOC results for soil-gas and quality control samples are summarized in Table 3 (Jacques 1997).

Soil-gas samples were collected in the morning of each sampling day and analyzed on the same day in the afternoon. The VOC results were generated using a Photovac 10S Plus portable gas chromatograph. The gas chromatograph was calibrated using prepared calibration standards that had a concentration tolerance of ± 2%; three-point calibration curves were established for each analyte (Figure 4). The calibration for the 1 ppmv range, which contained the majority of the analyte concentrations, was checked each day that samples were analyzed. The minimum detection limits and practical quantitation limits were established for the analyses; the reporting limit was rounded to 0.10 ppmv for each analyte (Table 4). Additional details are described in Jacques (1997).

Soil-gas sample collection from five probes was difficult. During attempts to collect samples from probes at D-4/9.1 m, D-5/9.1 m, and D-6/9.1 m, the lower ends of the sample tubes contained water that prevented withdrawal of a full purge volume of vapor; the vapor sample collected for analysis consisted of the vapor present in the tube when sample extraction began (i.e., the purge gas). As extraction continued, the water appeared to fill the sample tube as it was drawn to the surface, implying that a readily available source of water (i.e., perched water) was present at the probe depth. These observations are consistent with the theoretically limiting depth (9.75 m) from which the sample pump could lift water; water samples were not collected. Because these three vapor samples are not representative of subsurface vapor, the analytical results were not included in the data evaluation; however, the results are included in Table 3 for completeness. Probe D-10/13.4 m was also difficult to sample due to the presence of moisture, but the sample tube was successfully purged before collecting the vapor sample. Vapor sample collection was also difficult at probe D-3/23.2 m. The samples from these two probes are considered suspect, but due to the significant concentration levels indicated in the analytical results from the D-3/23.2 m sample, they were included in the data evaluation.

The results of the 1997 soil-gas survey were consistent with results from past soil-gas sampling and analysis at NRDWL. All of the same VOCs detected in 1993 in samples from shallow probes at NRDWL were also detected in 1997 in samples from shallow and deep probes (Jacques 1993). In addition, analyses of five deep soil-gas samples collected during drilling of wells 699-25-34D and 699-26-34B in 1993 at the north and south boundaries of the eastern half of NRDWL indicated that the only VOC present at higher concentration at depth was carbon tetrachloride, detected at concentrations of 9 to 10 ppmv in two samples, one from 25 m depth at the southern well and one at 37.5 m depth at the northern well (WHC 1993). In 1997, carbon tetrachloride was also the only VOC detected at concentrations exceeding 1 ppmv in deep samples.

The analyses of the 1997 deep soil-gas samples provide a baseline for VOC concentrations at depth. TCA was detected in 29 of the 30 samples included for data evaluation from the deep probes at concentrations ranging from approximately 0.07 to 0.37 ppmv (Figure 5). TCA concentrations are higher within and south of the NRDWL trenches; concentrations between 0.2 and 0. 4 ppmv were generally detected in the deeper samples. DCA was detected in samples from only two probes, both at D-11, at concentrations ranging from approximately 0.09 to 0.10 ppmv. DCA (a degradation product of TCA) was detected in the samples that had higher concentrations of TCA. The results for DCA were not illustrated on plots because there were so few detections. PCE was detected at concentrations ranging from approximately 0.06 to 0.43 ppmv, and TCE was detected at concentrations ranging from approximately 0.05 to 0.25 ppmv, in samples from deep probes (Figures 6 and 7). PCE and TCE concentrations tend to be higher within and south of the NRDWL trenches. Carbon tetrachloride was detected at concentrations ranging from approximately 0.08 to approximately 42 ppmv, and chloroform was detected at concentrations ranging from approximately 0.08 to approximately 46 ppmv, in samples from deep probes (Figures 8 and 9). For both contaminants, concentrations exceeding 1 ppmv were detected in samples from two probes at location D-3 at the edge of chemical trench 34: D-3/8.8 m and D-3/23.2 m. Each detection of TCA, PCE, TCE, carbon tetrachloride, and chloroform are shown in relation to depth in Figure 10.

The analyses of the 1997 shallow, soil-gas samples can be compared to the 1993 analyses of samples from the same locations (Table 5). In 1997, TCA, DCA, and TCE were detected in none of the samples from the shallow probes. PCE was detected in samples from 4 of the 6 shallow probes at concentrations ranging from 0.05 to 0.60 ppmv. Carbon tetrachloride and chloroform were detected in samples from two adjacent shallow probes in chemical trenches 33 and 34: S-3 and S-4. In the two samples from probe S-4, carbon tetrachloride concentrations averaged approximately 43 ppmv, and chloroform concentrations averaged approximately 24 ppmv.

During the 1993 soil-gas survey, all of these contaminants, except DCA, were detected at shallow probes at NRDWL. The Photovac gas chromatograph used during the 1993 survey had a 10.6 eV lamp, which does not provide quantitation for some of the chlorinated hydrocarbon compounds as accurately as the 11.7 eV lamp currently in use. However, vapor samples were recollected from the chemical trenches in 1993 and analyzed using a Scentograph gas chromatograph, which provides more reliable results than the 10.6 eV lamp for TCA, carbon tetrachloride, and chloroform.

The 1993 results for the same six shallow probes that were sampled in 1997 indicate detections of TCA in samples from two of the probes, DCA in none of the samples, TCE in samples from five of the probes, and PCE in samples from five of the probes. Carbon tetrachloride and chloroform were detected in samples from probes S-3 and S-4, and chloroform was also detected in the sample from probe S-2. The 1993 results for PCE and TCE for all of the shallow probes are illustrated in Figures 11 and 12, respectively.

The maximum concentrations detected for each VOC during the 1993 and 1997 surveys at all locations are listed in Table 6. In general, for the shallow probes, the maximum detected concentrations of TCA, PCE, and TCE have decreased, and the maximum detected concentrations of carbon tetrachloride and chloroform have increased.

## 5.0 IMPLICATIONS FOR THE DQO QUESTIONS

The results of the soil-gas survey were used to address the three DQO questions.

1. Are the COCs within NRDWL moving?

In general, the 1993 and 1997 soil-gas samples were collected at different depths and over different areas, making comparison difficult. To evaluate migration within the deep zone, additional sampling and analysis would be required over time. However, limited comparison of analytical results for 1993 and 1997 soil-gas samples suggests that the contaminants within NRDWL have not migrated significantly. Comparison of the concentrations detected in shallow samples indicates that maximum carbon tetrachloride concentrations are still laterally within the chemical trenches at NRDWL. Comparison of the concentrations detected in deep samples suggests that vertical migration of carbon tetrachloride was directly beneath the chemical trenches within a narrow zone. In general, the same VOCs that were detected in 1993 were detected in 1997.

2. Where are the COCs now?

Based on the 1997 soil-gas survey results, the soil vapor contaminants tend to be distributed at low concentration levels within or south of the NRDWL trenches. Soil vapor concentrations of TCA tend to be higher with depth. Soil vapor concentrations of PCE generally tend to be lower with depth. The highest concentrations of carbon tetrachloride and chloroform are detected in shallow and deep samples within and beneath the chemical trenches and are very localized.

3. Do the results of this sampling effort merit changing NRDWL's priority for closure?

Low concentration levels of VOC (less than 1 ppmv) were detected within and south of the eastern half of NRDWL. Only carbon tetrachloride and chloroform were detected at concentrations exceeding 1 ppmv; these higher concentrations (approximately 20 to 46 ppmv) were detected within and beneath chemical trenches 33 and 34. Concentrations of the VOC contaminants detected during the soil-gas survey have been generally decreasing in the NRDWL groundwater wells (Figures 13 through 19).

The only VOC contaminant detected in the soil-gas of potential concern with regard to groundwater quality is carbon tetrachloride. Detections of carbon tetrachloride in groundwater between 1991 and 1996 were sporadic and difficult to attribute to a particular point source. Groundwater will continue to be monitored to assess concentration trends. This potential risk is low compared to the potential risks associated with other 200 Area waste sites and does not merit changing the current priorities for NRDWL as described in the Waste Site Grouping report (DOE-RL 1997).

## 6.0 REFERENCES

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**Table 1. Summary of NRDWL Soil-Gas Probe Installation. (Page 1 of 3)**

| Phase | Location Number "S" = Shallow "D" = Deep | Probe Target Depth (m) | Probe Actual Depth (m) | Borehole Identification Number | Date Installed |
|---|---|---|---|---|---|
| I | S-1 | 1.8 | 1.8 | N/A | 1993 |
| I | S-2 | 1.8 | 1.8 | B8167 | 8/18/97 |
| I | S-3 | 1.8 | 1.8 | B8166 | 8/18/97 |
| I | S-4 | 1.8 | 1.8 | N/A | 1993 |
| I | S-5 | 1.8 | 1.8 | N/A | 1993 |
| I | S-6 | 1.8 | 1.8 | N/A | 1993 |
| I | D-1 | 9.1 | 9.1 | B8170 | 8/18/97 |
| I | | 18.3 | 19.5 | B8169 | 8/18/97 |
| I | | 27.4 | 25.9* | B8168 | 8/18/97 |
| I | | 36.6 | | | |
| I | D-2 | 9.1 | 9.1 | B8174 | 8/19/97 |
| I | | 18.3 | 18.3 | B8172 | 8/19/97 |
| I | | 27.4 | 29.3* | B8171 | 8/19/97 |
| I | | 36.6 | | | |
| I | D-3 | 9.1 | 8.8* | B8176 | 8/19/97 |
| I | | 18.3 | 18.3 | B8177 | 8/19/97 |
| I | | 27.4 | 23.2* | B8175 | 8/19/97 |
| II | | 36.6 | | | |
| I | D-4 | 9.1 | 9.1 | B8179 | 8/20/97 |
| I | | 18.3 | 18.3 | B8178 | 8/20/97 |
| II | | 27.4 | 27.1* | B8432 | 8/26/97 |
| II | | 36.6 | | | |

**Table 1. Summary of NRDWL Soil-Gas Probe Installation. (Page 2 of 3)**

| Phase | Location Number "S" = Shallow "D" = Deep | Probe Target Depth (m) | Probe Actual Depth (m) | Borehole Identification Number | Date Installed |
|---|---|---|---|---|---|
| II | D-5 | 9.1 | 9.1 | B8430 | 8/26/97 |
| II | | 18.3 | 18.3 | B8429 | 8/26/97 |
| II | | 27.4 | 26.8* | B8428 | 8/26/97 |
| II | | 36.6 | | | |
| I | D-6 | 9.1 | 9.1 | B8183 | 8/20/97 |
| I | | 18.3 | 18.3 | B8181 | 8/20/97 |
| I | | 27.4 | 22.6* | B8180 | 8/20/97 |
| I | | 36.6 | | | |
| I | D-7 | 9.1 | 9.1 | B8187 | 8/21/97 |
| I | | 18.3 | 18.3 | B8188 | 8/21/97 |
| I | | 27.4 | 26.4* | B8184 | 8/20/97 |
| I | | 36.6 | | | |
| I | D-8 | 18.3 | 18.3 | B8190 | 8/21/97 |
| I | | 27.4 | 29.7* | B8189 | 8/21/97 |
| I | | 36.6 | | | |
| I | D-9 | 18.3 | 19.5* | B8444 | 8/27/97 |
| I | | 27.4 | | | |
| I | | 36.6 | | | |
| II | D-10 | 18.3 | 13.4* | B8194 | 8/22/97 |
| I | | 27.4 | 25.1* | B8192 | 8/22/97 |
| I | | 36.6 | | | |
| II | D-11 | 18.3 | 18.3 | B8427 | 8/25/97 |
| I | | 27.4 | 26.2* | B8426 | 8/25/97 |
| I | | 36.6 | | | |

**Table 1. Summary of NRDWL Soil-Gas Probe Installation. (Page 3 of 3)**

| Phase | Location Number "S" = Shallow "D" = Deep | Probe Target Depth (m) | Probe Actual Depth (m) | Borehole Identification Number | Date Installed |
|---|---|---|---|---|---|
| II | D-12 | 18.3 | 18.6 | B8195 | 8/25/97 |
| II | | 27.4 | 13.4* | B8196 | 8/25/97 |
| II | | 36.6 | | | |
| II | D-13 | 18.3 | 18.3 | B8434 | 8/27/97 |
| II | | 27.4 | 26.2* | B8433 | 8/26/97 |
| II | | 36.6 | | | |
| II | D-14 | 18.3 | 19.5* | B8435 | 8/27/97 |
| II | | 27.4 | | | |
| II | | 36.6 | | | |

*Depth at refusal; actual probe depth generally paired with closest available target depth.

**Table 2. NRDWL Abandoned Probe Installations.**

| Location Number | Depth of Installation (m) | Length of Rod Left in Ground (m) | Borehole Identification Number | Date Attempted | Reason for Abandonment |
|---|---|---|---|---|---|
| D-2 | 9.1 | 0 | B8173 | 8/19/97 | Tip would not release |
| D-6 | 3.7 | 0 | B8182 | 8/20/97 | Lost tip |
| D-7 | 10.4 | 0 | B8185 | 8/21/97 | Tip would not release |
| D-7 | 18.3 | 0 | B8186 | 8/21/97 | Could not set screen |
| D-8* | 29.7 | 3.6 | B8189 | 8/21/97 | Joint broke at 25.9 m bgs during backpull; sample point usable |
| D-9 | 17.7 | 8.5 | B8191 | 8/21/97 | Rods broke at 9.1 m bgs |
| D-10 | 15.1 | 14.6 | B8193 | 8/22/97 | Could not thread sample screen past 12.2 m; top rod broke at joint during backpull |
| D-11 | 3.7 | 0 | B8197 | 8/25/97 | Refusal at 3.7 m bgs |
| D-4 | 2.4 | 0 | B8431 | 8/26/97 | Lost tip |

*Probe installation not abandoned
bgs = below ground surface

**Table 3. Analytical Results for Soil-Gas Samples Collected at NRDWL, September 1997.**

| Sample & Analysis Date | Probe Number | Depth (m) | Purge Volume (mL) | 1,1,1-TCA (ppmv) | 1,1-DCA (ppmv) | PCE (ppmv) | TCE (ppmv) | Carbon Tetrachloride (ppmv) | Chloroform (ppmv) | HEIS Number |
|---|---|---|---|---|---|---|---|---|---|---|
| 9/2/97 | Ambient Air | NA | 900 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | BOLM21 |
| 9/2/97 | Cal Check | NA | NA | 0.93 | 0.91 | 0.92 | 0.92 | 0.95 | 0.89 | BOLM42 |
| 9/2/97 | Cal Check | NA | NA | 0.96 | 0.99 | 0.94 | 0.98 | 0.98 | 0.98 | BOLM43 |
| 9/2/97 | Cal Standard | NA | NA | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | BOLM41 |
| 9/4/97 | Ambient Air | NA | 1000 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | BOLM44 |
| 9/4/97 | Cal Check | NA | NA | 0.96 | 0.95 | 0.94 | 0.96 | 0.91 | 0.90 | BOLM69 |
| 9/4/97 | Cal Check | NA | NA | 0.97 | 0.97 | 0.93 | 0.96 | 0.99 | 1.0 | BOLM70 |
| 9/4/97 | Cal Standard | NA | NA | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | BOLM68 |
| 9/4/97 | S-1 | 1.8 | 100 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | BOLM65 |
| 9/4/97 | S-2 | 1.8 | 100 | <0.10 | <0.10 | 0.15 | <0.10 | <0.10 | <0.10 | BOLM66 |
| 9/4/97 | S-3 | 1.8 | 100 | <0.10 | <0.10 | 0.068 j | <0.10 | 0.82 | 0.94 | BOLM63 |
| 9/2/97 | S-4 | 1.8 | 100 | <0.10 | <0.10 | 0.53 | <0.10 | 41 e | 22 | BOLM40 |
| 9/4/97 | S-4 replicate | 1.8 | 100 | <0.10 | <0.10 | 0.60 | <0.10 | 45 e | 25 e | BOLM64 |
| 9/4/97 | S-5 | 1.8 | 100 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | BOLM66 |
| 9/4/97 | S-6 | 1.8 | 100 | <0.10 | <0.10 | 0.053 j | <0.10 | <0.10 | <0.10 | BOLM67 |
| 9/4/97 | D-1 | 9.1 | 450 | 0.098 j | <0.10 | 0.37 | <0.10 | <0.10 | <0.10 | BOLM57 |
| 9/4/97 | D-1 | 19.5 | 960 | 0.20 | <0.10 | 0.31 | <0.10 | <0.10 | <0.10 | BOLM58 |
| 9/4/97 | D-1 | 25.9 | 1275 | 0.18 | <0.10 | 0.27 | <0.10 | <0.10 | <0.10 | BOLM59 |
| 9/4/97 | D-2 | 9.1 | 450 | 0.16 | <0.10 | 0.35 | <0.10 | 0.12 | 0.14 | BOLM60 |
| 9/4/97 | D-2 | 18.3 | 900 | 0.18 | <0.10 | 0.30 | <0.10 | <0.10 | 0.14 | BOLM61 |
| 9/4/97 | D-2 | 29.3 | 1440 | 0.19 | <0.10 | 0.20 | <0.10 | <0.10 | <0.10 | BOLM62 |
| 9/4/97 | D-3 | 8.8 | 435 | 0.10 | <0.10 | <0.10 | 0.051 j | 20 | 37 e | BOLM46 |
| 9/4/97 | D-3 | 18.3 | 900 | 0.24 | <0.10 | 0.43 | 0.068 j | 0.45 | 1.6 | BOLM47 |
| 9/4/97 | D-3 | 23.2 | 500 b | <0.10 | <0.10 | 0.21 | <0.10 | 42 e | 46 e | BOLM48 |
| 9/4/97 | D-4 | 9.1 | 250 e,c | 0.14 | <0.10 | 0.087 j | <0.10 | 0.22 | 0.23 | BOLM49 |
| 9/4/97 | D-4 | 18.3 | 900 | 0.30 | <0.10 | 0.37 | 0.071 j | 0.13 | 0.31 | BOLM50 |
| 9/4/97 | D-4 | 27.1 | 1335 | 0.31 | <0.10 | 0.22 | 0.063 j | 0.099 j | 0.26 | BOLM51 |
| 9/4/97 | D-5 | 9.1 | 250 e,c | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | 0.18 | BOLM52 |
| 9/4/97 | D-5 | 18.3 | 900 | 0.27 | <0.10 | 0.32 | <0.10 | <0.10 | 0.11 | BOLM53 |
| 9/4/97 | D-5 | 26.8 | 1320 | 0.27 | <0.10 | 0.23 | <0.10 | <0.10 | 0.11 | BOLM54 |
| 9/4/97 | D-5 Duplicate | 26.8 | 1320 | 0.25 | <0.10 | 0.28 | <0.10 | <0.10 | 0.12 | BOLM55 |
| 9/4/97 | D-6 | 9.1 | 250 e,c | 0.067 j | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | BOLM45 |
| 9/2/97 | D-6 | 18.3 | 900 | 0.28 | <0.10 | <0.10 | <0.10 | <0.10 | 0.080 j | BOLM38 |
| 9/2/97 | D-6 | 22.6 | 1110 | 0.19 | <0.10 | 0.068 j | <0.10 | 0.087 j | 0.12 | BOLM39 |
| 9/2/97 | D-7 | 9.1 | 450 | 0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | BOLM24 |
| 9/2/97 | D-7 | 18.3 | 900 | 0.31 | <0.10 | <0.10 | 0.073 j | <0.10 | <0.10 | BOLM25 |
| 9/2/97 | D-7 | 26.4 | 1320 | 0.32 | <0.10 | <0.10 | 0.077 j | <0.10 | <0.10 | BOLM26 |
| 9/2/97 | D-8 | 18.3 | 900 | 0.37 | <0.10 | 0.087 j | 0.16 | <0.10 | <0.10 | BOLM31 |
| 9/2/97 | D-8 | 29.7 | 1460 | 0.31 | <0.10 | 0.069 j | 0.10 | <0.10 | <0.10 | BOLM32 |
| 9/2/97 | D-9 | 19.5 | 960 | 0.24 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | BOLM20 |
| 9/2/97 | D-10 | 13.4 | 660 e | .074 j | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | BOLM22 |
| 9/2/97 | D-10 | 25.1 | 1240 | 0.19 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | BOLM23 |
| 9/2/97 | D-11 | 18.3 | 900 | 0.35 | 0.10 | 0.095 j | 0.25 | <0.10 | <0.10 | BOLM33 |
| 9/2/97 | D-11 | 26.2 | 1290 | 0.36 | 0.088 j | 0.12 | 0.19 | <0.10 | <0.10 | BOLM34 |
| 9/2/97 | D-12 | 13.4 | 660 | 0.30 | <0.10 | 0.060 j | 0.059 j | 0.11 | 0.15 | BOLM35 |
| 9/2/97 | D-12 | 18.6 | 915 | 0.34 | <0.10 | 0.11 | 0.072 j | 0.087 j | 0.17 | BOLM36 |
| 9/2/97 | D-13 | 18.3 | 900 | 0.36 | <0.10 | 0.070 j | 0.19 | <0.10 | <0.10 | BOLM29 |
| 9/2/97 | D-13 | 26.2 | 1290 | 0.33 | <0.10 | 0.074 j | 0.13 | <0.10 | <0.10 | BOLM30 |
| 9/2/97 | D-14 | 19.5 | 960 | 0.22 | <0.10 | <0.10 | 0.078 j | <0.10 | <0.10 | BOLM27 |
| 9/2/97 | D-14 Duplicate | 19.5 | NA | 0.24 | <0.10 | <0.10 | 0.077 j | 0.067 j | <0.10 | BOLM28 |

e: Sample probe contained moisture and was difficult to sample

b: Sample probe was plugged or contained moisture and was difficult to sample

c: Low sample volume

e: Value exceeds calibration range

j: Value less than reporting limit

NA Not Applicable

**Table 4. Minimum Detection Limits (MDL) and Practical Quantitation Limits (PQL).**

| Limit | 1,1,1-TCA (ppmv) | 1,1-DCA (ppmv) | PCE (ppmv) | TCE (ppmv) | Carbon Tetrachloride (ppmv) | Chloroform (ppmv) |
|---|---|---|---|---|---|---|
| MDL | 0.027 | 0.028 | 0.031 | 0.027 | 0.026 | 0.024 |
| PQL | 0.082 | 0.083 | 0.093 | 0.080 | 0.077 | 0.072 |
| Reporting | 0.100 | 0.100 | 0.100 | 0.100 | 0.100 | 0.100 |

**Table 5. VOC Concentrations Detected in Samples from Shallow Probes S-1 through S-6 in 1993.**

| Probe | 1,1,1-TCA (ppmv) | PCE (ppmv) | TCE (ppmv) | Carbon Tetrachloride (ppmv) | Chloroform (ppmv) |
|---|---|---|---|---|---|
| **Analyzed Using the Photovac 10S Plus with 10.6eV Lamp** | | | | | |
| S-1 | ND | 0.017 | ND | ND | ND |
| S-2 | 0.120 | 0.620 | 0.013 | ND | ND |
| S-3 | ND | 0.390 | 0.018 | 4.500 | 3.000 |
| S-4 | ND | 5.000 | 0.028 | ND | ND |
| S-5 | ND | <0.010 | <0.010 | ND | ND |
| S-6 | ND | 0.084 | 0.043 | ND | ND |
| **Analyzed Using the Scentograph Gas Chromatograph** | | | | | |
| S-1 | 0.110 | 0.180 | <0.010 | ND | <0.010 |
| S-2 | ND | 2.380 | 0.025 | ND | 0.065 |
| S-3 | ND | 0.730 | 0.071 | 8.000 | 8.800 |
| S-4 | 0.120 | 8.100 | 0.035 | 0.300 | 0.560 |
| S-5 | NS | NS | NS | NS | NS |
| S-6 | NS | NS | NS | NS | NS |

ND = Not Detected
NS = Not Sampled

**Table 6. Maximum VOC Concentrations Detected in 1997 and 1993 Soil-Gas Surveys.**

| Year Depth | 1,1,1-TCA (ppmv) | 1,1-DCA (ppmv) | PCE (ppmv) | TCE (ppmv) | Carbon Tetrachloride (ppmv) | Chloroform (ppmv) |
|---|---|---|---|---|---|---|
| 1997 Shallow | <0.10 | <0.10 | 0.60 | <0.10 | 45 | 25 |
| 1997 Deep | 0.37 | 0.10 | 0.43 | 0.25 | 42 | 46 |
| 1993 Shallow* | 8.7 | ND | 8.1 | 0.20 | 8 | 8.8 |
| 1993 Deep | ND | ND | ND | ND | 9.7 | ND |

*Analyzed Using Scentograph Gas Chromatograph
ND = Not Detected

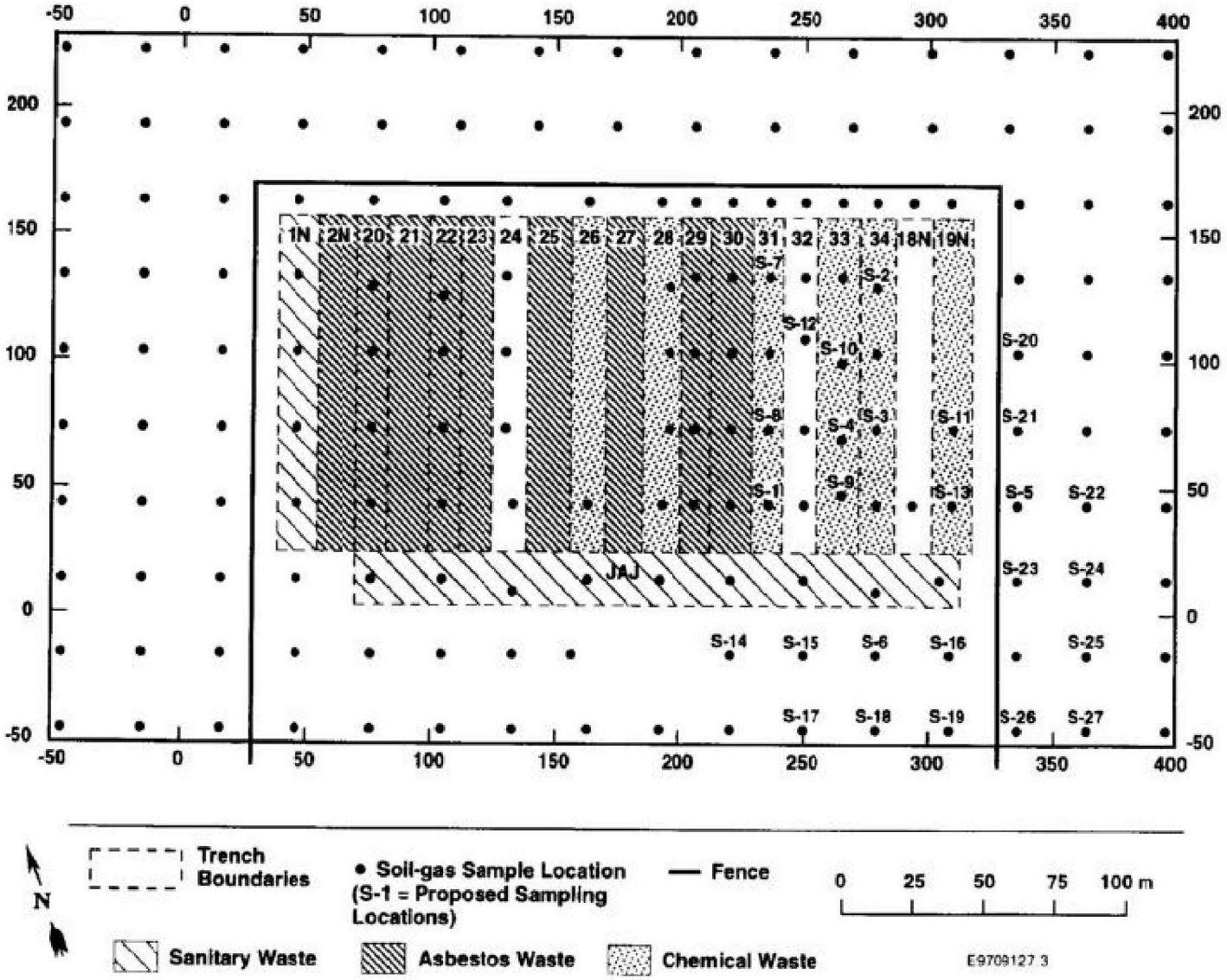



Figure 1. Proposed Shallow Soil-Gas Sampling Locations.

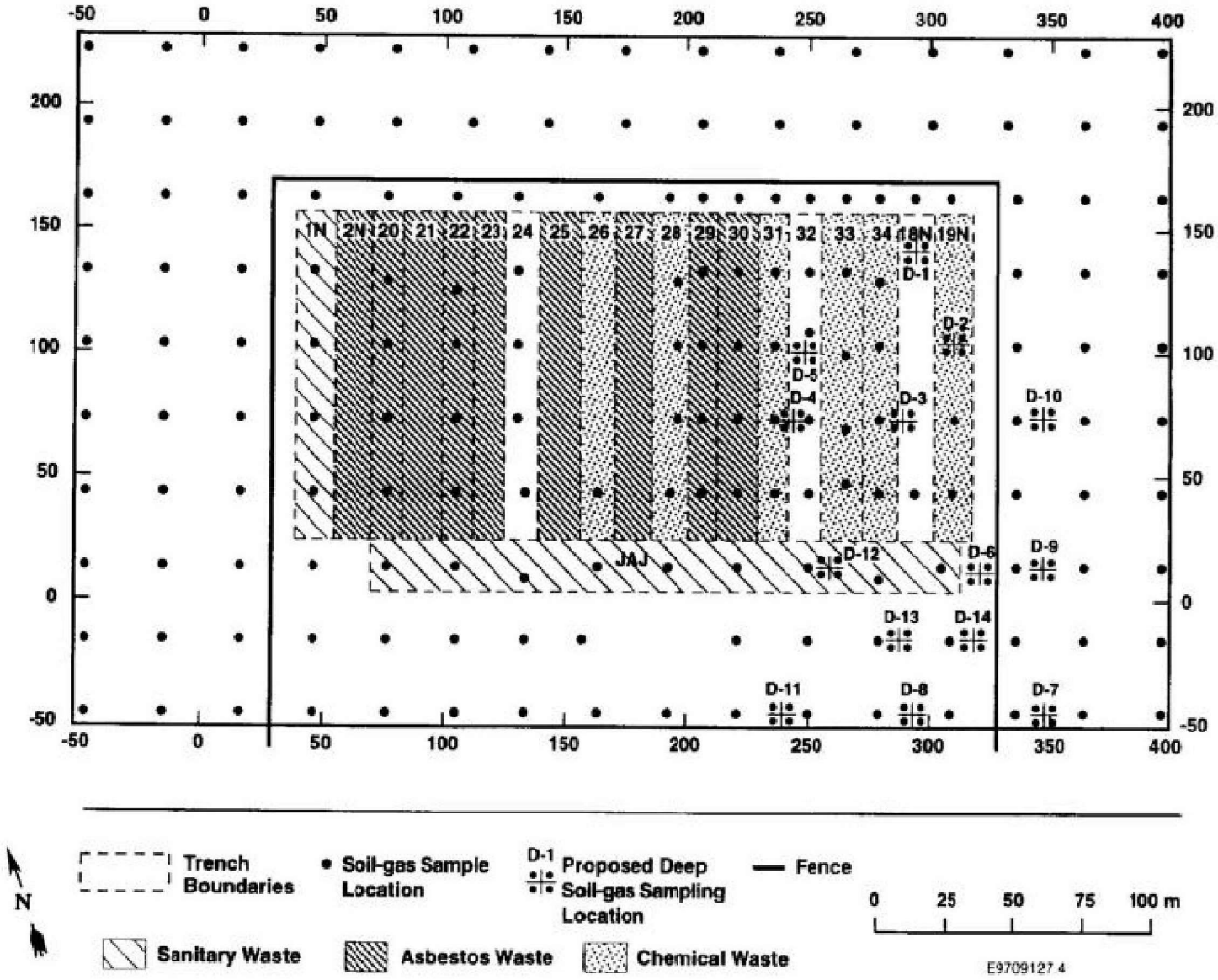



Figure 2. Proposed Deep Soil-Gas Sampling Locations.

**Figure 3. Typical NRDWL Soil-Gas Probe.**

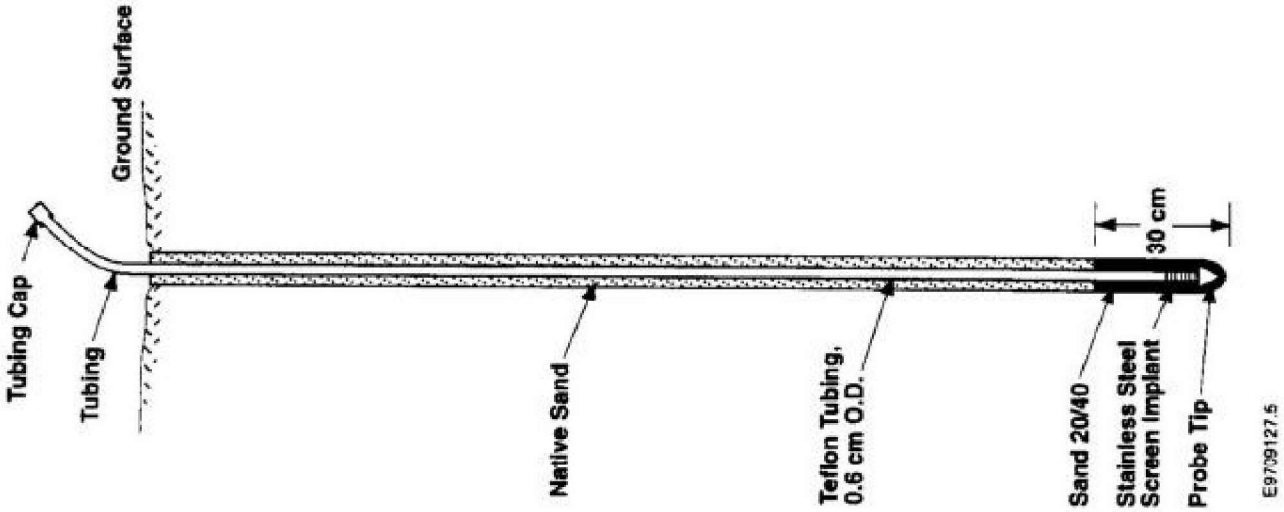
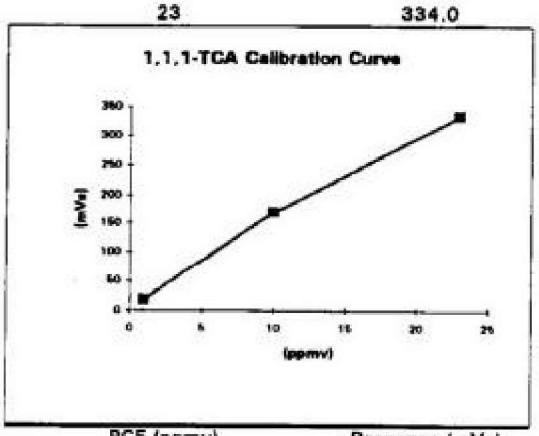
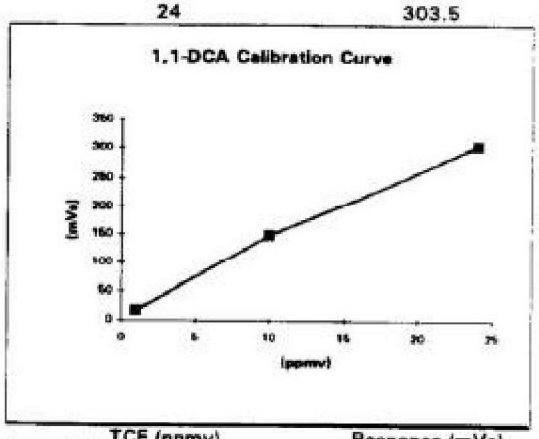


**Figure 4. Calibration Curves for the NRDWL Soil-Gas Survey.**

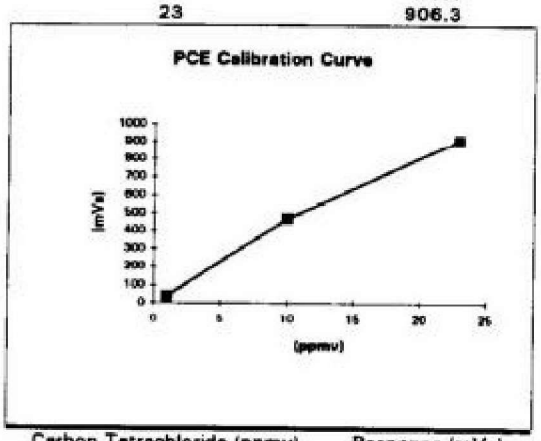
| 1,1,1-TCA (ppmv) | Response (mVs) |
|---|---|
| 1.0 | 18.7 |
| 10 | 170.1 |
| 23 | 334.0 |



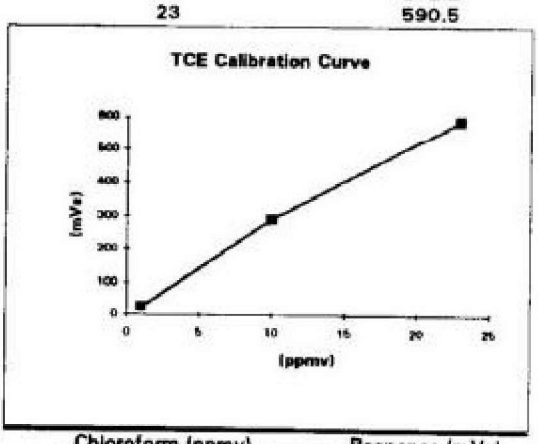

| 1,1-DCA (ppmv) | Response (mVs) |
|---|---|
| 1.0 | 15.8 |
| 10 | 148.2 |
| 24 | 303.5 |



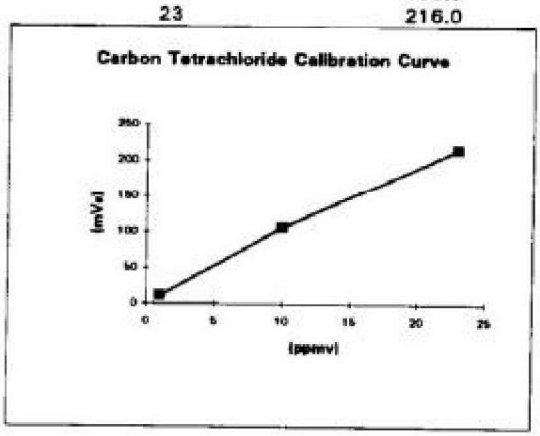

| PCE (ppmv) | Response (mVs) |
|---|---|
| 1.0 | 37.2 |
| 10 | 467.1 |
| 23 | 906.3 |




| TCE (ppmv) | Response (mVs) |
|---|---|
| 1.0 | 26.3 |
| 10 | 292.2 |
| 23 | 590.5 |




| Carbon Tetrachloride (ppmv) | Response (mVs) |
|---|---|
| 1.0 | 10.8 |
| 10 | 106.3 |
| 23 | 216.0 |




| Chloroform (ppmv) | Response (mVs) |
|---|---|
| 1.0 | 9.7 |
| 10 | 97.4 |
| 23 | 199.7 |

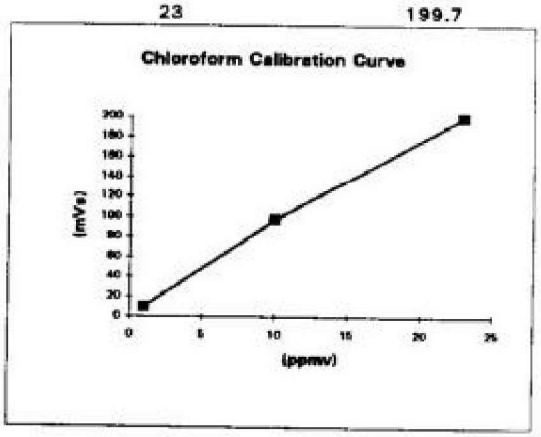


**Figure 5. 1997 Soil-Gas Survey Results for TCA.**

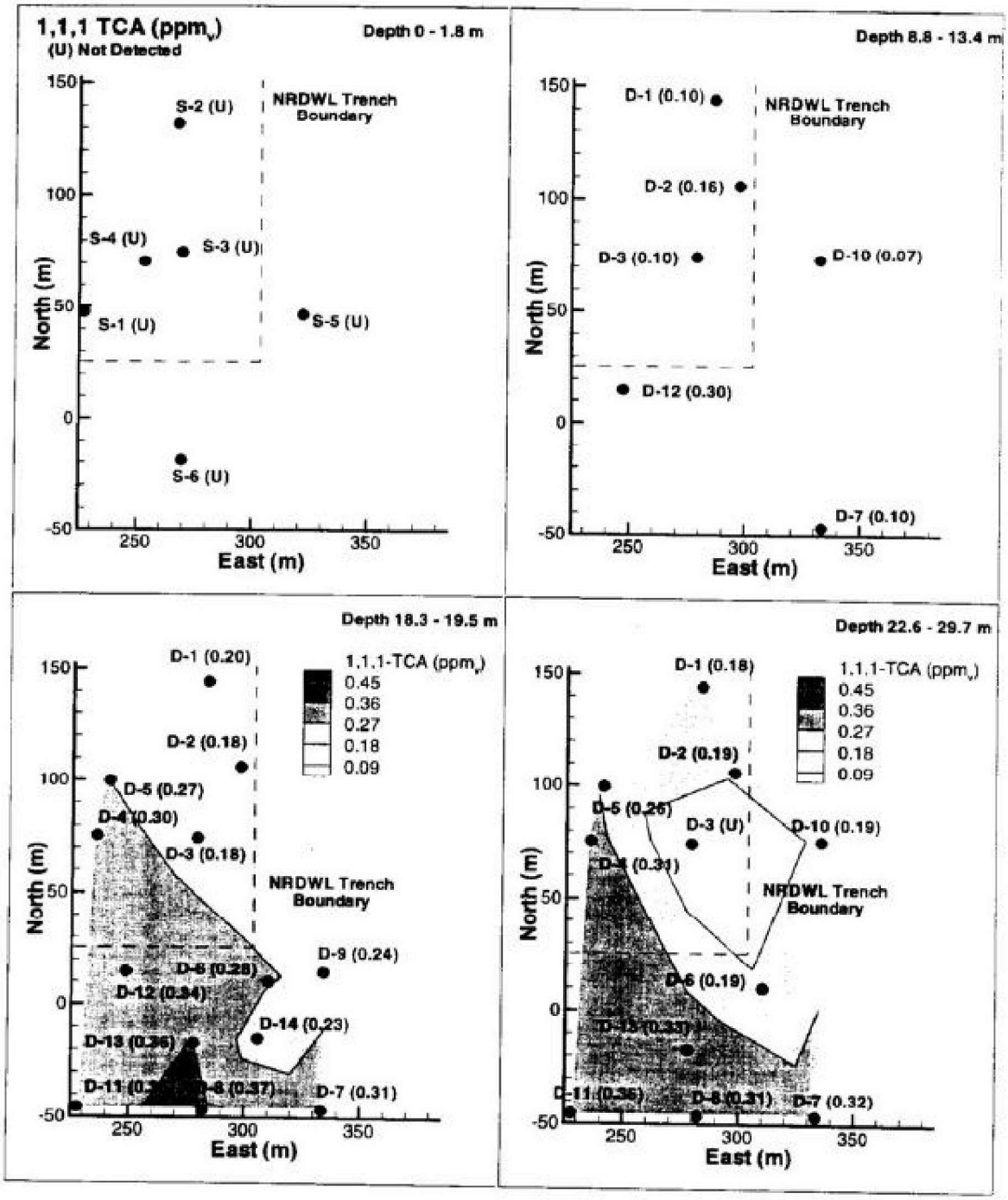


**Figure 6. 1997 Soil-Gas Survey Results for PCE.**

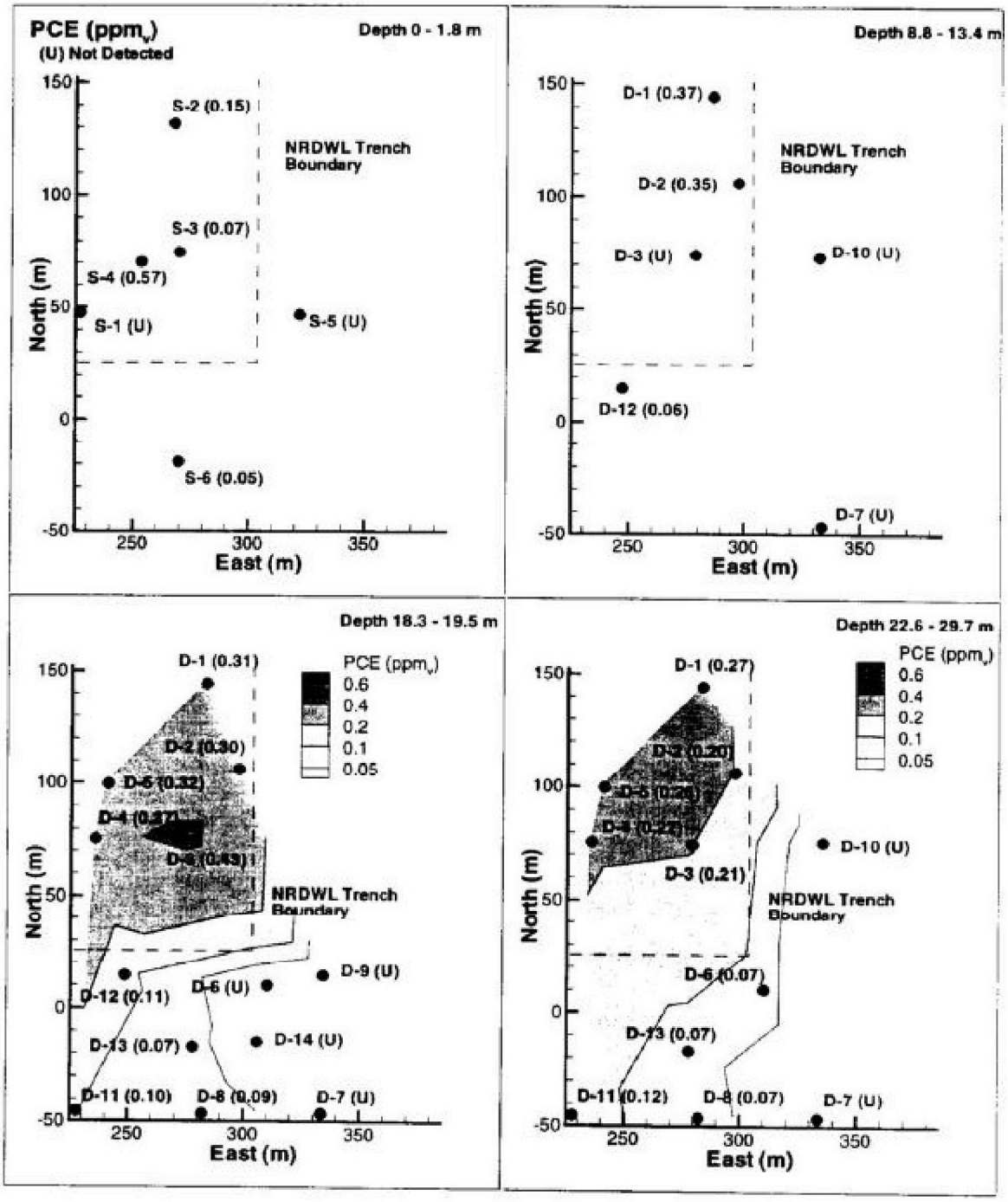


**Figure 7. 1997 Soil-Gas Survey Results for TCE.**

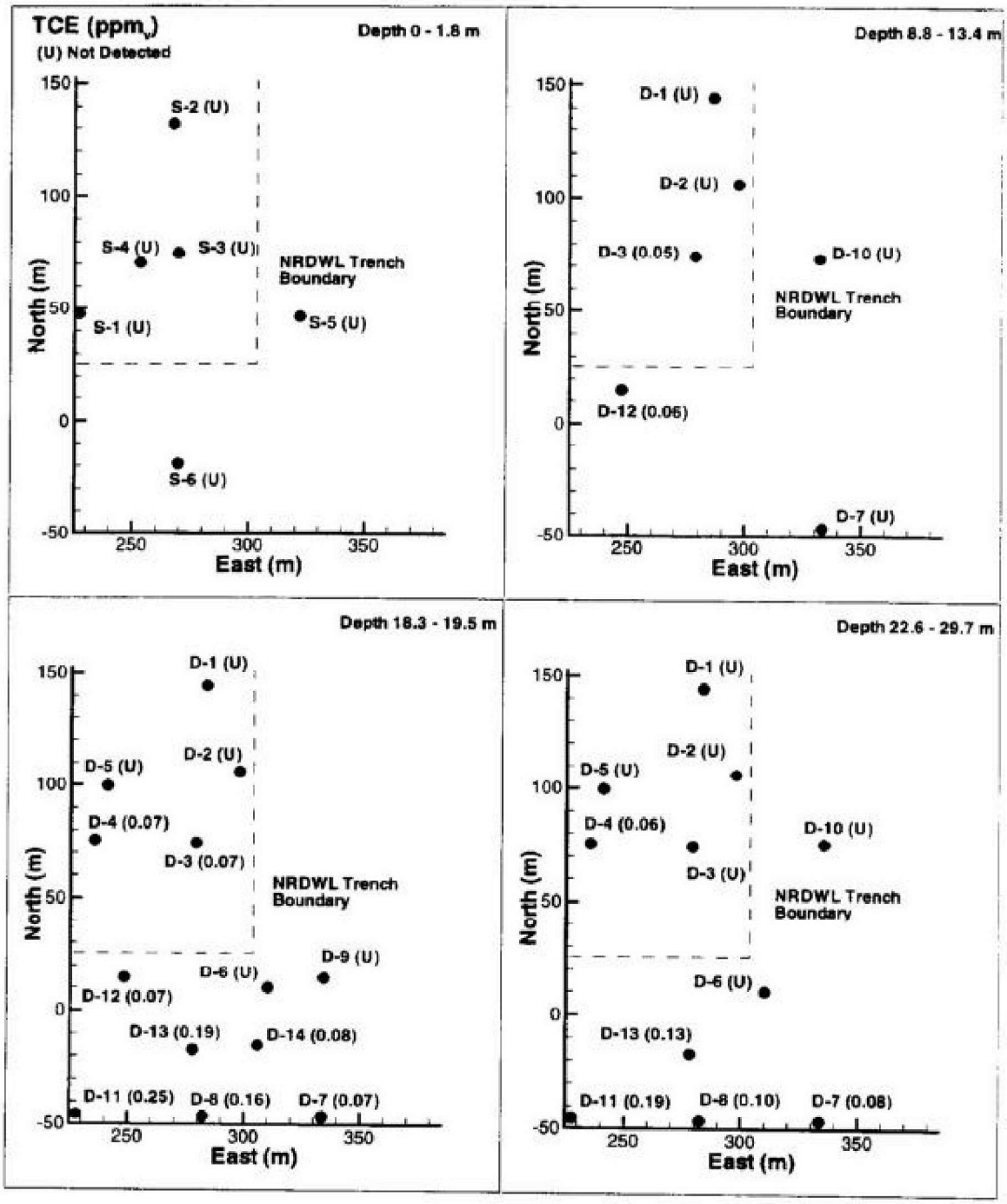


**Figure 8. 1997 Soil-Gas Survey Results for Carbon Tetrachloride.**

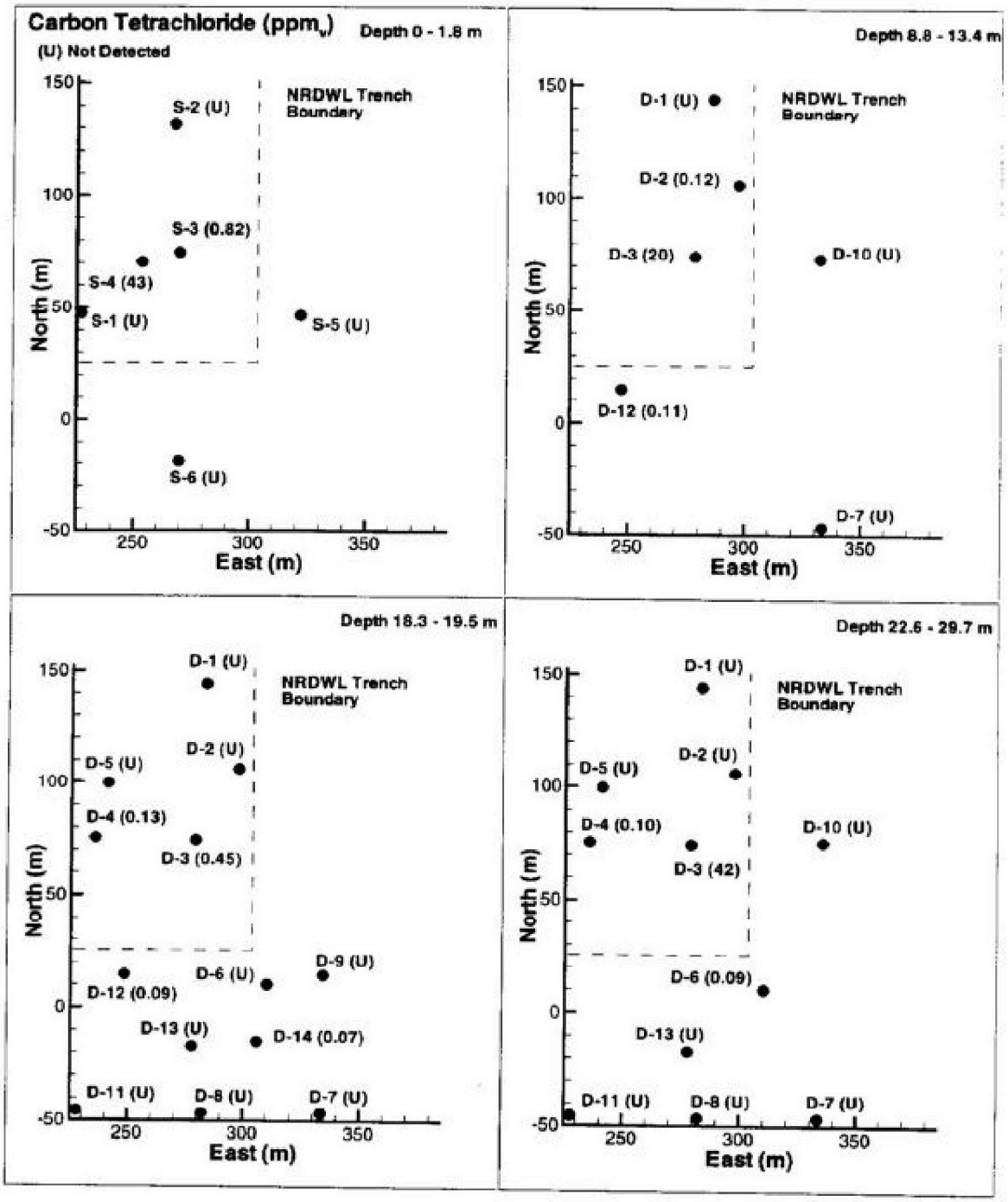


**Figure 9. 1997 Soil-Gas Survey Results for Chloroform.**

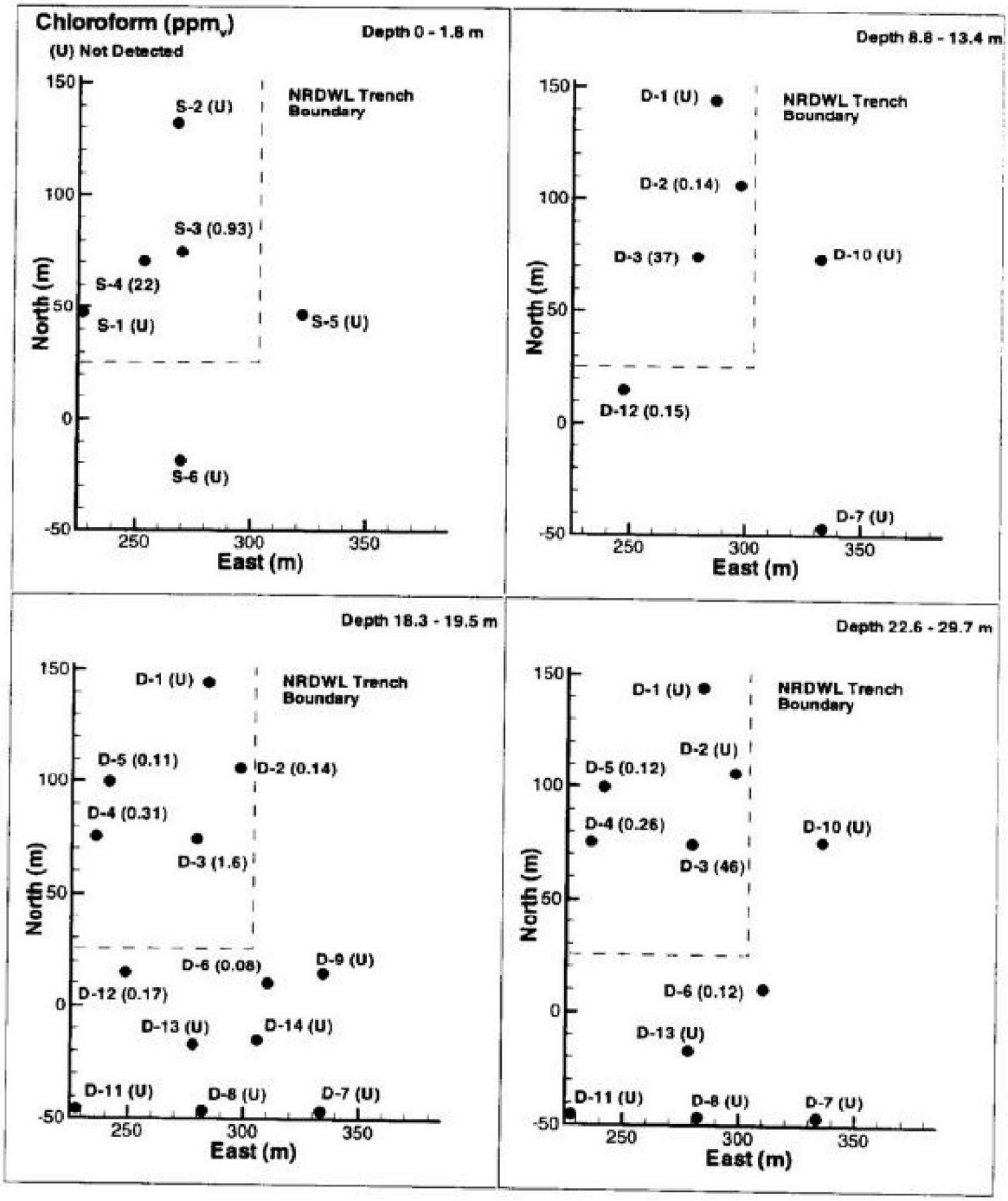
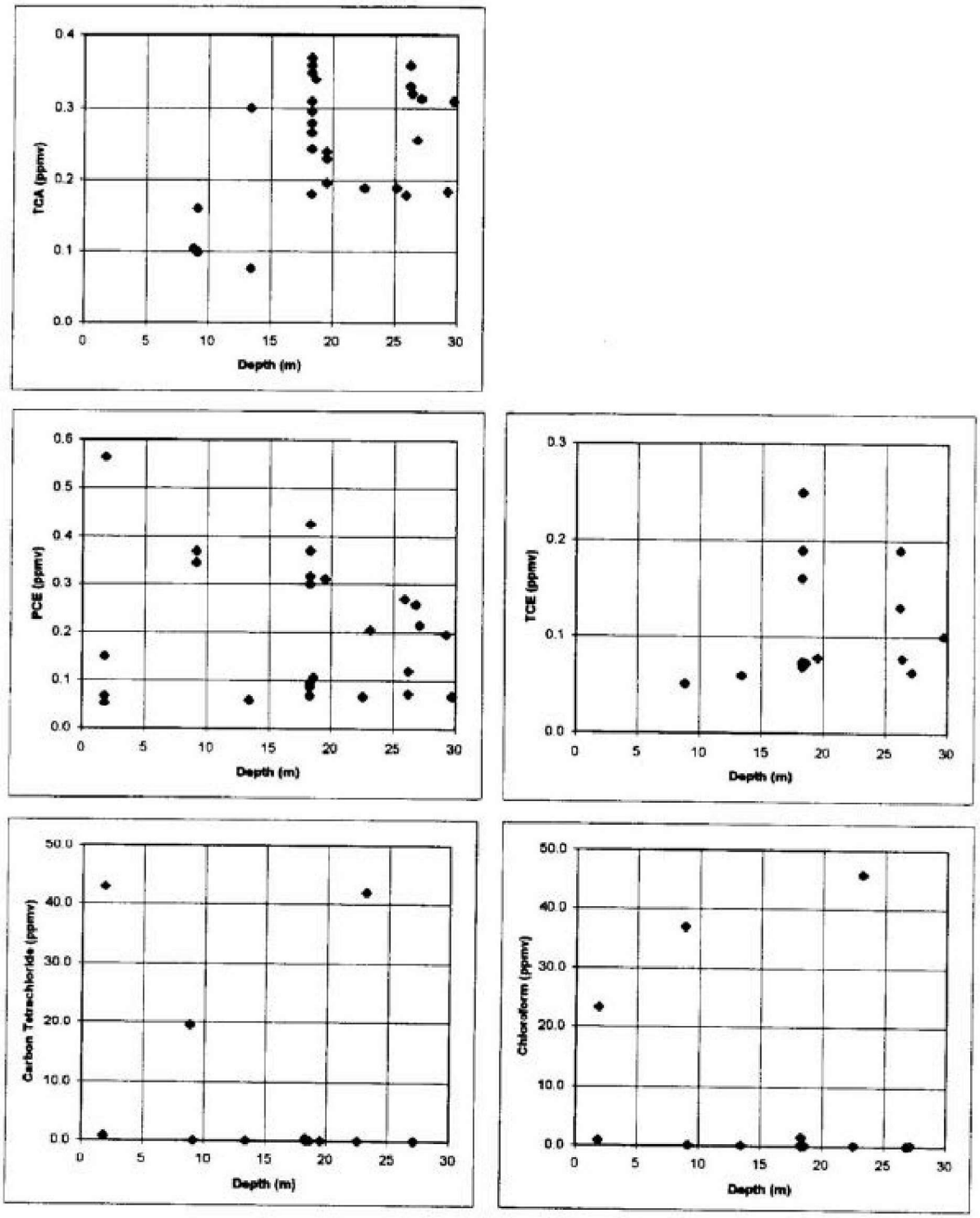


**Figure 10. Relationship Between Concentrations of VOC Detected in 1997 Soil-Gas Survey and Depth.**



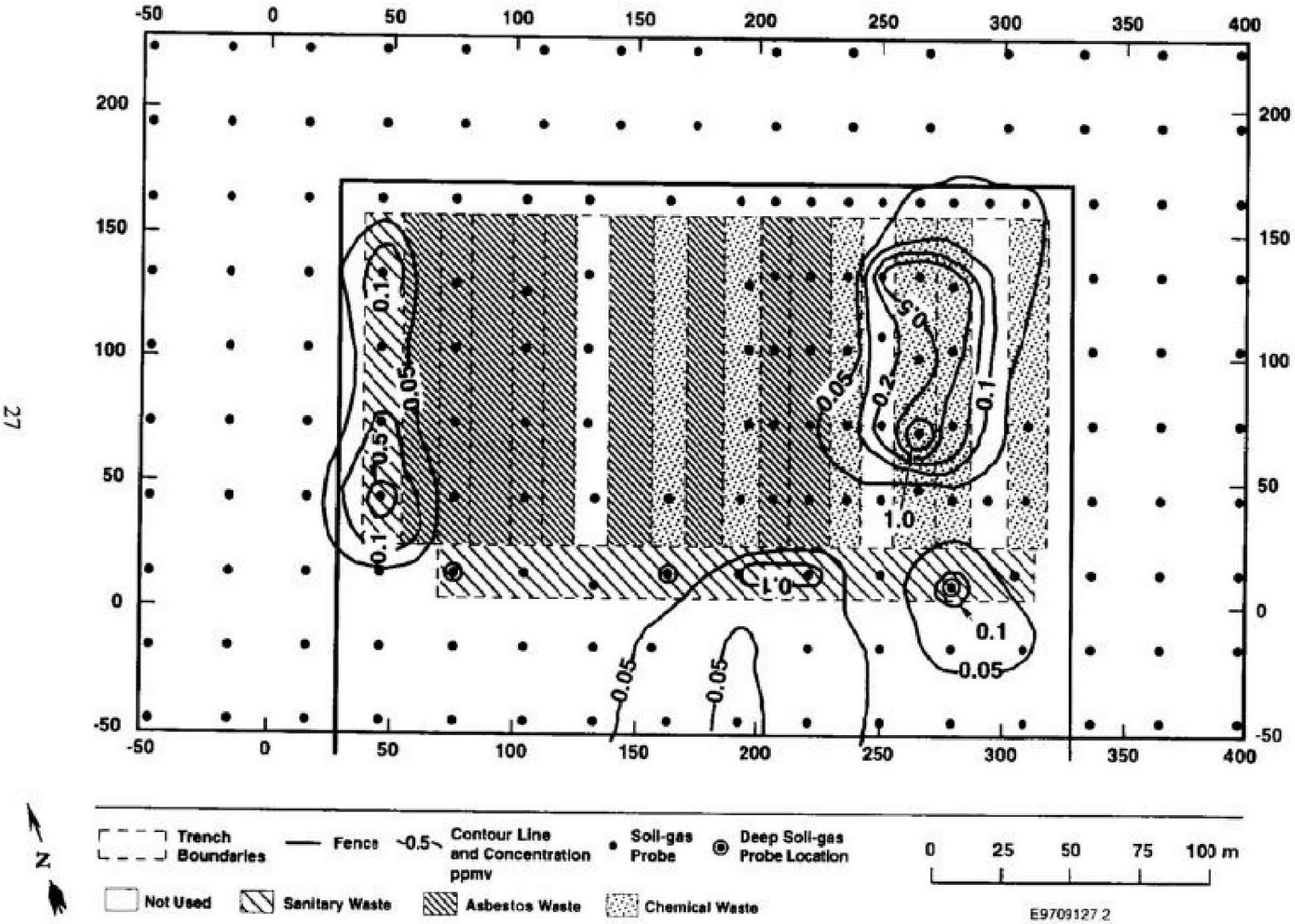



Figure 11. Soil-Gas Survey Results for PCE.

**Figure 12. 1993 Soil-Gas Survey Results for TCE.**

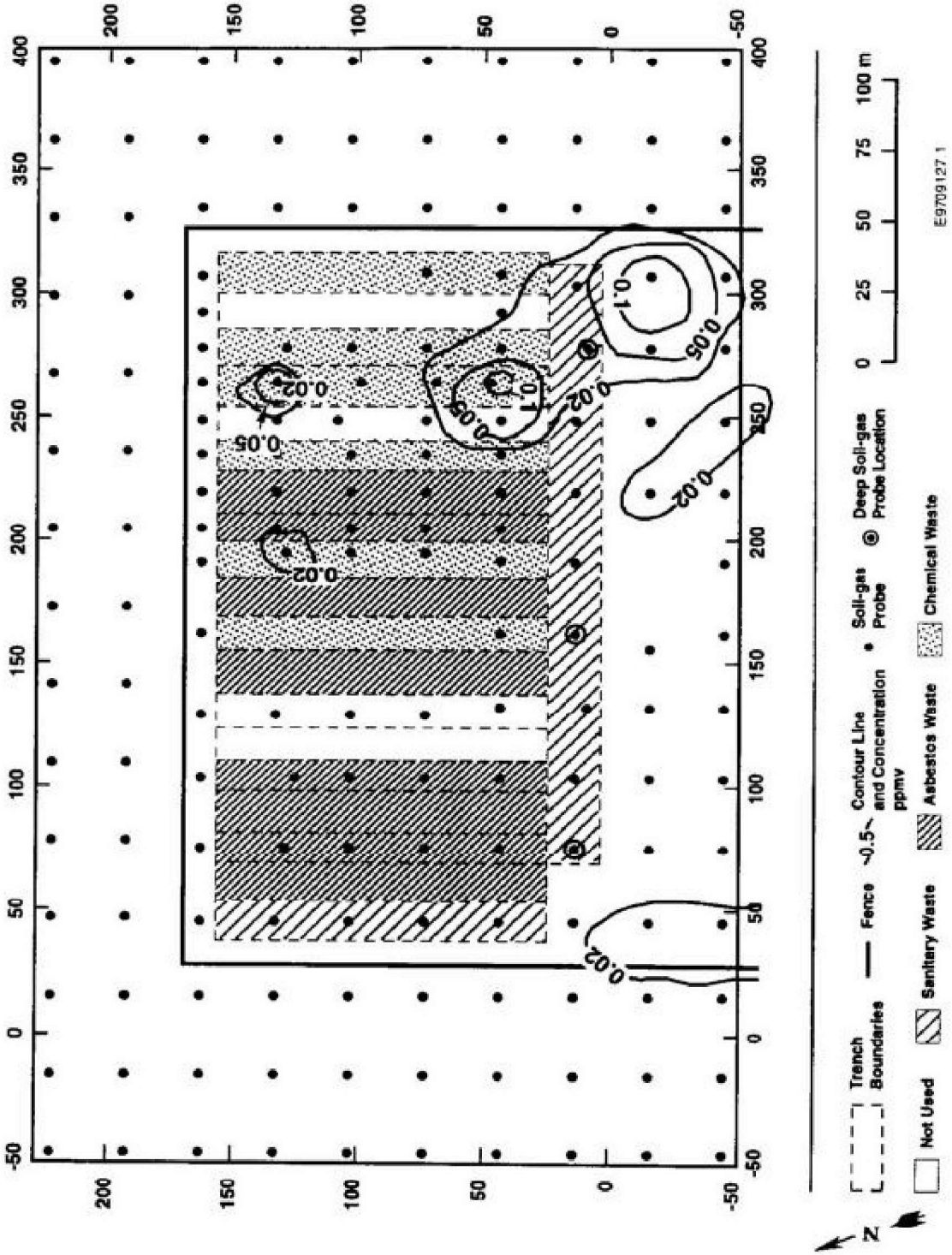


**Figure 13. Groundwater Monitoring Results for Downgradient Well 699-26-33.**

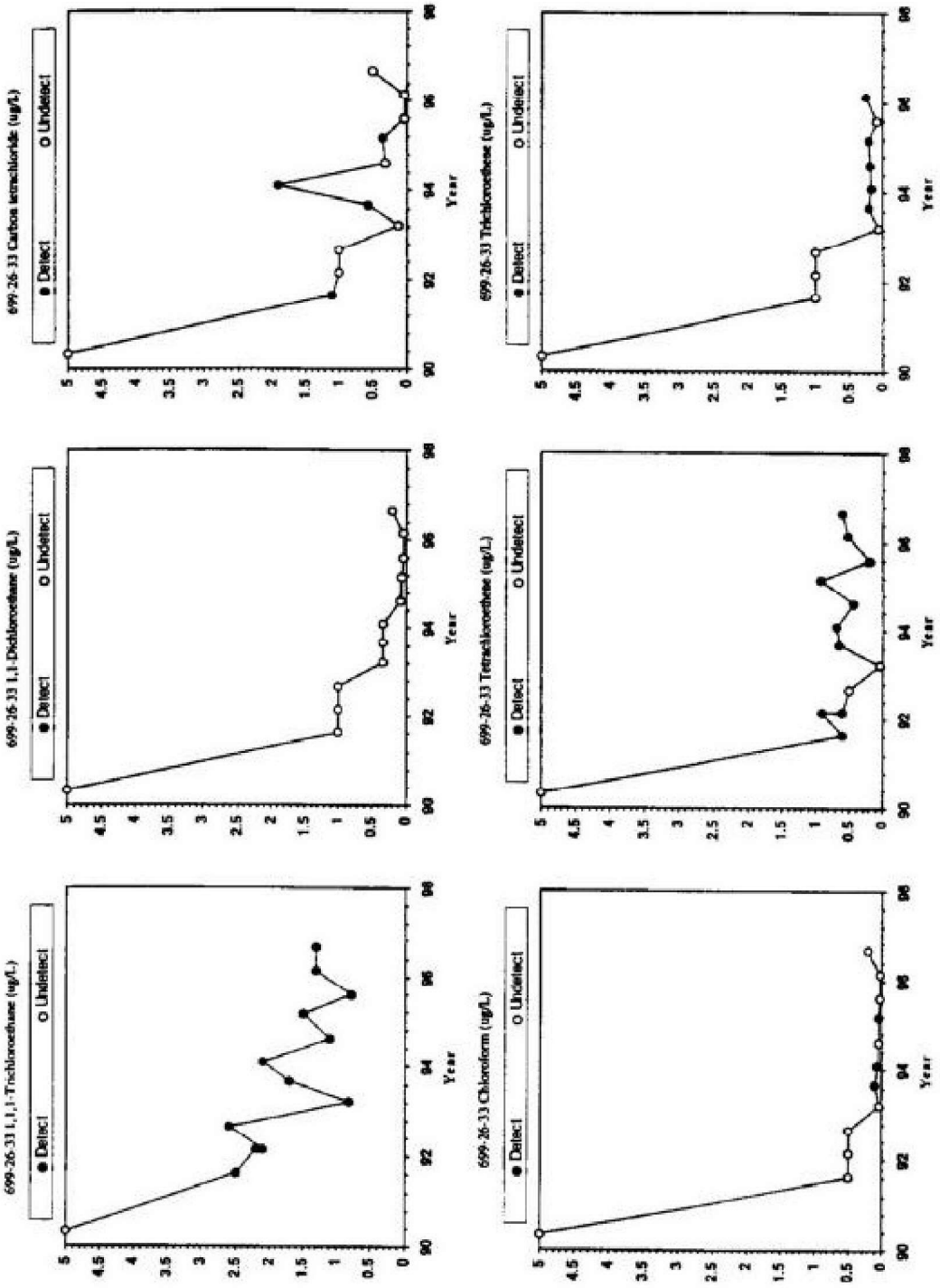


**Figure 14. Groundwater Monitoring Results for Downgradient Well 699-25-34A.**

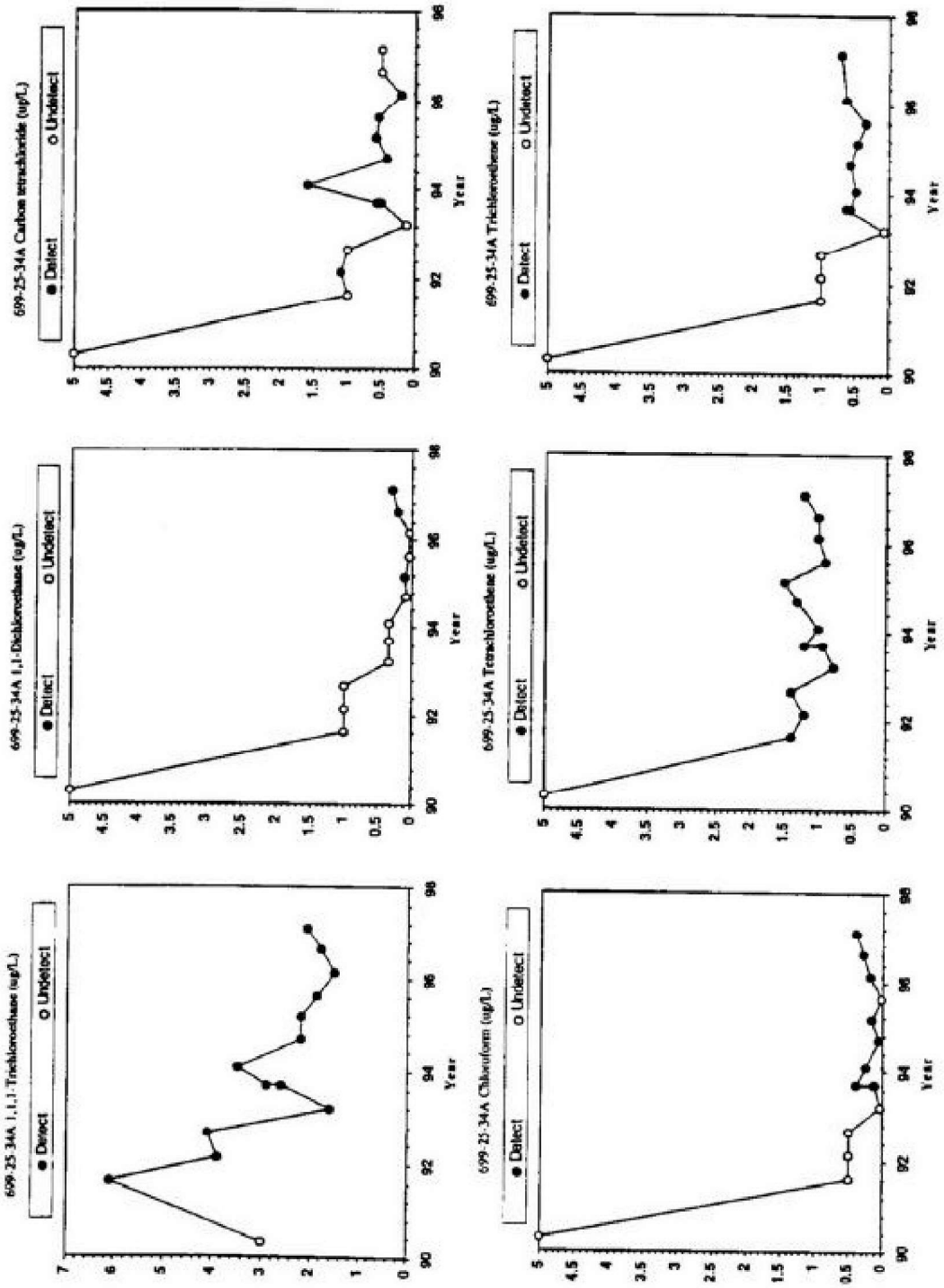


**Figure 15. Groundwater Monitoring Results for Downgradient Well 699-25-34B.**

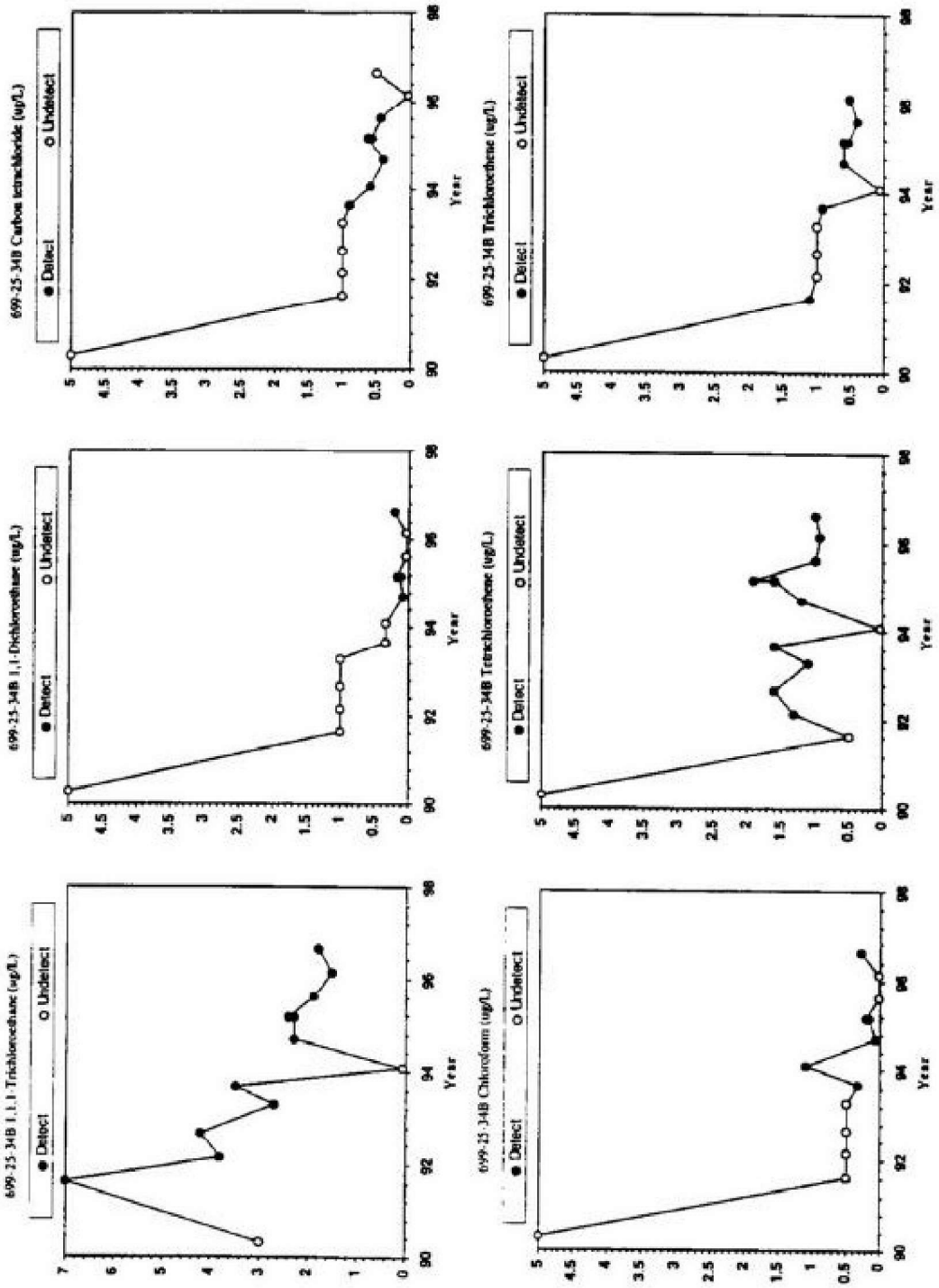


**Figure 16. Groundwater Monitoring Results for Downgradient Well 699-25-34D.**

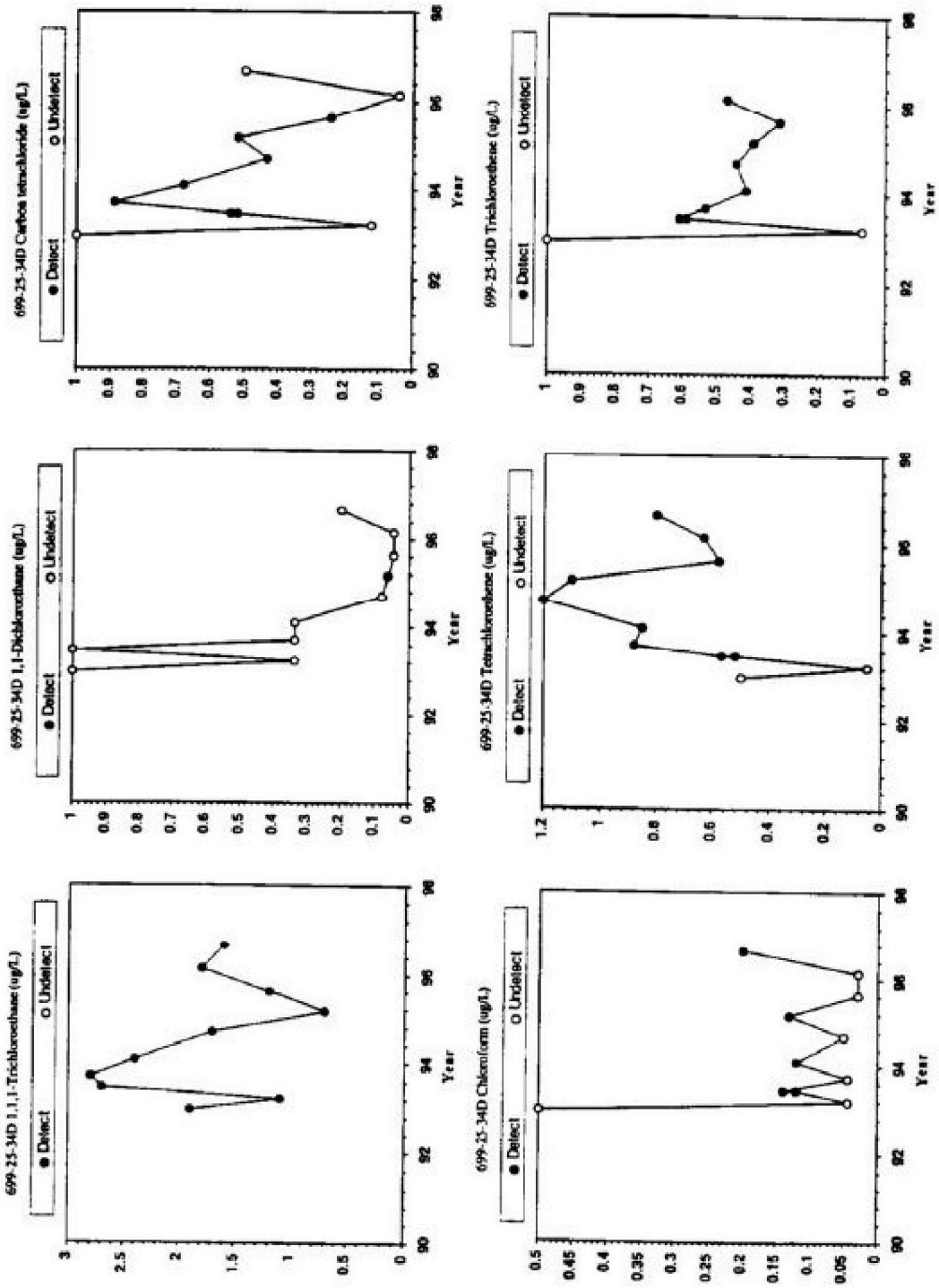


**Figure 17. Groundwater Monitoring Results for Downgradient Well 699-26-34B.**

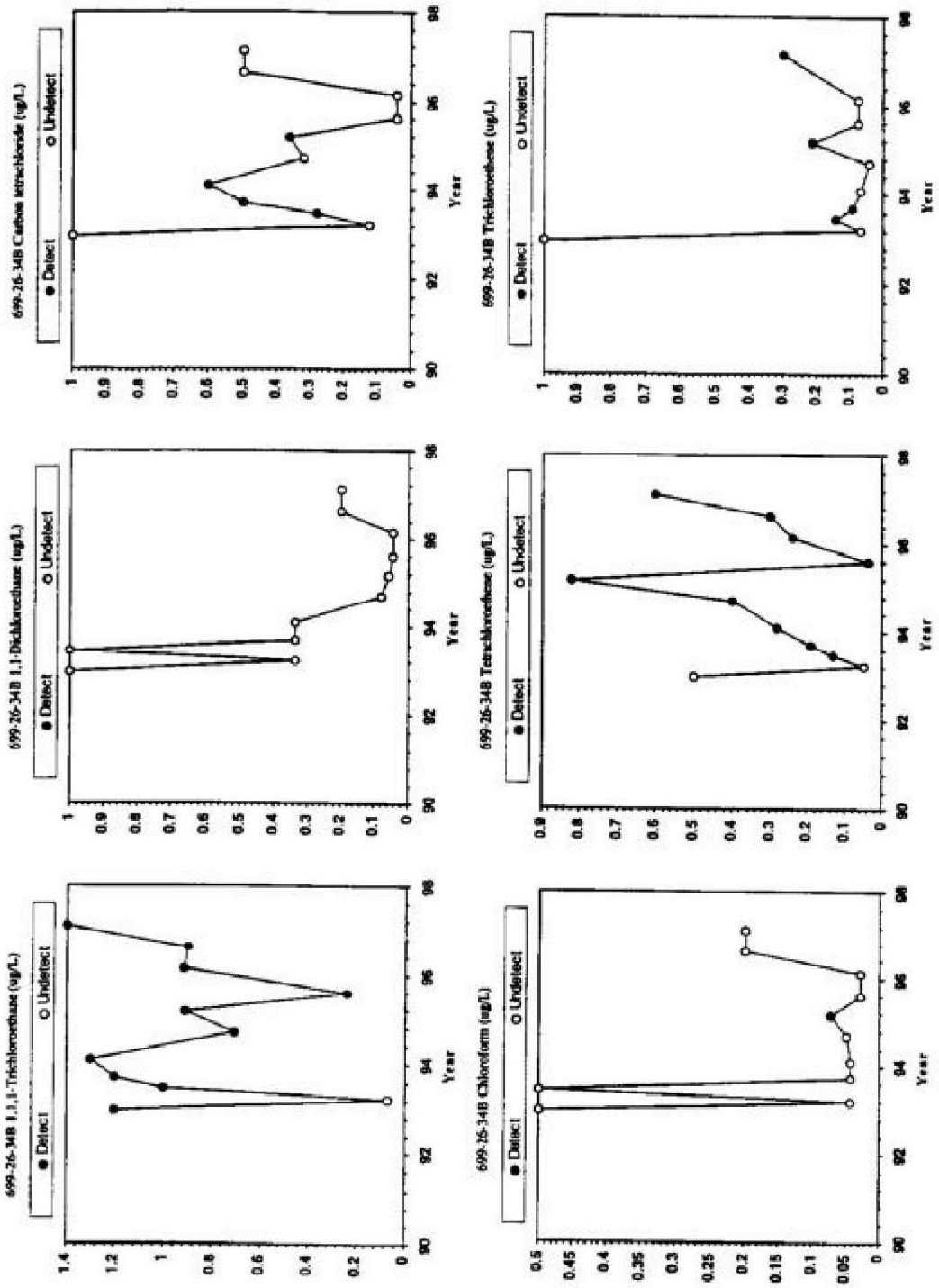


**Figure 18. Groundwater Monitoring Results for Upgradient Well 699-26-35A.**

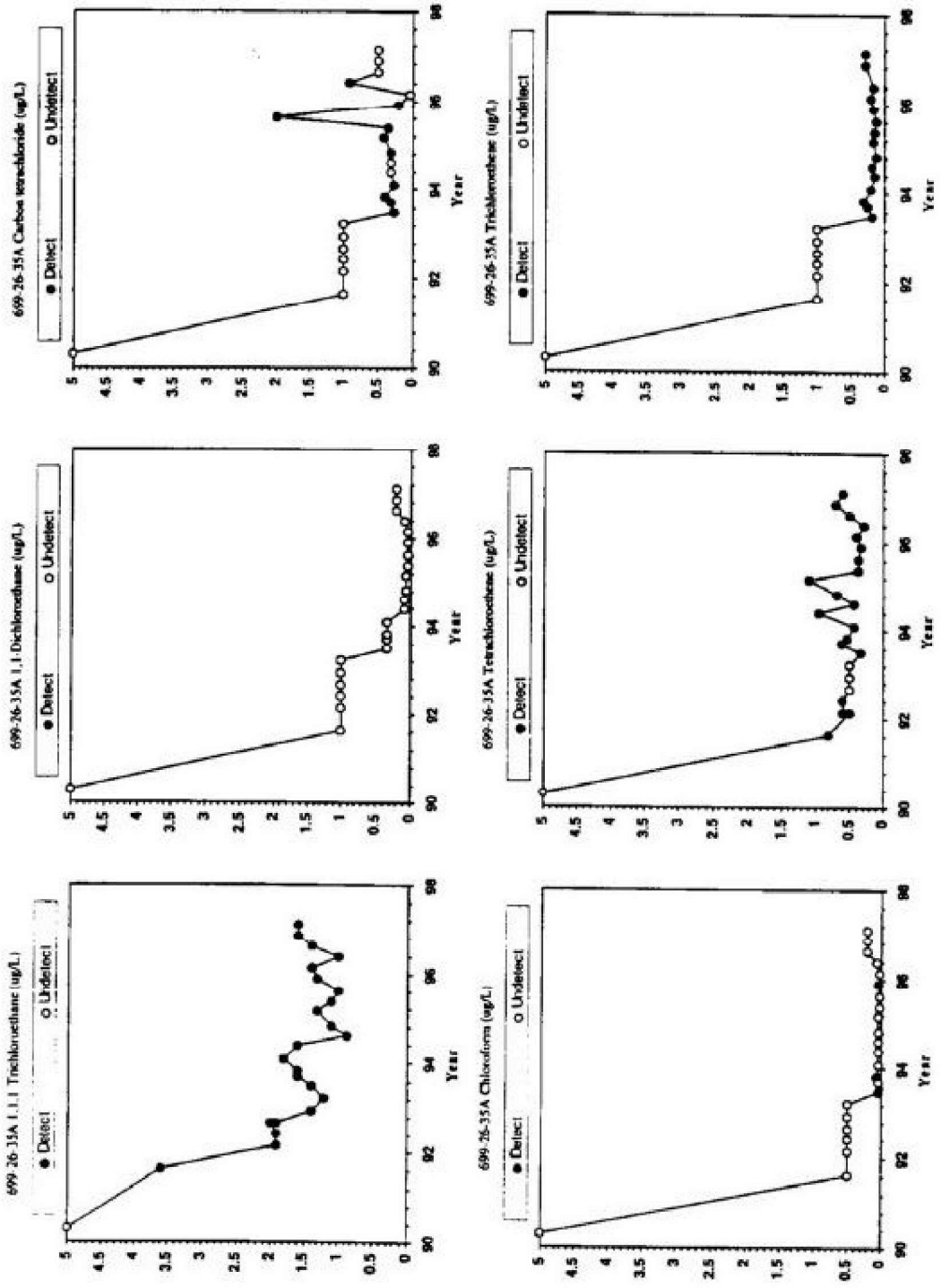
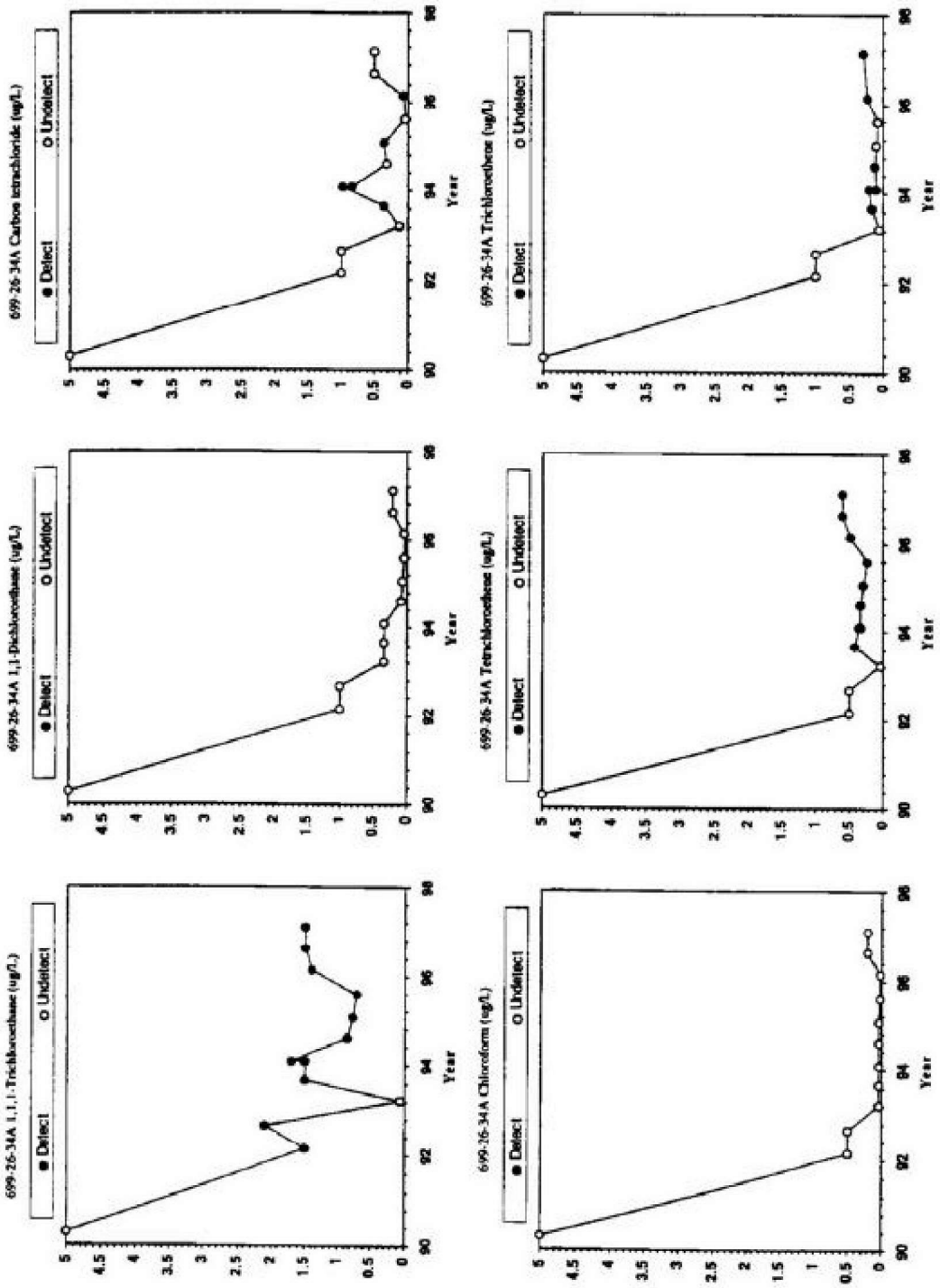


**Figure 19. Groundwater Monitoring Results for Upgradient Well 699-26-34A.**



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| 5. Proj./Prog./Dept./Div.: Environmental | 6. Cog. Engr.: I. D. Jacques | 7. Purchase Order No.: NA |
| 8. Originator Remarks: Approval/Release | | 9. Equip./Component No.: NA |
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7. Abstract

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## ACRONYMS

| | |
|---|---|
| AID | argon ionization detector |
| cis-1,2-DCE | cis-1,2-dichloroethylene |
| DOE | U.S. Department of Energy |
| EII | Environmental Investigations Instruction |
| FID | flame ionization detector |
| GC | gas chromatograph |
| HEIS | Hanford Environmental Information System |
| JAJ | J.A. Jones |
| NA | not analyzed |
| ND | not detected |
| NRDWL | Nonradioactive Dangerous Waste Landfill |
| OD | outside diameter |
| 1,1,1-TCA | 1,1,1-trichloroethane |
| PCE | perchloroethylene |
| PID | photoionization detector |
| PNL | Pacific Northwest Laboratory |
| QA | quality assurance |
| QC | quality control |
| RCRA | *Resource Conservation and Recovery Act of 1976* |
| SWL | Solid Waste Landfill |
| TCE | trichloroethylene |
| TSD | treatment, storage, or disposal |
| VOC | volatile organic compound |
| WHC | Westinghouse Hanford Company |

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# 1.0 SUMMARY

A soil-gas survey was conducted for the Nonradioactive Dangerous Waste Landfill (NRDWL), which is part of the 200-IU-3 Operable Unit of the Hanford Site. The soil-gas survey was performed in accordance with Section 7.1.1 of the *Nonradioactive Dangerous Waste Landfill Closure/Postclosure Plan* (DOE-RL 1990). The objective was to assess the extent of detectable gaseous or volatile organic compounds (VOC) within the vadose zone of the NRDWL resulting from hazardous wastes disposed from 1975 to 1985.

Beginning in March 1993, soil-gas probes were installed in the vadose zone within the fenced boundary of the NRDWL and the area immediately outside the NRDWL fence. Gas samples from the soil-gas probes were analyzed using portable field-screening instruments during the initial portion of the soil-gas survey to determine potentially contaminated regions within the study area. Each soil-gas probe was monitored for combustible gas, methane, carbon dioxide, oxygen, and total VOCs. The screening data indicated elevated carbon dioxide and deficient oxygen levels in the southern and western portion of the NRDWL near the boundary with the adjacent Solid Waste Landfill (SWL). These anomalies may represent increased subsurface microbial activity, which may result from biodegradation of landfill contents. In addition, organic vapors were detected in the northeast portion of the NRDWL (the hazardous waste portion of the landfill) using a photoionization detector and a flame ionization detector. Concentration levels of the other screening parameters were at or below the detection limit of the screening instruments. Installation of the soil-gas network and the initial field-screening results were summarized in an earlier report (Jacques 1993a).

The final portion of the NRDWL soil-gas survey involved collecting soil-gas samples for onsite analysis using portable gas chromatographs (GC). These analyses were used to further delineate the regions of potential contamination detected by the field screening instruments. In addition, deep soil-gas probes were installed at four locations of the soil-gas network as prescribed in DOE-RL (1990). The probes were installed at depths of 9 and 15 ft. Soil gas collected from the probes was also analyzed using the portable GCs. This report documents the methods implemented and activities performed to collect and analyze soil-gas samples from the NRDWL soil-gas network. It also discusses results from the soil-gas analyses and proposes strategies for future investigation.

Several organic compounds listed on the NRDWL waste inventories were identified in samples collected from the soil-gas network. Three organic chemicals--acetone, trichloroethylene (TCE), and perchloroethylene (PCE)--were identified at varying concentrations throughout the entire landfill site. The highest concentrations of these chemicals appeared to be associated with specific waste disposal trenches. Three other organic chemicals--chloroform, carbon tetrachloride, and 1,1,1-trichloroethane--were detected in association with specific chemical trenches at the NRDWL. Trace amounts of cis-1,2-dichloroethylene and 1,1,2-trichloroethane were also detected in the study area.

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## 2.0 FACILITY DESCRIPTION

The NRDWL is an inactive disposal facility regulated by the *Resource Conservation and Recovery Act* (RCRA) as a Treatment, Storage, or Disposal (TSD) facility. It is located adjacent to and northeast of the Solid Waste Landfill (SWL) in the 600 Area of the Hanford Site (Figure 2-1). The NRDWL was operated from 1975 through 1985 and received nonradioactive dangerous waste from process operations, research and development laboratories, and maintenance functions on the Hanford Site.

Nineteen trenches are defined within the NRDWL (Figure 2-2). Dangerous waste was disposed in six chemical trenches (19N, 26, 28, 31, 33, and 34). Chemical trench 34 was the first to be used and was opened in January 1975 (DOE/RL 1990). Waste disposal at the NRDWL was discontinued in May 1985. Unused portions of trenches 19N and 26 have remained open since that time.

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According to *Nonradioactive Dangerous Waste Landfill Closure/Postclosure Plan* (DOE/RL 1990), nine trenches (2N, 20, 21, 22, 23, 25, 27, 29, and 30) were used for disposal of asbestos waste from 1975 through 1988. Trench 1N was used exclusively for disposal of sanitary wastes. Trenches 24, 32, and 18N were never used. The geophysical survey data, however, revealed some discrepancies from this reported information. It appears that it is trench 23 instead of trench 24 (as reported in DOE/RL [1990]) that is unused. The geophysical data also indicated that trench 31 extends into the area designated for trench 32 (Mitchell et al. 1993). According to the geophysical data, the other trenches were positioned as reported in DOE/RL (1990).

The general waste disposal method used at the NRDWL was the trench method. Wastes were placed in an excavated trench and covered with native soil. The trenches were excavated on 46-ft centers to a depth of about 15 ft. The trenches were about 16 ft wide at the base and about 400 ft in length. Excavated soil was deposited in spoils piles on both sides of the trench and used later to cover the waste materials (DOE/RL 1990).

The chemical trenches were constructed with a gravel access ramp to the bottom of each trench. Chemicals were normally overpacked in 55-gal drums before disposal in the trenches. The wastes were placed standing on end in rows in the unlined trenches. Occasionally when the shipment of drums was large, the drums were stacked two-high. At the end of the day, a portion of the spoils pile was pushed over the drums. The final cover over the trenches was about 6 to 10 ft of native soil (DOE/RL 1990).

Waste acceptance criteria at the time of disposal required a detailed list of each waste constituent and its volume. Chemical wastes consisted of small quantities of laboratory chemicals, waste oils, waste solvents, and empty chemical containers. The chemical wastes were both regulated and unregulated. Chemicals disposed in the NRDWL are listed by trench in DOE/RL (1990). The first trenches used, trenches 34 and 33, contain the largest amounts of regulated chemicals. Trenches used later contained smaller amounts of both regulated and unregulated chemicals.

Waste liquids were either absorbed with porous materials or lab-packed before disposal. Lab-packed wastes contained liquids in no greater than 1-gal glass or 5-gal plastic or metal containers packed in at least twice their volume of absorbent. The final lab-pack disposal container was generally a

55-gal drum. No containers holding free liquids were known to have been disposed at the NRDWL site (DOE/RL 1990).

For the asbestos and sanitary trenches, waste was unloaded at the base of the open trench or at the top of the working face. As the waste was unloaded, a tractor was used to push the wastes to the desired height. Asbestos waste and sanitary solid wastes were generally put into containers for disposal. Sanitary wastes included unregulated solid materials such as office, construction, and some gardening wastes. At the end of the day, a portion of the spoils pile was pushed over the wastes. The final cover was about 4 to 6 ft thick (DOE/RL 1990).

The NRDWL is currently managed by Westinghouse Hanford Company (WHC) and will be closed in conformance with standards required under WAC 173-303-610 as described in DOE-RL (1990). One of the requirements specified in DOE-RL (1990) is a soil-gas survey to assess detectable gaseous vapors in the vadose zone. The results of this survey will complement data generated from other characterization activities (e.g., groundwater monitoring or soil sampling).

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Figure 2-1. Location of the SWL and the NRDWL on the Hanford Site.

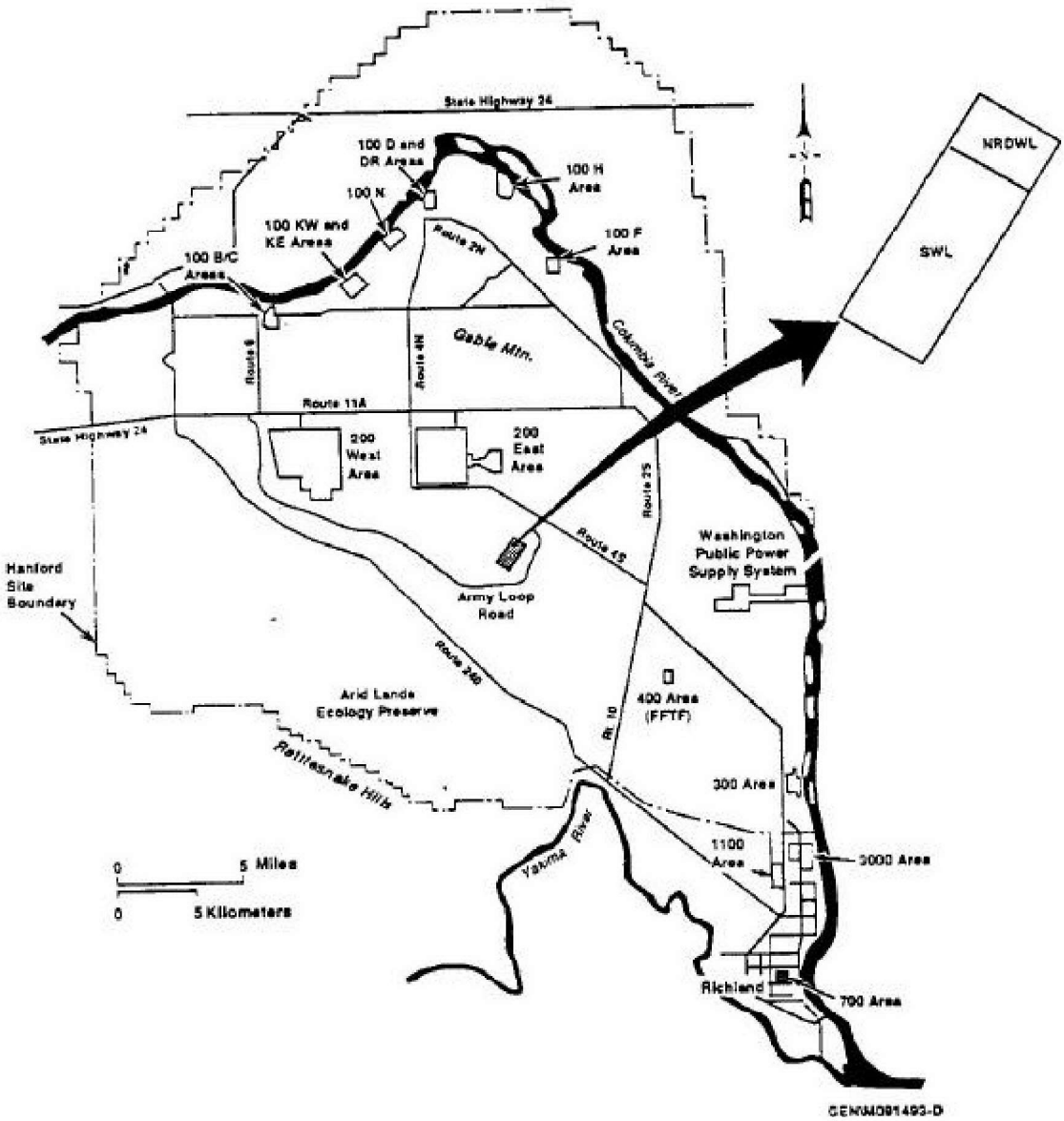
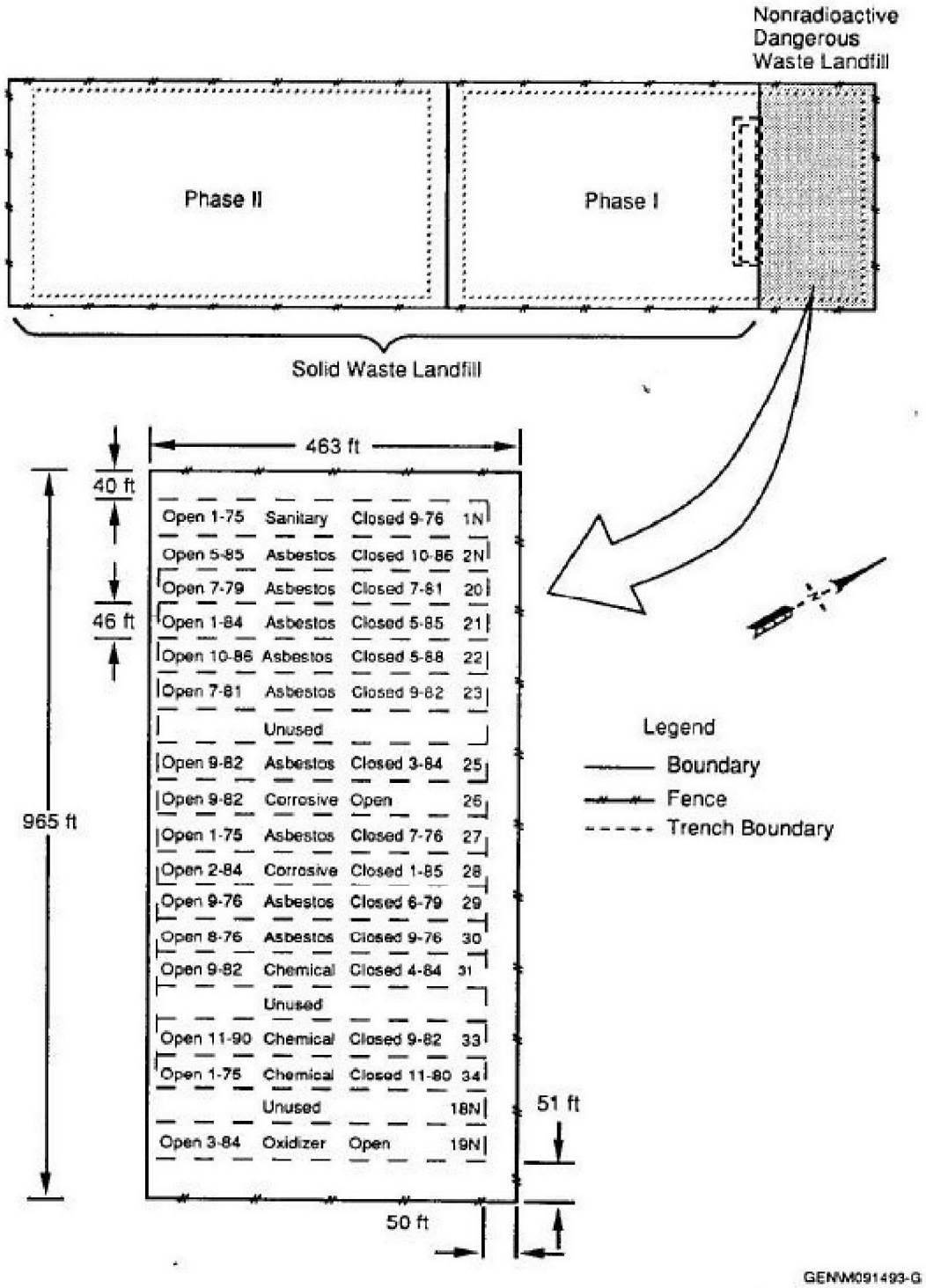


Figure 2-2. Trench Locations and Waste Designations for the NRDWL.

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## 3.0 SITE DESCRIPTION

Surface geological conditions at the NRDWL and the adjacent SWL consist of surficial dune sand overlying the flood-deposited silts, sands, and gravels of the Hanford formation. These deposits overlie silts, sands, and gravels of the fluvial/lacustrine Ringold Formation (Evans et al. 1989). Some gravel exists at the surface around the NRDWL, primarily as the result of trenching and road-making activities.

The unconfined aquifer occurs in the sediments of both the Hanford formation and Ringold Formation at a depth of about 125 ft below ground surface. The general groundwater flow direction is from west to east. The hydraulic gradient under the SWL and NRDWL is flat, approximately 0.1 ft/1,300 ft (0.00001). Estimates of groundwater flow rates range from 2 to 5 ft per day (Evans et al. 1989).

The surficial dune sand layer is about 3 to 4 ft thick. Beneath the surface sand is a narrow horizontal silt layer about 3 to 4 in. thick that marks the top of the sand subunit of the Hanford formation (Evans et al. 1989). This silt layer is evident in the open trenches of the NRDWL and was encountered in the undisturbed areas of the site both during the surface geophysical survey and when the soil-gas probes were installed (Mitchell et al. 1993). In contrast to the undisturbed areas, the closed disposal trenches represent large disturbed areas containing reworked soil and wastes. The disturbed portions of the site contain medium- to coarse-grained sands.

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# 4.0 METHODS

## 4.1 SHALLOW SOIL-GAS PROBES

During March 1993, 170 shallow soil-gas probes were installed over a 30-acre area extending 200 ft beyond the north, east, and west NRDWL perimeter fence and 200 ft into the north end of the SWL (Figure 4-1). Figure 4-1 also shows the designation for each trench and the type of waste disposed. The J.A. Jones (JAJ) trench is a sanitary waste trench used by the general engineering contractor.

Probes were installed along each trench centerline in the chemical disposal area and along alternating trench centerlines in the asbestos disposal area. The trench centerlines are oriented to magnetic north. Soil-gas probes located on the waste trenches were positioned using the geophysical data (Mitchell et al. 1993). Positions were chosen that were judged most likely to encounter vapors while minimizing the potential to penetrate buried waste. Open trenches and berms prevented installation of probes in some areas. Probe locations outside the NRDWL fence followed a 100-ft grid, which is also oriented to magnetic north (Jacques 1993a). Figure 4-2 shows an aerial view of the NRDWL.

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Each soil-gas probe was installed in accordance with Environmental Investigations Instruction (EII) 5.9, "Soil-Gas Sampling" (WHC 1988). The soil-gas probes consisted of a dedicated, perforated stainless-steel point connected to an 8-ft section of ¼-in. outside diameter (OD) Teflon (a trademark of E. I. du Pont de Nemours & Company) tubing. The soil-gas probes were driven to a depth of approximately 4 to 6 ft below ground surface using a PD-36 (a trademark of Rhino Tool Company) pneumatic post driver (Figure 4-3). This depth was chosen to ensure that the probe inlet was placed beneath the confining silt layer when it was present. The end of the tubing protruding from the ground was capped with a plastic cap. Finally, the soil around the tubing was firmly packed to ensure minimal annular space between the tubing and the emplacement hole. Probe depths and locations were recorded in the field logbook, and a marker flag with the probe coordinates was placed next to each probe (Jacques 1993b).

Approximately one week after the soil-gas probes were installed, each probe was sampled using a series of portable vapor monitoring instruments. These data identified two main areas of potential vapor contamination. The southern and western portions of the site appeared to contain organic vapors characteristic of a sanitary landfill. The northeastern portion of the site appeared to contain organic vapors associated with chemical waste disposal. A more detailed discussion of the probe installation and field-screening procedures as well as the analytical results can be found in Jacques (1993b).

## 4.2 FIELD-SCREENING SAMPLES

On June 3 and 4, 1993, the shallow soil-gas probes were screened a second time for total-VOC levels using two portable vapor screening instruments (Figure 4-4). The instruments used were a MicroTip HL-2000 (a trademark of Photovac International, Inc.) Photoionization Detector (PID) equipped with a 10.6-eV lamp and an OVA 128 Organic Vapor Analyzer (a trademark of Foxboro

Company) Flame Ionization Detector (FID). The instruments were calibrated twice daily (morning and noon) as follows.

- The PID was zeroed using ambient air filtered through a charcoal filter. The instrument span was set using 101 ppm isobutylene in air. Finally, the calibration was verified using 9.51 ppm isobutylene in air.

- The FID factory calibration was checked using 9 and 95 ppm methane in air. The instrument was zeroed to ambient air.

The instruments were connected directly to each soil-gas probe using a 1-in. section of Tygon (a trademark of the Norton Company) tubing. A consistent methodology was used for collecting the field-screening measurements as follows.

(1) The PID was connected to the probe and allowed to pump for about 30 seconds. This purge time was sufficient to pump about 3 tube-volumes (about 250 mL). The instrument response was then recorded.

(2) The FID was attached to the probe and the instrument response was recorded. The soil gas in several probes did not contain sufficient oxygen to support the FID hydrogen flame. In these cases, the instrument was disconnected from the probe before the flame was extinguished, and the response was recorded as less than detectable.

Field-screening measurements were recorded in the field using a GRiD 2260 Convertible (a trademark of GRiD Systems Corporation) pen-based notebook computer. The computer application stored the data in a table format, which was then directly imported into a spreadsheet format where the data were sorted according to probe location. These field-screening data are listed in Appendix A.

## 4.3 SOIL-GAS SAMPLES

Beginning on June 17, 1993, soil-gas samples were collected for analysis using a portable gas chromatograph (GC). A plastic 60-cc syringe fitted to a 3-way valve was attached to the soil-gas probe using a 1-in. piece of Tygon tubing. The probe was purged using the 60-cc syringe to extract a total purge volume of 360 mL and expel it out the exhaust end of the 3-way valve (Figure 4-5). The purge volume (about 4 tube volumes) was determined by testing VOC recovery from several sample probes using various purge volumes. A purge volume of 360 mL proved to produce the most representative and reproducible results.

After the probe was purged, a 1-mL vapor sample was collected using a 5-mL, gas-tight syringe. The syringe needle was inserted into the sample tube through the 1-in. Tygon connector. Before the sample was collected, the syringe was flushed two to three times with soil gas to equilibrate the sample with the syringe. After the sample was collected, the needle was sealed by inserting it into a rubber septum. The sample was then transported to a trailer located near the NRDWL entrance for analysis. The entire sampling operation took about 5 to 10 minutes. Each sample was tracked using a unique Hanford Environmental Information System (HEIS) number. Quality control



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samples collected included equipment blanks, ambient air samples, field duplicate samples, split samples, and calibration standards (Jacques 1993b).

Table 4-1 contains a list of the principal analytes for the NRDWL soil-gas survey. The analytes were selected based on volatility, previous soil-gas studies, and burial inventories for the NRDWL. The vapor samples were analyzed for detectable VOCs using a Photovac 10S Plus (a trademark of Photovac International, Inc.) portable GC (10S Plus). The 10S Plus is a self-contained, battery-powered portable gas chromatograph that incorporates a 10-m non-polar, wide-bore, capillary column and a photoionization detector (PID) with a 10.6 eV lamp. The PID is a broad-spectrum detector that is particularly sensitive to aromatic compounds and can adequately detect the chlorinated compounds listed in Table 4-1. The 1-mL soil-gas samples were injected directly to the column. The 10S Plus was operated isothermally at 40 °C using ultra high-purity air carrier gas at a flow rate of 8 mL/min.

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The 10S Plus was equipped with a library to detect a variety of compounds based on retention time. Quantification is based on peak area, with appropriate response factors for each compound of interest. Three-point calibration curves for benzene, carbon tetrachloride, cis-1,2-dichloroethylene (cis-1,2-DCE), TCE, and tetrachloroethylene were developed using calibration gas standards. The calibration gas standards have a concentration tolerance of ± 2%. Three-point calibration curves for chloroform, 1,1-dichloroethane, dichloromethane, 1,4-dioxane, tetrahydrofuran, 1,1,1-trichloroethane, and 1,1,2-trichloroethane were prepared by adding headspace vapor above laboratory-grade pure chemical standards into a Tedlar (a trademark of E.I. du Pont de Nemours & Company) bag containing 1.5 L high-purity air. This method is described in Photovac 1990 and has a concentration tolerance of about ± 5%. One-mL samples of the gas standards were analyzed to create the method library.

At the beginning of each sampling day, the 10S Plus was calibrated using a gas calibration standard containing 1 ppm each of cis-1,2-DCE, TCE, and tetrachloroethylene. The acceptable calibration tolerance was ± 10% (ASTM 1993).

All the probes located within the NRDWL fence were sampled and analyzed using the 10S Plus. In addition, all the probes in the NRDWL monitoring network with positive field-screening results from either the PID or the FID located outside the NRDWL fence were sampled. Finally, about 50% of the probes located outside the NRDWL fence showing non-detectable concentrations of total-VOC were sampled and analyzed using the 10S Plus. This consisted of sampling and analyzing alternate probes in the grid outside the NRDWL fence. If significant levels of VOC were detected, samples were collected from the adjacent probes until background levels were detected.

On June 23, 24, and 28, 1993, 15 duplicate samples were collected and analyzed by the Pacific Northwest Laboratory (PNL) Environmental Sciences Department. Ambient air, calibration standards, and samples from selected NRDWL soil-gas probes were collected in 0.5-L glass gas sampling bulbs. The gas samples were drawn through the glass sampling bulbs with a battery-powered pump drawing at a rate of 2 L per minute. A minimum of 3 minutes purge time was used for all samples.

The samples were analyzed using a Hewlett Packard 5971A GC/MS at the PNL Sigma 5 Building in Richland. The system is equipped with a 15-m DB-624

megabore column. One-mL air samples were injected into the split injector with a gas-tight syringe. A 1-mL aliquot was collected from two of the samples by WHC for onsite split analysis.

Beginning on July 29, 1993, the soil-gas probes located over the NRDWL chemical trenches were resampled and analyzed using a second portable GC. Vapor samples of about 500 mL volume were collected in 1-L Tedlar bags. The samples were collected using a battery powered pump drawing at a rate of about 500 mL per minute. Each soil-gas probe was purged for a minimum of two minutes. Each sample was tracked using a unique HEIS number. Quality control samples collected included equipment blanks, ambient air samples, field duplicate samples, and calibration standards (Jacques 1993b).

The samples were transported to a trailer located outside the NRDWL fence for analysis using a Sentex Scentograph (a trademark of Sentex Systems Incorporated) portable GC. The Scentograph is a self-contained, battery-powered portable gas chromatograph that incorporates a 30-m non-polar, wide-bore, capillary column and an argon ionization detector (AID). The AID is a broad-spectrum detector with an effective ionization potential of 11.7 eV. The sample was drawn into the Scentograph from the sample bag by an on-board pump and routed to a preconcentrator. The sample was then desorbed at high temperature into the column for separation. The Scentograph column was operated isothermally at 40 °C using high-purity argon carrier gas at a flow rate of 6.5 mL/min.

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Quantification of the compounds of interest is based on a comparison of an observed peak area and a peak of known concentration in the method library. A calibration gas standard containing carbon tetrachloride, chloroform, TCE, 1,1,1-trichloroethane, 1,1,2-trichloroethane, and tetrachloroethylene was prepared each sampling day by adding headspace vapor above laboratory-grade pure chemical standards to a Tedlar bag containing 1.5 L high-purity air (Photovac 1990). The calibration standard was analyzed to create the method library.

## 4.4 DEEP SOIL-GAS PROBES

Beginning on September 21, 1993, eight deep soil-gas probes were installed in the NRDWL study area. The probes were installed in pairs with one probe driven to a depth of about 9 ft and the second driven to a depth of about 15 ft. Three pairs of probes were installed along the interface between the SWL and the NRDWL. One pair of probes was installed as an up-gradient sampling point in the northwest corner of the study area. Figure 4-6 shows the location of the four sets of deep probes.

The deep probes were driven using a Geoprobe 8A soil probe unit (a trademark of Geoprobe Systems). Each probe consisted of a 6-in. stainless steel wire-mesh gas inlet section attached to a steel probe point. A length of 1/4-in. OD teflon tubing is attached to the gas inlet section and extends to the soil surface. The teflon tubing was capped to prevent contamination of the sample tube. As the probes were installed, the annulus around each gas inlet section was backfilled with about 8 in. of 20/40 silica sand. A 4-in. cap of bentonite was installed above the silica sand to seal the annulus. Native soil served as the backfill around the teflon tubing to the soil surface.

Beginning on October 12, 1993, each deep soil-gas probe and the adjacent shallow probe installed earlier was sampled and analyzed using the two portable GCs used earlier in the survey. Vapor samples of about 500 mL volume were collected in 1-L Tedlar bags. The samples were collected using a battery powered pump drawing at a rate of about 500 mL per minute. Each soil-gas probe was purged for a minimum of one minute. Each sample was tracked using a unique HEIS number. Quality control samples collected included equipment blanks, ambient air samples, field duplicate samples, and calibration standards (Jacques 1993a).

The samples were transported to a trailer located outside the NRDWL fence for analysis using a Photovac 10S Plus portable GC and a Sentex Scentograph portable GC. The two GCs were calibrated and operated in the same manner as discussed in the earlier sections of this report.

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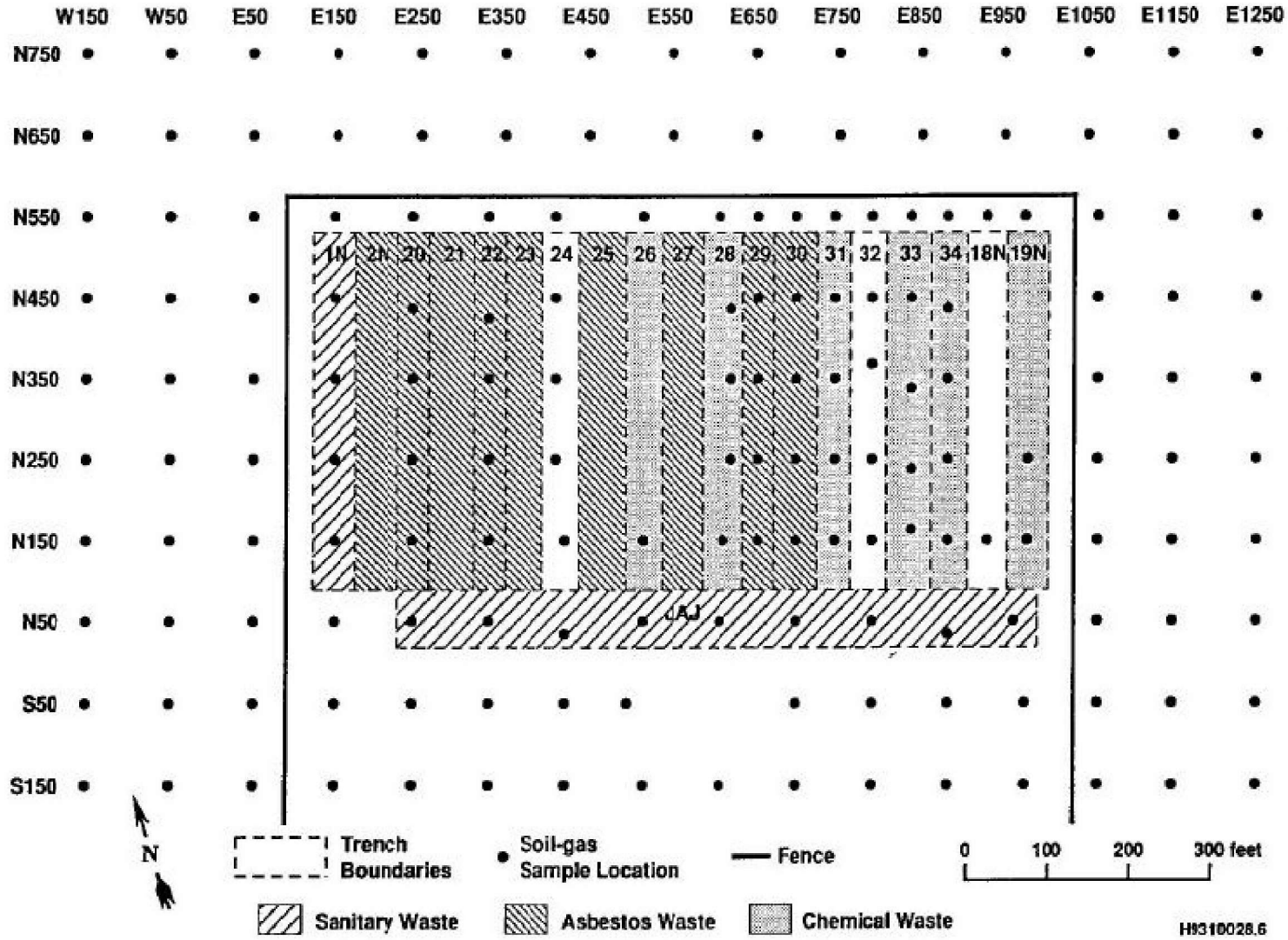


Figure 4-1. NRDWL Soil-Gas Probe Locations.

Figure 4-2. Aerial View of the NRDWL Looking Southwest.

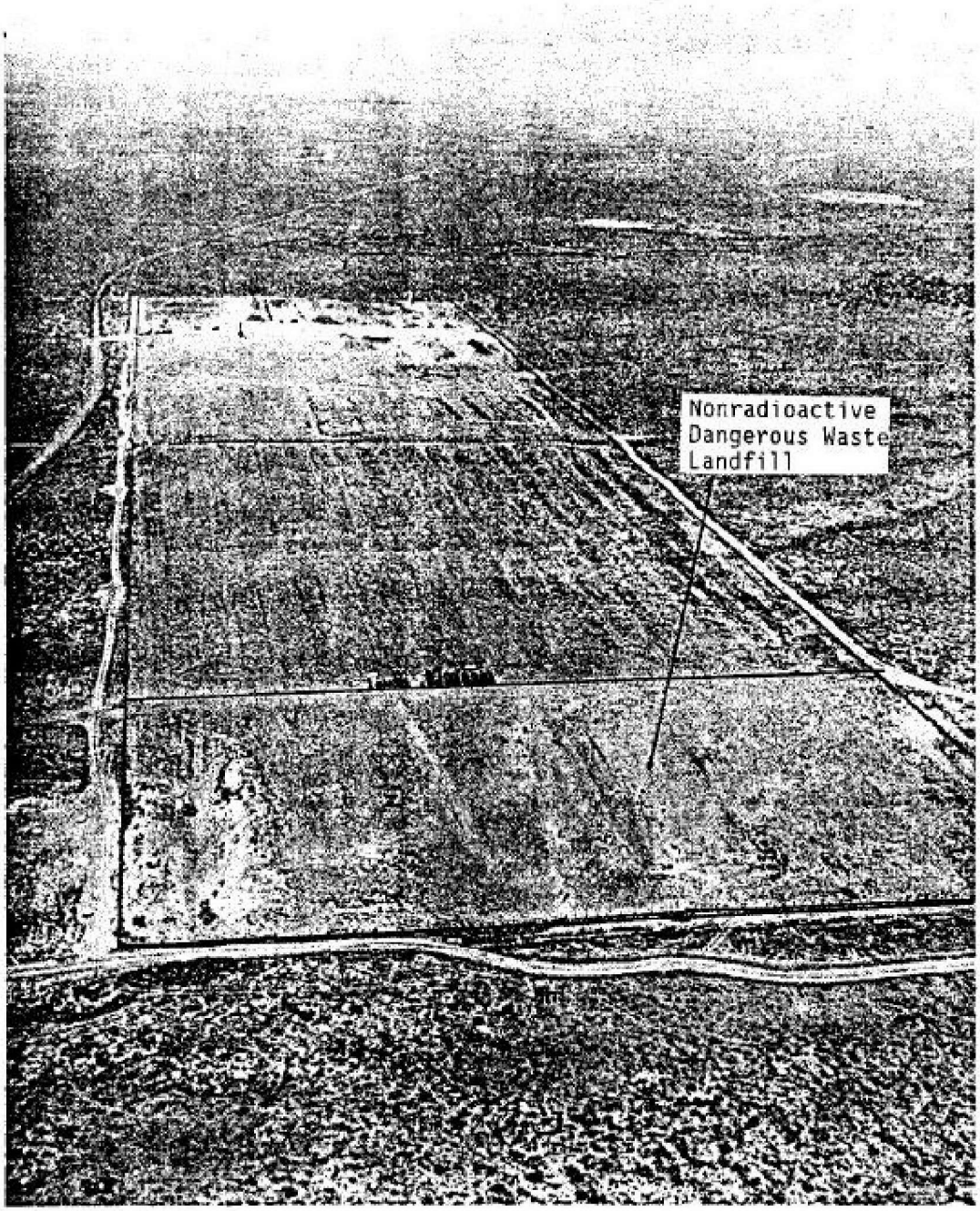


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Figure 4-3. Installing Soil-Gas Probes.

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Figure 4-4. Collecting Field-Screening Data.

Figure 4-5. Collecting Soil-Gas Samples.

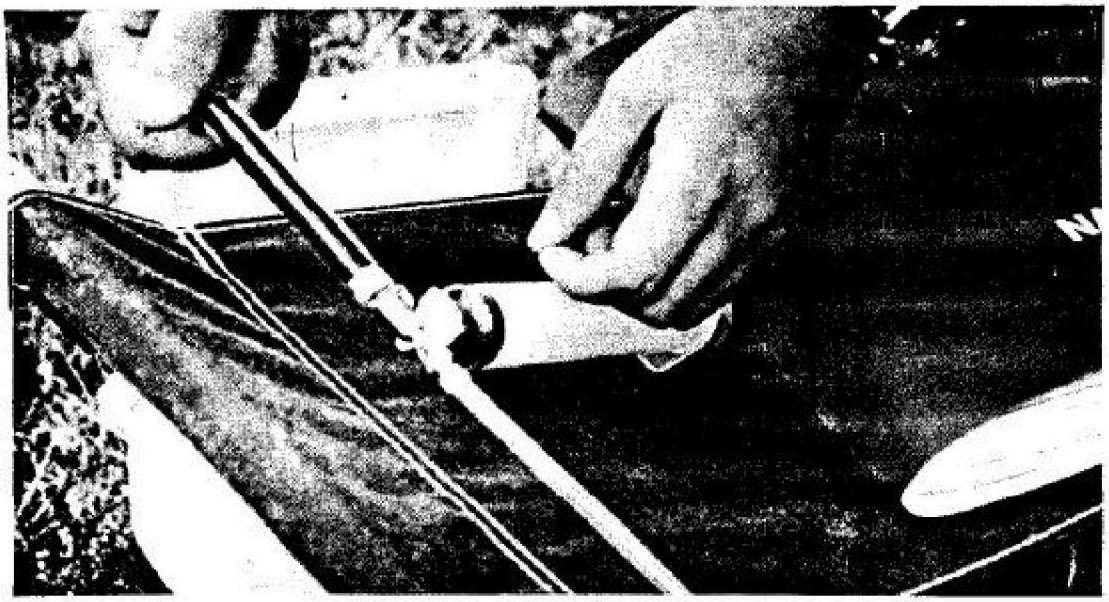

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Figure 4-6. NRDWL Deep Soil-Gas Probe Locations.

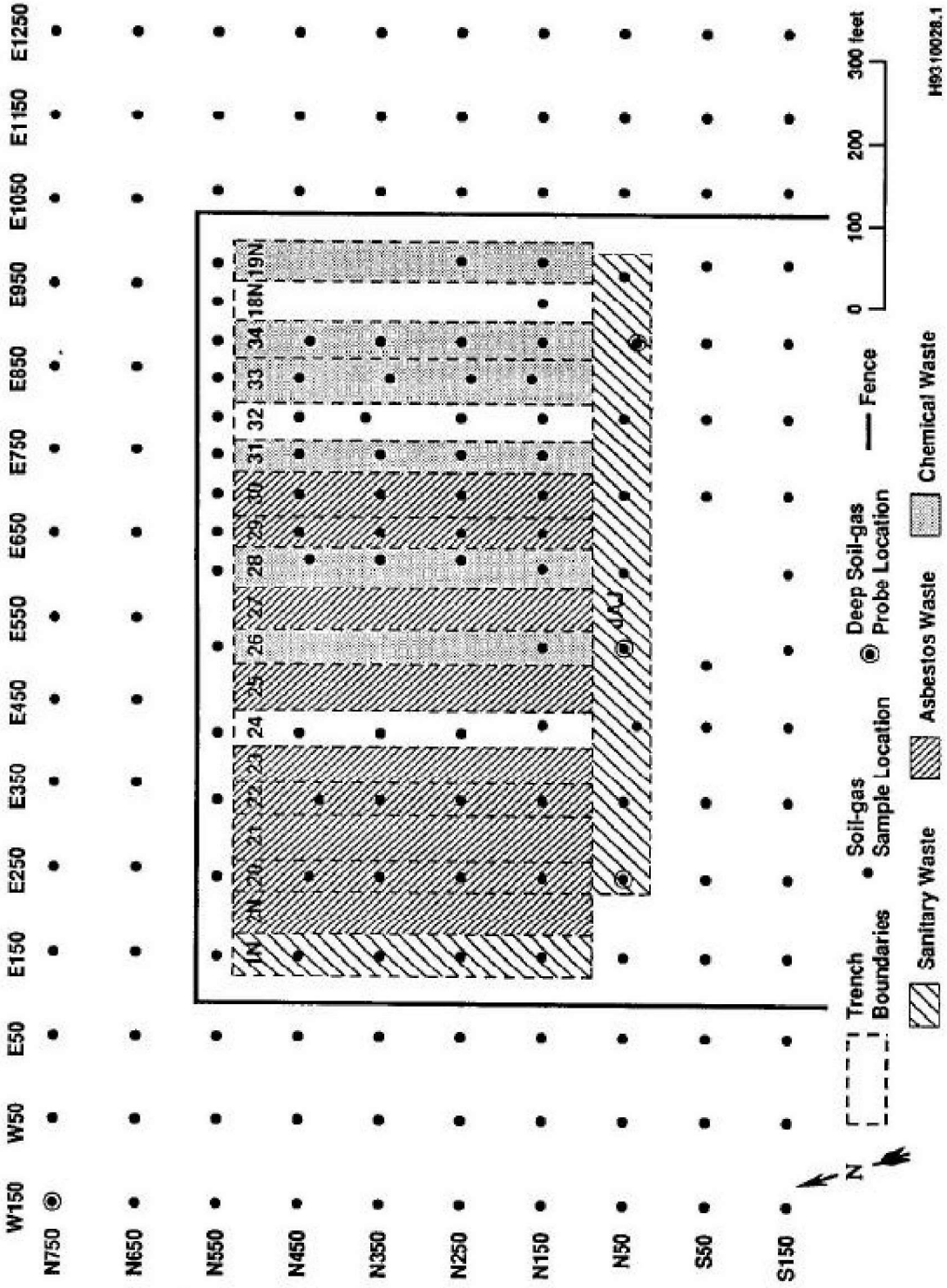




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Table 4-1. Principal Soil-Gas Analytes at the NRDWL.

| Analyte | CAS Number | Formula | Molecular Weight | Ionization Potential (eV) |
|---|---|---|---|---|
| Acetone | 67-64-1 | $CH_3COCH_3$ | 58.08[1] | 9.69[2] |
| Benzene | 71-43-2 | $C_6H_6$ | 78.11[2] | 9.56[2] |
| Carbon tetrachloride | 56-23-5 | $CCl_4$ | 153.82[2] | 11.47[2] |
| Chloroform | 67-66-3 | $CHCl_3$ | 119.38[2] | 11.42[2] |
| 1,1-dichloroethane (DCA) | 74-34-3 | $CHCl_2CH_3$ | 98.96[2] | 11.06[2] |
| dichloromethane (methylene chloride) | 75-09-2 | $CH_2Cl_2$ | 84.93[2] | 11.35[2] |
| 1,4-dioxane | 123-91-1 | $OCH_2CH_2OCH_2CH_2$ | 88.20[2] | 9.19[3] |
| Tetrachloroethylene (PCE) | 127-18-4 | $Cl_2C{=}CCl_2$ | 165.83[2] | 9.71[2] |
| Tetrahydrofuran | 109-99-9 | $C_4H_8O$ | 72.16[3] | 9.45[3] |
| 1,1,2-Trichloroethane (1,1,2-TCA) | 79-00-5 | $CHCl_2CH_2Cl$ | 133.40[2] | N/A |
| Trichloroethylene (TCE) | 79-01-6 | $ClCH{=}CCl_2$ | 131.39[2] | 9.94[2] |

1. Montgomery, J.H., and L.M. Welkom, 1989, *Groundwater Chemicals Desk Reference*, Lewis Publishers, Inc., Chelsea, Michigan.

2. Verschueren, K., 1983, *Handbook of Environmental Data on Organic Chemicals*, Second Edition, Van Nostrand Reinhold, New York.

3. NIOSH, 1990, *Pocket Guide to Chemical Hazards*, National Institute for Occupational Safety and Health, U.S. Department of Health and Human Services, Washington, D.C.

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# 5.0 RESULTS AND OBSERVATIONS

## 5.1 SHALLOW SOIL-GAS RESULTS

Table A-1 of Appendix A contains results for soil-gas probes sampled in the NRDWL soil-gas network and analyzed using the Photovac 10S Plus portable GC. Each probe is listed by its grid coordinates. Several of the target analytes, including benzene, 1,1-dichloroethane, dichloromethane, 1,4-dioxane, and tetrahydrofuran, were not detected during the survey. For simplicity, only the principal analytes detected are included in the table. The values shown are expressed as parts per million volume/volume (ppm-v). Where a compound was not detected in the sample, it is designated as Not Detected (ND). Compounds detected but in concentrations less than 0.010 ppm-v are shown as <0.010.

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The table also shows the depth of each sample probe and the total-vapor values detected during the PID and FID screening survey in June 1993. The PID and FID field-screening values are also shown as ppm-v. Several of the probes could not be monitored with the FID because the vapors did not contain sufficient oxygen to support the flame. These values are listed as Not Analyzed (NA). These field-screening data were used to direct and focus sampling the probes for GC analysis.

The GC data indicate three principal analytes were detected in a relatively widespread distribution throughout the NRDWL site. These compounds were acetone, TCE, and PCE. Figures 5-1, 5-2, and 5-3 are contour maps of the acetone, TCE, and PCE distributions throughout the NRDWL soil-gas network. The maps were produced using SURFER, version 4, (a registered trademark of Golden Software, Inc.).

Figure 5-1 shows the distribution of acetone over the NRDWL site. The contour data indicate low concentrations of acetone were detected primarily in the western portion of the NRDWL site. This portion of the NRDWL corresponds to the location of the sanitary trench (1N). Low concentrations of acetone were also detected in the southeastern margin of the study area near the Phase I portion of the SWL. It is reported that liquid sewage waste and sludge was disposed along the facility fenceline in both of these areas. This disposal practice may explain the presence of acetone in these regions. Acetone can be a byproduct of oxidative decomposition of humus or sewage sludge by soil bacteria and is often detected in landfill gases (Verchueren 1983).

The acetone concentrations measured in soil-gas samples collected from the chemical trench portions of the NRDWL were near the detection levels of the GC. Acetone does not appear to be a principal contaminant in the NRDWL chemical trenches.

Figure 5-2 shows the distribution of TCE throughout the NRDWL site. The distribution of TCE appears to be associated with two main disposal areas, with small amounts of the material detected throughout the study area. One region of high concentrations is found in probes on the E835 profile along the centerline of chemical trench 33. Trichloroethylene is listed several times in the waste inventory of this trench.

Another region containing relatively high concentrations of TCE is the southeast corner of the study area over the closed SWL sanitary trenches. Trichloroethylene was identified in an earlier soil-gas study of the SWL (Evans 1989).

Finally, TCE was detected in low levels in many of the soil-gas samples. These low levels of TCE appear to be associated with higher levels of the solvent PCE. Trichloroethylene can be produced as a breakdown product of PCE, which may explain the wide distribution of trace levels of this material.

Figure 5-3 shows the distribution of PCE throughout the NRDWL site. Perchloroethylene appears to have the highest concentration and widest distribution of the contaminants detected at the NRDWL. The relatively low vapor pressure and high boiling point of this material may contribute to its persistence in the vadose zone environment. The data indicate two main regions of PCE contamination with small amounts of the compound distributed throughout the site.

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The highest concentration of PCE was detected in soil-gas associated with chemical trenches 33 and 34. Perchloroethylene is listed as a constituent in the waste inventory of both trenches. A second region of elevated PCE concentration is on the western side of the NRDWL and appears to be associated with the sanitary trench 1N. Operating records state this trench received only sanitary wastes. However, the soil-gas values indicate PCE may have been disposed in this area.

A third region of relatively high PCE concentration is in the southern portion of the study area. This region is associated with closed sanitary trenches that are part of the Phase I section of the SWL. As was discussed earlier concerning TCE contamination, these values may be associated with SWL disposal activities. Perchloroethylene was also detected by the earlier soil-gas study at the SWL (Evans 1989).

Three other compounds of interest--carbon tetrachloride, chloroform, and 1,1,1-TCA--were detected almost exclusively in soil-gas samples collected from the chemical trench area. However, the concentrations do not appear to follow a clear pattern. After evaluating the data, it was decided to resample the probes in the chemical trench region and analyze the vapors with an instrument capable of detecting these chlorinated chemicals at lower concentrations than the Photovac 10S Plus GC. These data are contained in Table A-4.

## 5.2 QA/QC RESULTS

Table A-2 of Appendix A contains the results of all QA/QC samples tested to support analysis of the soil-gas network using the Photovac 10S Plus GC. These values are also listed as ppm-v and show compounds detected in each sample. The majority of the samples were GC blank analyses or equipment blanks and show nondetects for all compounds. The compounds acetone and PCE were the most widespread VOC detected in the soil gas and were occasionally detected in low concentrations in the ambient air samples.

Analyses of a 1.1 ppm-v cis-1,2-DCE, 1.3 ppm-v TCE, and 1.2 ppm-v PCE standard calibration gas are shown in Table A-2. The measured values are within ± 10% of the actual values (ASTM 1993). Duplicate analyses are also

shown on the table. The duplicate samples show high correlation concerning the compounds detected. However, the actual measured values may vary considerably. This is not uncommon for soil-gas analyses because of the highly variable nature of volatile compounds in the soil gas (ASTM 1993).

Table A-3 of Appendix A contains the analytical results of duplicate samples analyzed by the PNL Environmental Sciences Group. The main purpose of these analyses was to verify the identification of the compounds detected in the soil-gas samples. Each PNL gas sample consisted of a much larger volume than the WHC samples, and larger purge volumes were used to collect the sample. These factors make direct comparison of the PNL and WHC values inappropriate (ASTM 1993). However, correlation of the compounds identified between the two analytical techniques is high.

Aliquots of two PNL samples were collected by WHC and analyzed using the Photovac 10S Plus GC. These two samples were obtained from probes N159, E835 and N249, E881. The bottom portion of Table A-3 shows a comparison of the PNL and WHC results. The principal analyte detected in the N159, E835 sample was 1,1,1-TCA, and the two measured values were within 63% of each other. Carbon tetrachloride detected in the PNL samples appears to be below the detection level of the Photovac 10S Plus GC. The principal analytes detected in the N249, E881 were chloroform, carbon tetrachloride, and PCE. These three measured values were within 93%, 87%, and 100% respectively.

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Two standard calibration gases were also analyzed by PNL. The 1.1 ppm-v cis-1,2-DCE, 1.3 ppm-v TCE, and 1.2 ppm-v PCE standard calibration gas was analyzed as sample B08KJ8. The analyses show good correlation for TCE and PCE. The measured cis-1,2-DCE value was about ±20% of the actual value. Samples of the 1.1 ppm-v carbon tetrachloride standard gas were analyzed by PNL on two occasions. The measured values were consistently three to four times higher than the stated value. Additional analyses of this gas indicate the stated value for this standard is incorrect and should be in the range detected by the PNL analyses.

## 5.3 CHEMICAL TRENCH SOIL-GAS RESULTS

Table A-4 of Appendix A contains analytical results for samples collected from the soil-gas probes located over the chemical trenches. These samples were collected in late July and early August 1993. The samples were analyzed using a Scentograph portable GC to better define the distribution of chlorinated compounds detected by the Photovac 10S Plus GC. The compounds detected are similar to those observed by the Photovac GC but in somewhat higher concentrations. This may be related to greater volatilization of the target compounds due to the higher ambient temperatures during this time of year.

As determined in the earlier analyses, the compounds and concentrations detected in this region of the NRDWL appear to be randomly distributed. There are no discernable plumes, but instead clusters of chemicals. This corresponds to the disposal method of placing the drums in the trenches in groups as they were received. To better understand the data, the concentrations of chemicals detected in each trench were charted along the length of the trench from south to north.

Figure 5-4 shows the identity and concentration of contaminants detected in soil gas analyzed from five consecutive soil-gas probes located along the E605 profile. This profile corresponds to the centerline of chemical trench 28. The probes were located at about 100-ft intervals from N159 to N549. The VOC concentrations are shown on a log scale in ppm-v. The profile shows two regions, N349 and N429, where carbon tetrachloride, 1,1,1-TCA, and TCE were detected. The disposal record for trench 28 indicates 825 gal of 1,1,1-TCA was disposed on 6-22-84 and may explain the presence of this material in this region. The concentrations of PCE probably do not correspond directly to disposal of the chemical in this trench. The source of PCE appears to relate to dispersion of the chemical as a vapor in the soil pore space, as shown on earlier contour maps. This may also be true of the TCE vapors.

Figure 5-5 shows the concentration of contaminants detected in the soil-gas probes along the E651 profile. This profile corresponds to trench 29, which is designated as an asbestos trench. This trench does not appear to contain disposed chemicals. The low concentration of carbon tetrachloride may be due to dispersion of contaminants from trench 28. As stated earlier, the PCE concentrations also appear to result from dispersion of this material from other regions of the site.

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Figure 5-6 shows the concentration of contaminants detected in soil-gas probes along the E697 profile, which corresponds to trench 30. This trench is also designated an asbestos disposal trench. Other than PCE, no target analytes were detected in vapors collected from this trench.

Figure 5-7 shows soil-gas contaminants detected along the E743 profile, which corresponds to trench 31. According to DOE/RL (1990), trench 31 is a chemical trench operated from September 1982 to April 1984. The geophysical survey of the site revealed a large disturbed area in this region that extended north into the area designated for trench 32. According to DOE/RL (1990) trench 32 was unused. The geophysical and soil-gas data indicate this information is not entirely correct.

Figure 5-8 shows soil-gas contaminants detected along the E789 profile corresponding to trench 32. Several target analytes, including chloroform, TCE, and 1,1,1-TCA were detected in the south end of this trench area. The 1,1,1-TCA was also detected in the south region of trench 31. The data indicate that hazardous chemicals were disposed in this enlarged trench, which extends through the area designated for trenches 31 and 32. The materials detected in these regions are listed in the waste inventory of trench 31 (DOE/RL 1990). The high PCE value detected at probe N449 E789 may indicate waste PCE material was disposed in this region. Perchloroethylene is also listed as a waste constituent for trench 31.

Figure 5-9 shows soil-gas contaminants detected along the E835 profile, which corresponds to chemical trench 33. Figure 5-10 shows contaminants detected along the E881 profile corresponding to chemical trench 34. As can be seen from these figures, relatively high concentrations of the principal analytes were detected in both trenches, especially the southern portions of the trenches. Trenches 33 and 34 are the oldest chemical trenches in NRDWL and contain the largest inventory of hazardous chemicals. The soil-gas data appear to confirm this information. All of the constituents detected in the soil gas are listed as wastes disposed in the two trenches.

## 5.4 DEEP SOIL-GAS RESULTS

Table A-5 of Appendix A contains analytical results for soil-gas samples collected from the four sets of deep probes installed in September 1993. Also included are analytical results for samples collected from the shallow probe located adjacent to each set of deep probes. The samples were analyzed for VOC concentrations using a Photovac 10S Plus portable GC and are expressed as ppm-v. The methane, carbon dioxide, and oxygen values were obtained using a GA90 Infrared Gas Analyzer (a trademark of Geotechnical Instruments). These values are expressed as percent (%).

Three sets of deep probes were placed south of the JAJ sanitary trench along the interface between the SWL and the NRDWL. Figure 5-11 shows the levels of carbon dioxide, oxygen, and PCE detected in the three probes located at grid location N20 E881. This grid point is located on the eastern side of the SWL/NRDWL interface. The depth of each probe increases downward on the Y axis. The X axis of the graph is a logarithmic scale and shows the concentration of each analyte in parts per million.

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The concentration of PCE increased slightly in the deeper probes at this sampling location. The concentrations of carbon dioxide and oxygen were detected in levels typical of soil gas collected near a landfill. The concentration of carbon dioxide is elevated and increased with depth. The increased carbon dioxide levels are probably the result of microbial decomposition of organic materials in the landfill. As the carbon dioxide levels increase, the oxygen levels show a decrease with depth. The reduced oxygen levels would also indicate microbial activity.

Figure 5-12 shows the levels of carbon dioxide, oxygen, and PCE detected in the three probes located at the middle of the SWL/NRDWL interface. This grid location is N39 E513. As observed at grid point N20 E881, the PCE concentrations increase with depth. This may result from migration of the dense PCE vapors downward through the porous layers of the soil profile. Also, the levels of carbon dioxide increase with depth while the oxygen levels decrease. This trend is similar to what was observed at grid point N20 E881 and is probably related to microbial activity associated with the SWL.

Figure 5-13 shows the carbon dioxide, oxygen, and PCE levels detected in the three deep probes located on the western side of the SWL/NRDWL interface. This grid location is N39 E237. As observed with the other probes along the SWL/NRDWL interface, the PCE levels show a slight increase in concentration at depth. The levels of carbon dioxide also increase while the oxygen levels decrease.

Finally, one set of deep probes was placed upgradient and outside the NRDWL at grid location N750 W149. This sampling location was selected to represent ambient soil-gas conditions for the study area. Figure 5-14 shows the carbon dioxide and oxygen levels detected at grid location N750 W149. The concentration of PCE measured at this grid location was less than the detection limit of the GC. The carbon dioxide levels are somewhat elevated at this location and increase slightly with depth. The oxygen levels are near ambient levels in the shallow probe and show a slight decrease with depth.

Figure 5-1. Contour Map Showing Acetone Levels at the NRDWL.

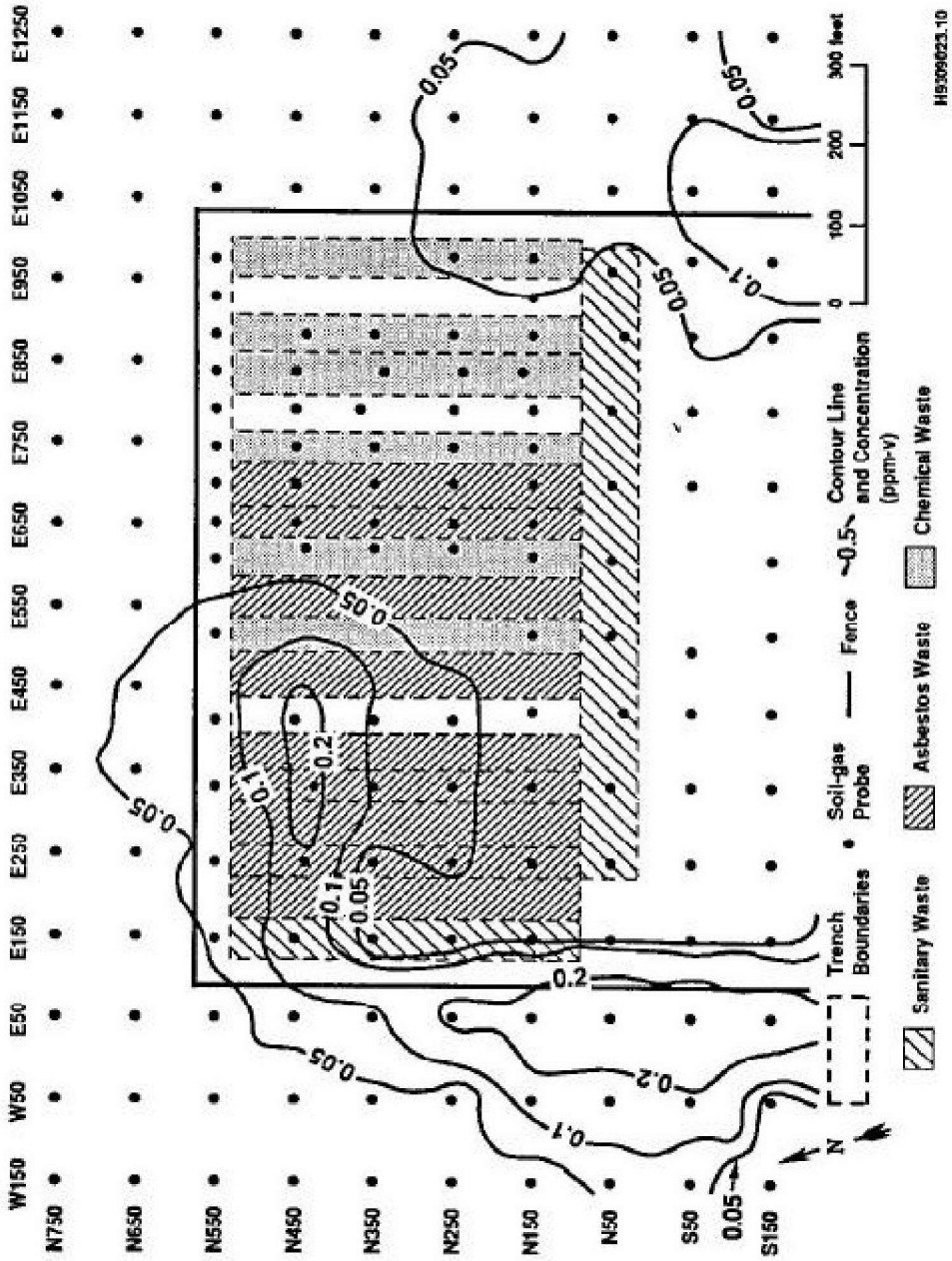




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Figure 5-2. Contour Map Showing Trichloroethylene Levels at the NRDWL.

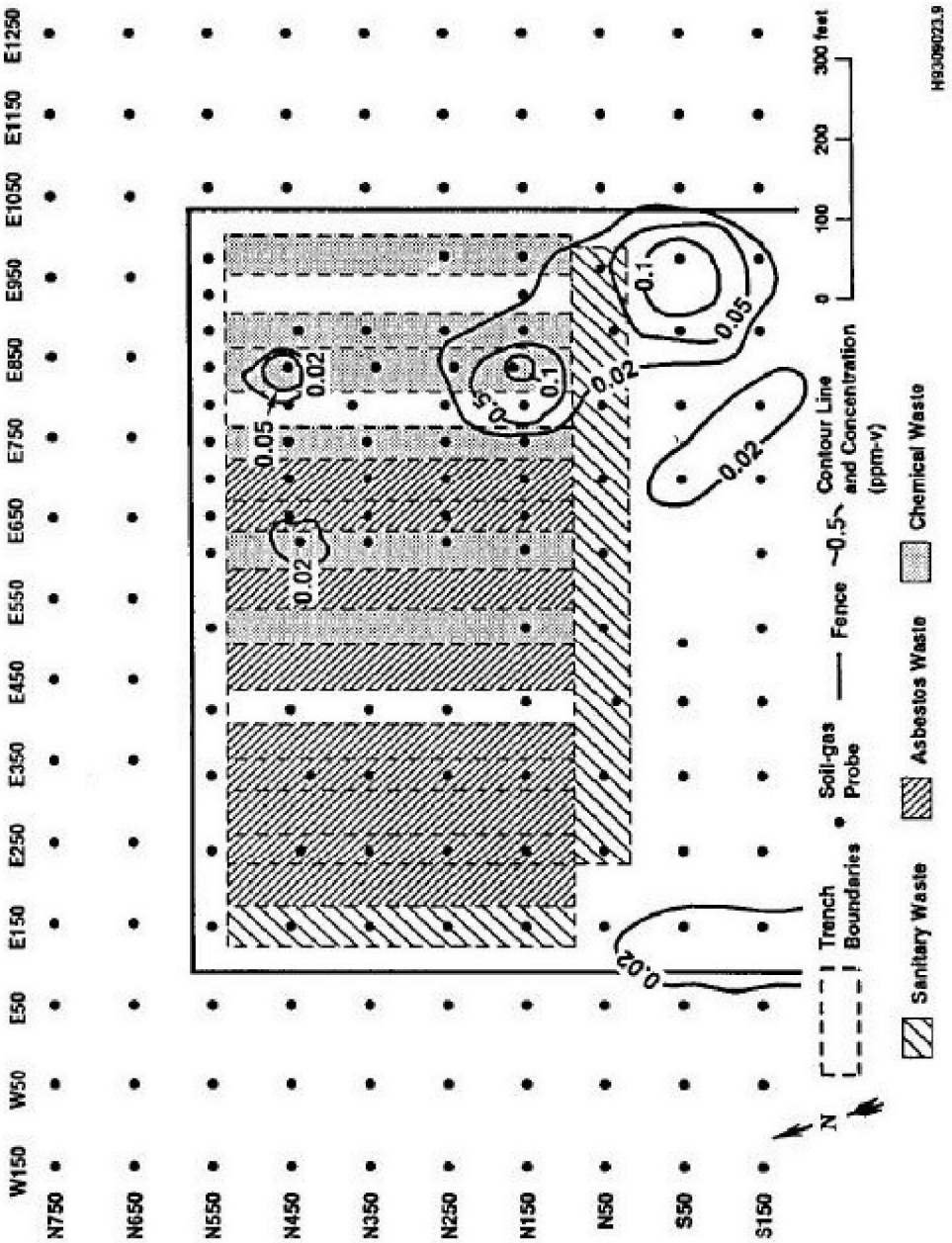

Figure 5-3. Contour Map Showing Perchloroethylene Levels at the NRDWL.

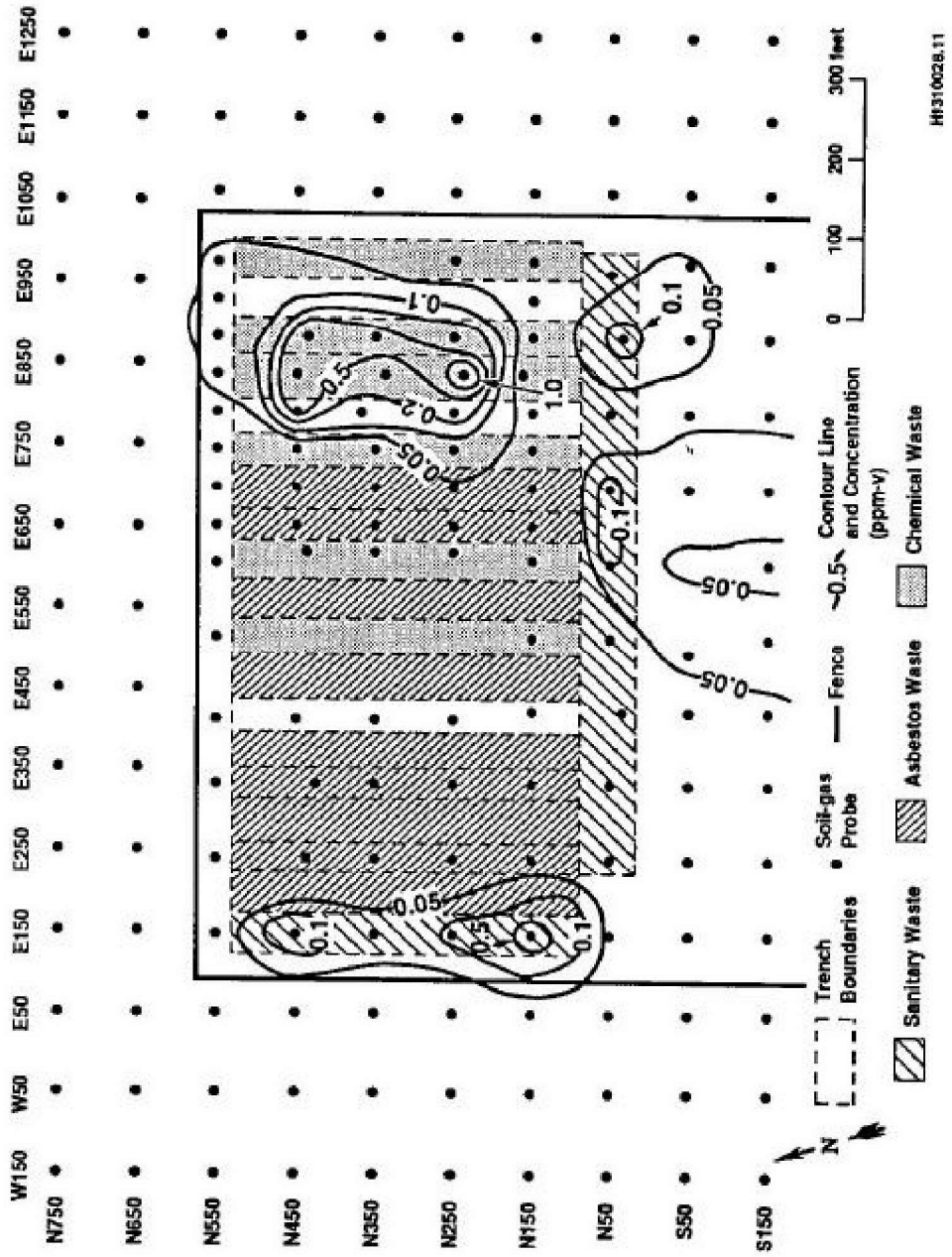


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Figure 5-4. Concentration of Contaminants Detected in the E605 (Trench 28) Profile.

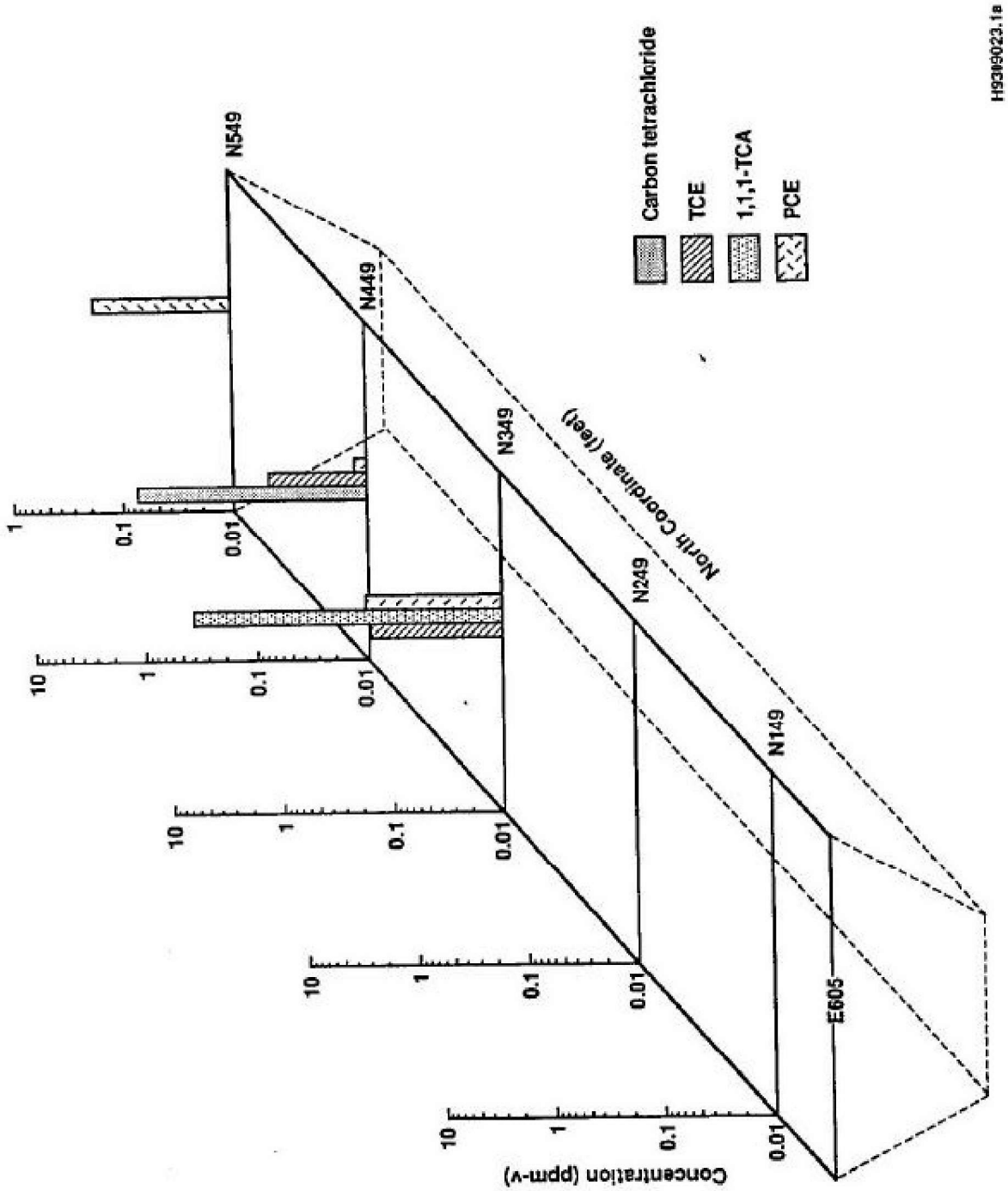


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Figure 5-5. Concentration of Contaminants Detected in the E651 (Trench 29) Profile.

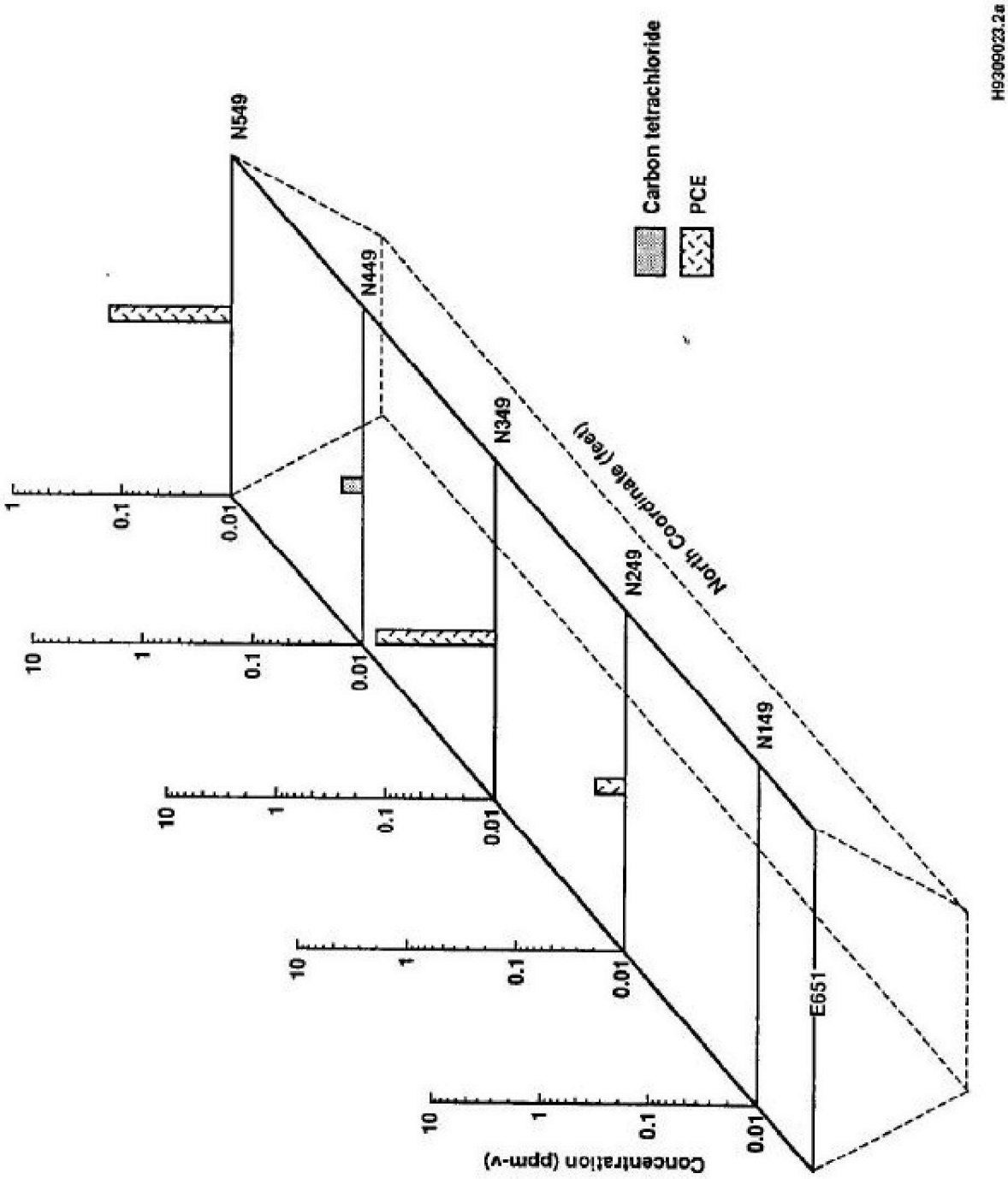


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Figure 5-6. Concentration of Contaminants Detected in the E697 (Trench 30) Profile.

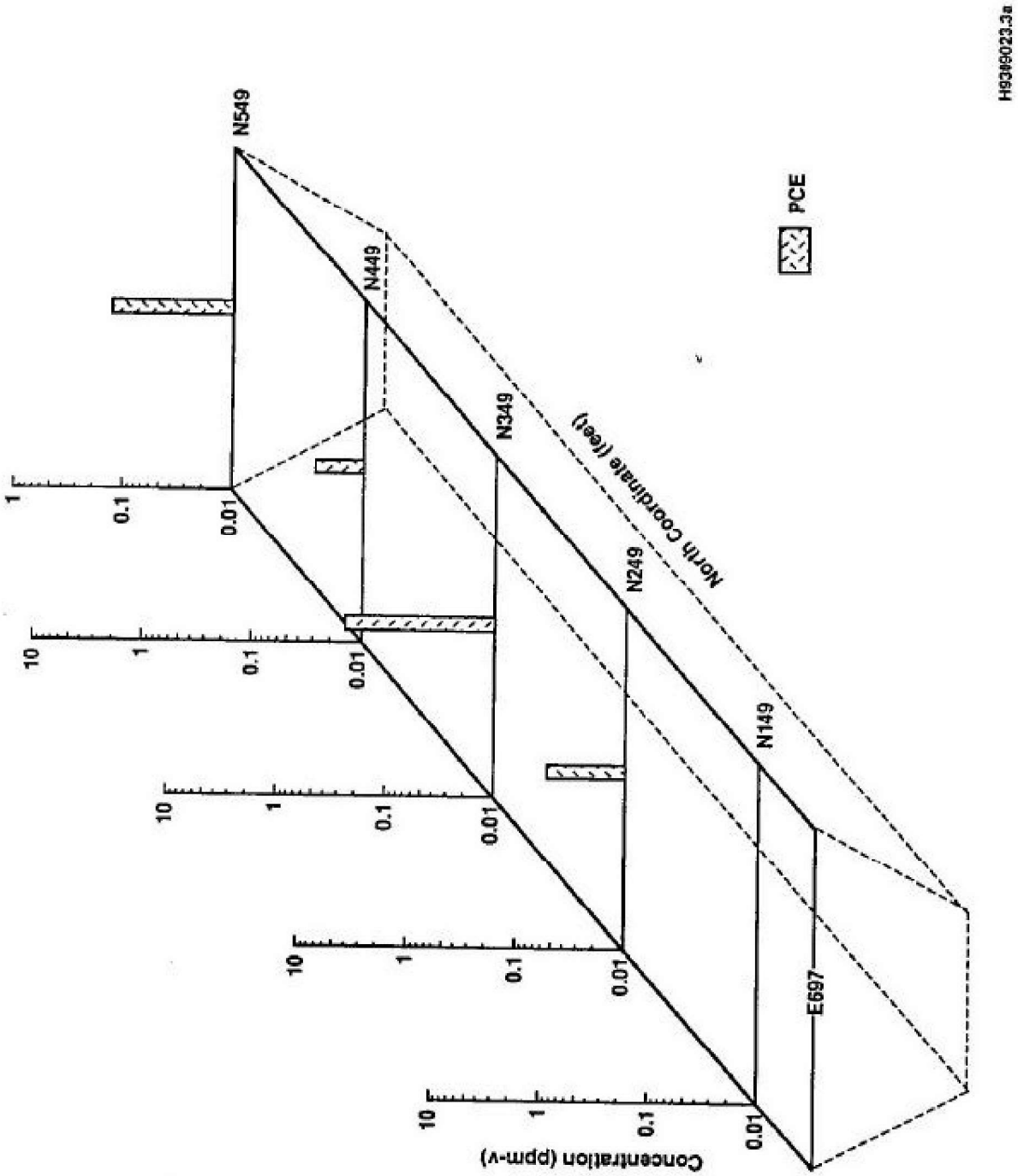


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Figure 5-7. Concentration of Contaminants Detected in the E743 (Trench 31) Profile.

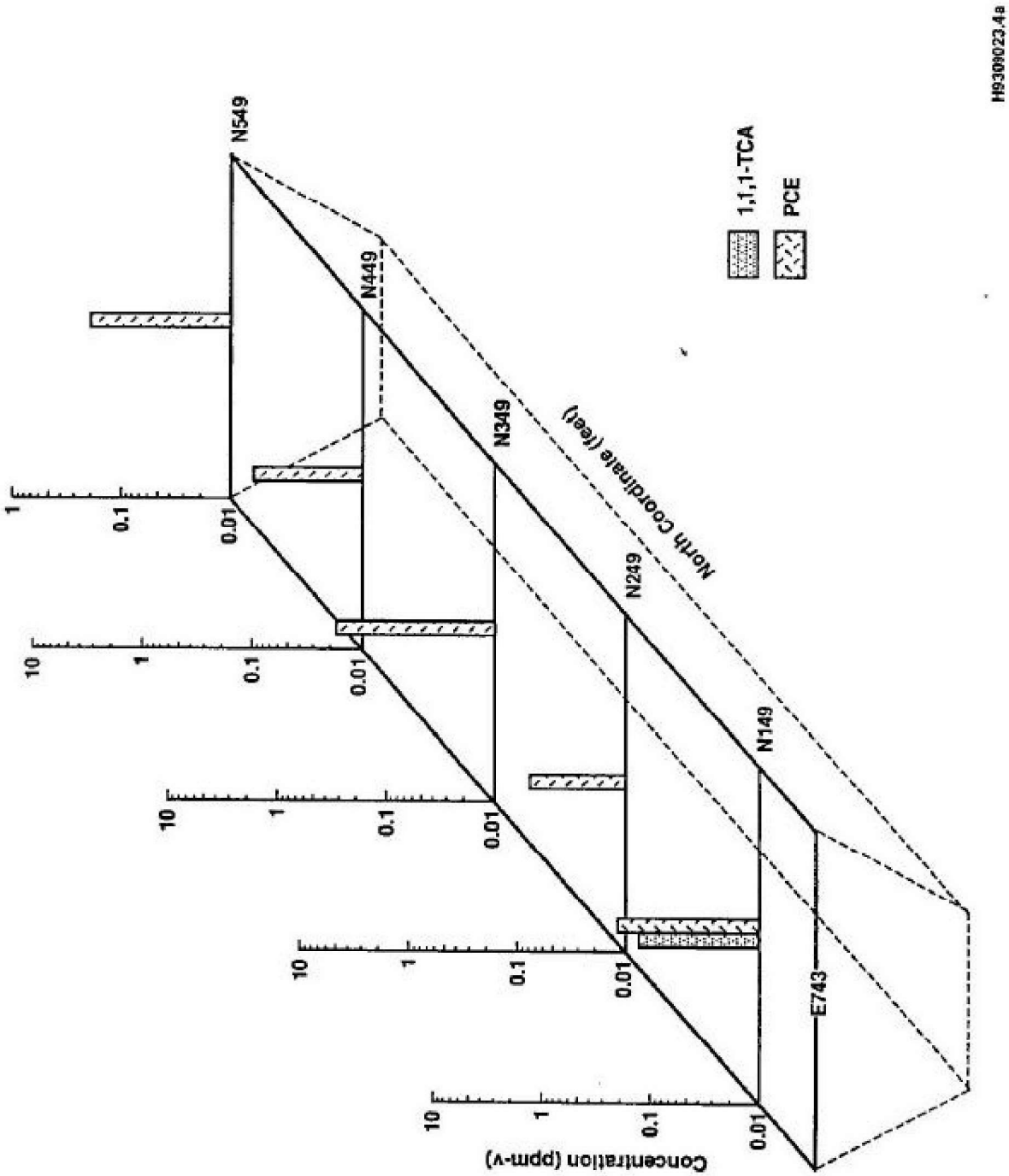




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Figure 5-8. Concentration of Contaminants Detected in the E789 (Trench 32) Profile.

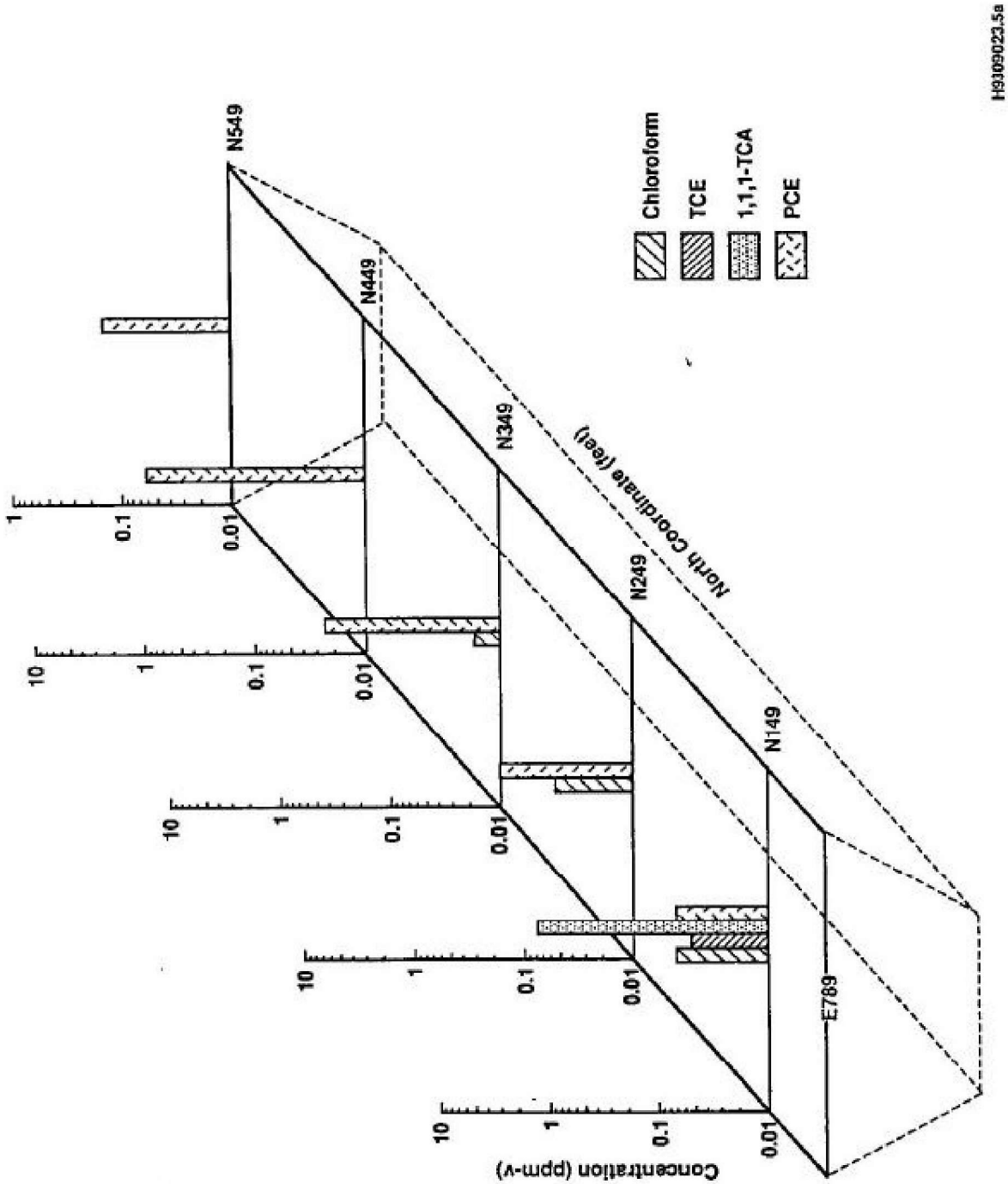


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Figure 5-9. Concentration of Contaminants Detected in the E835 (Trench 33) Profile.

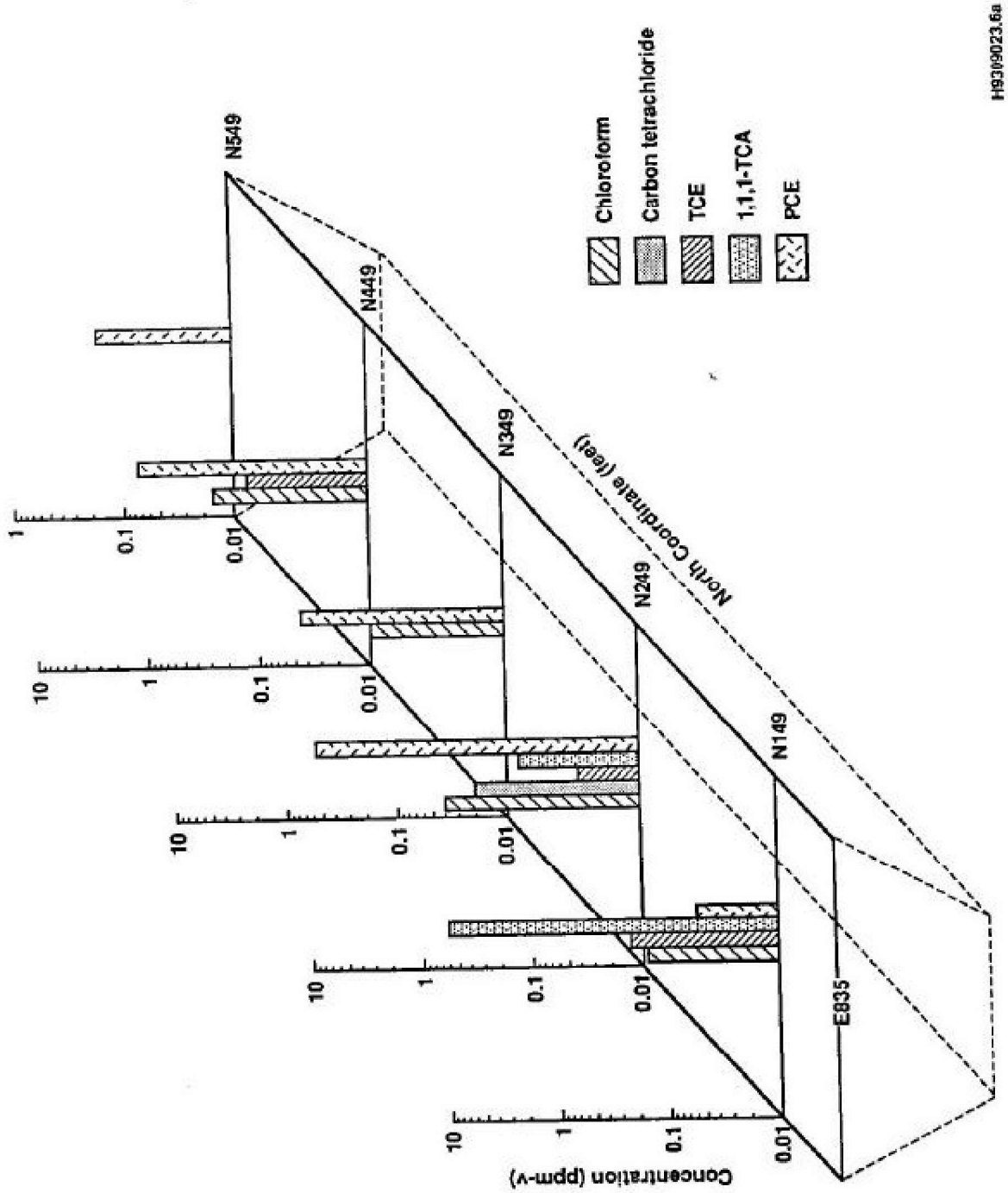


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Figure 5-10. Concentration of Contaminants Detected in the E881 (Trench 34) Profile.

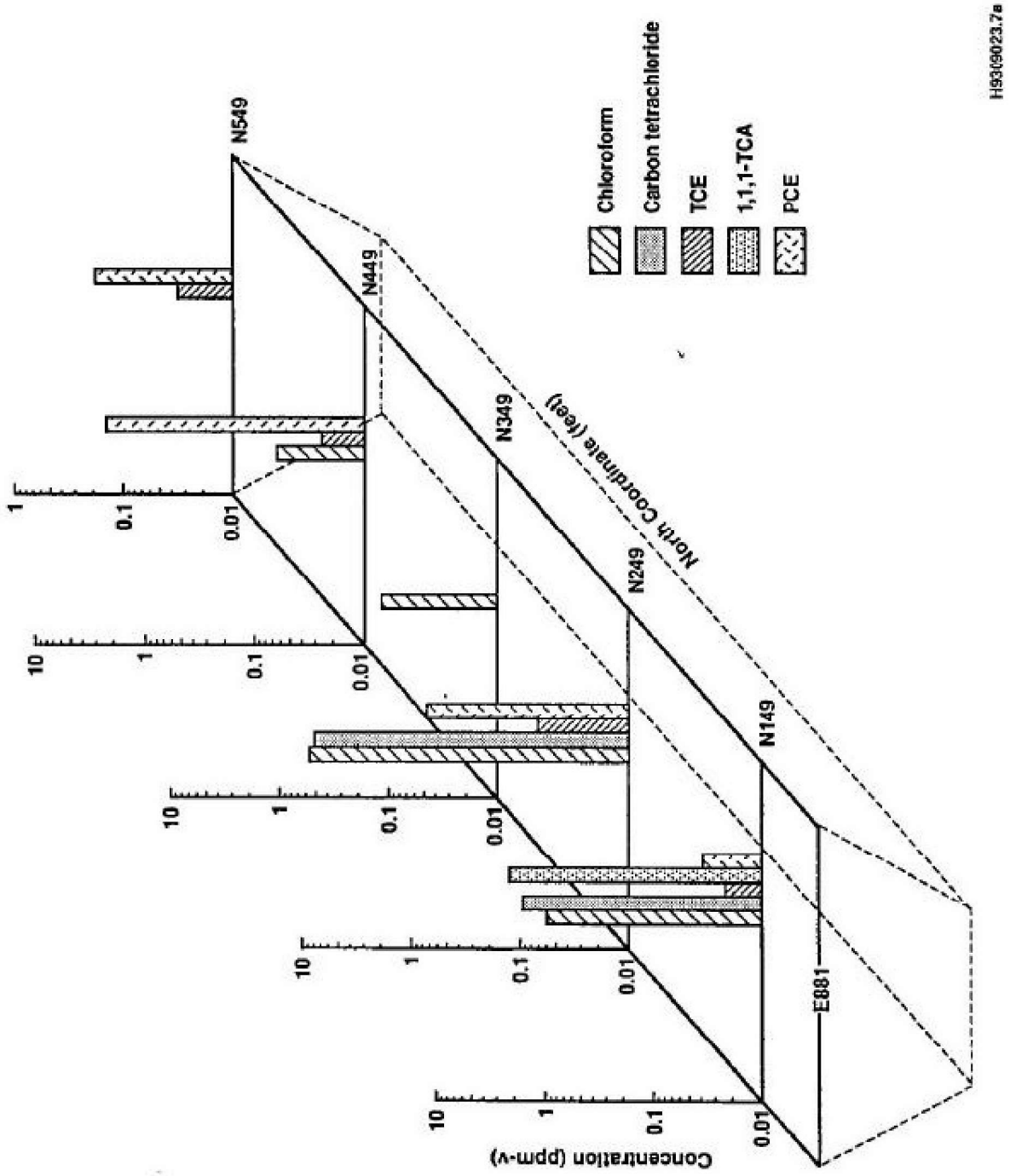

Figure 5-11. Deep Probe Results for Grid Location N20 E881.

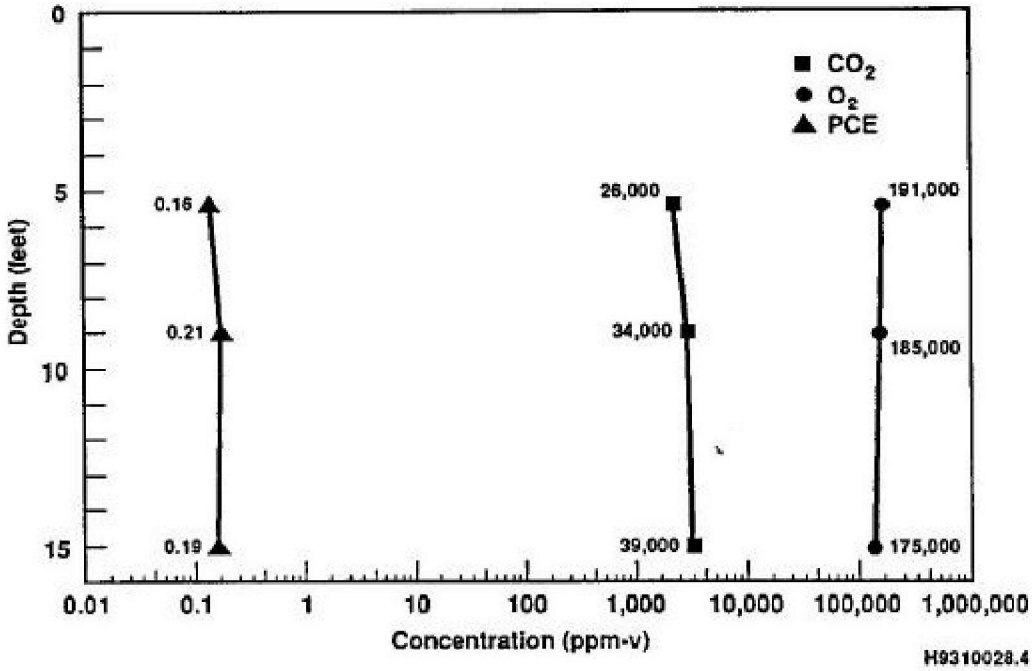


Figure 5-12. Deep Probe Results for Grid Location N39 E513.

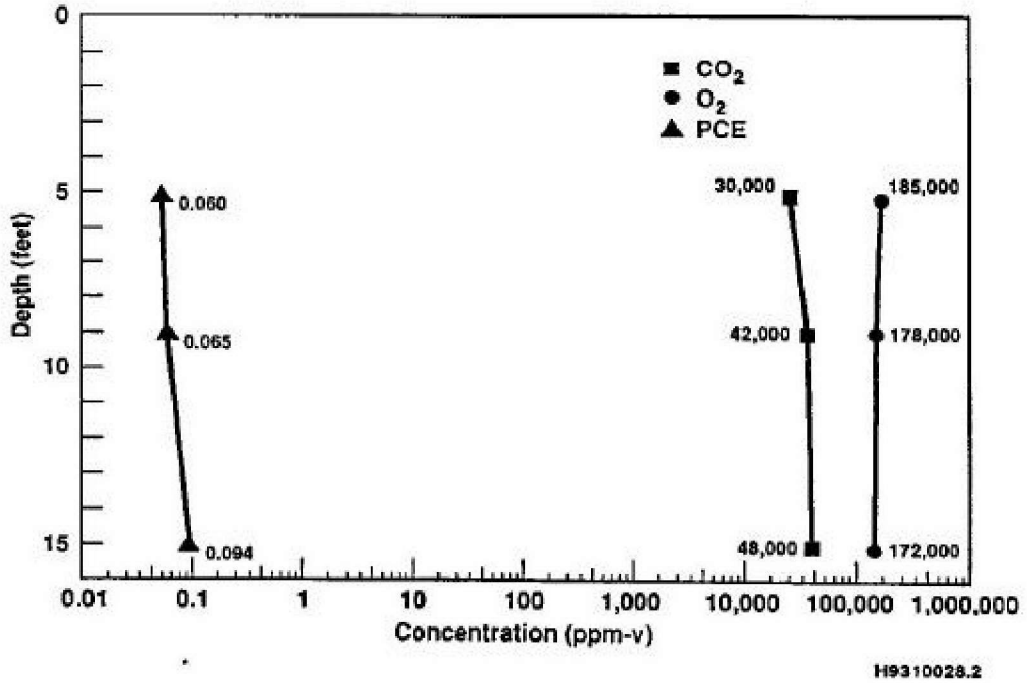




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Figure 5-13. Deep Probe Results for Grid Location N39 E237.

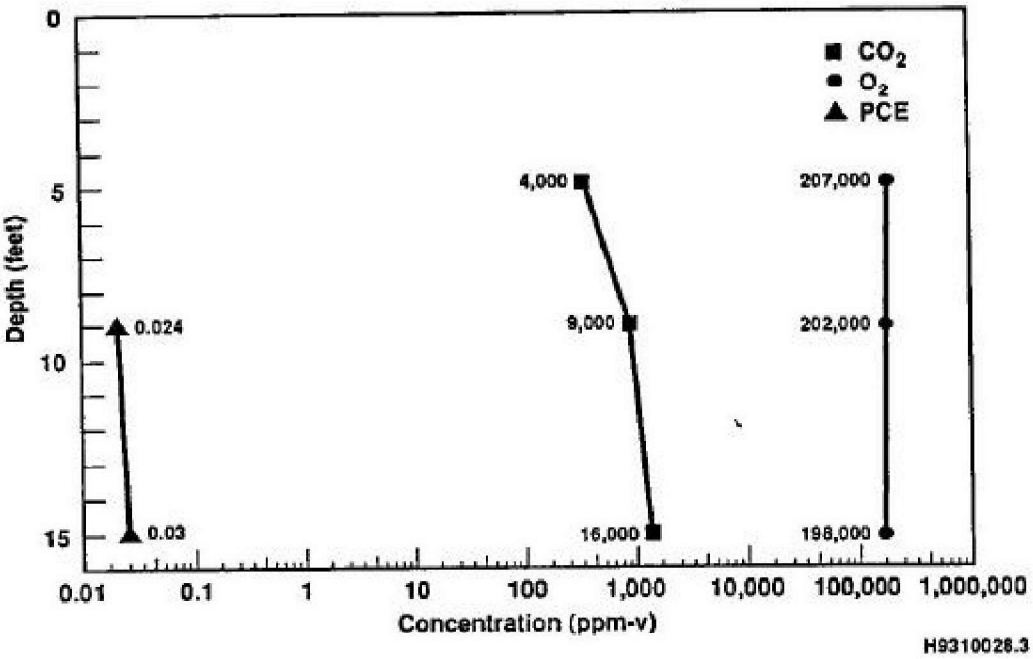
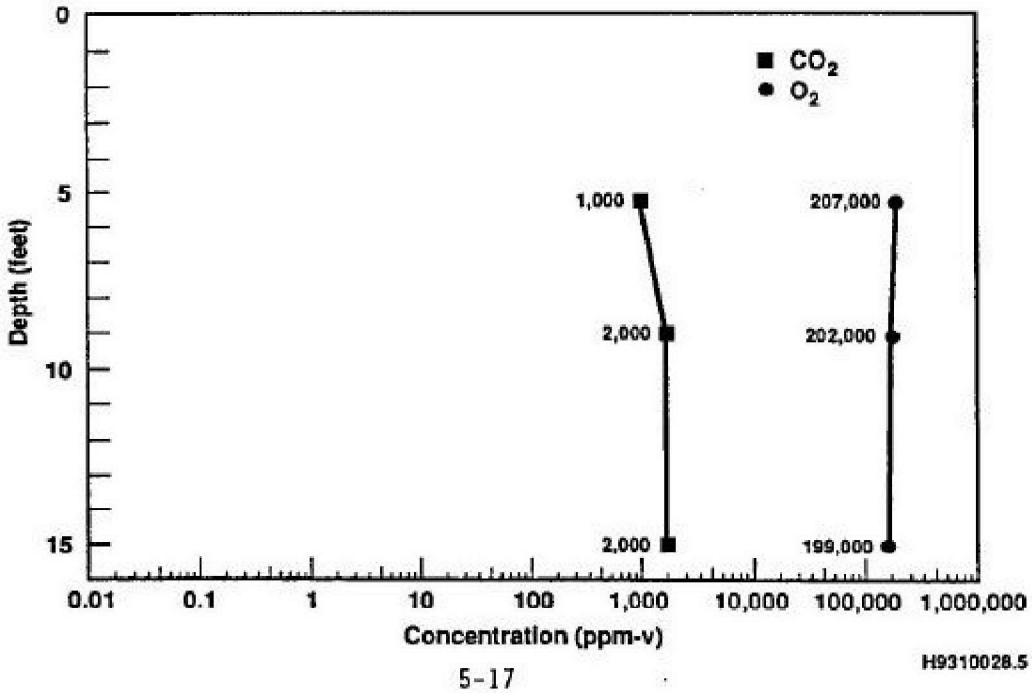



Figure 5-14. Deep Probe Results for Grid Location N750 W149.



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## 6.0 CONCLUSIONS AND RECOMMENDATIONS

The field-screening data collected helped define the general areas of potential VOC contamination on the NRDWL site and were used to focus sample collection and GC analysis. The data also showed positive correlation to less-than-detectable background VOC values measured in the area outside of the NRDWL site. These field-screening data were used to decrease the number of background samples needed to characterize the soil gas outside the NRDWL site.

Several volatile organic compounds disposed in the NRDWL were detected in the soil vapors collected from the site. The highest concentration and diversity of contaminants was detected in the chemical disposal trench region. The contaminants detected show a high correlation to trench location and waste inventories. The diversity and quantity of contaminants detected was greatest in the older trenches. Chemical trenches that operated in later years, when waste disposal regulations were more stringent, appeared to contain fewer volatile organic constituents. Even within a single waste trench, the distribution of detected vapors is not uniform. This may indicate the vapors are emanating from a point source such as a drum or single type of disposed waste.

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Three volatile organic compounds appear to have a relatively wide distribution throughout the study area. One of the compounds, acetone, appears to be related to disposal of sewage wastes along the western fence of the NRDWL and the eastern fence of the Phase I portion of the SWL. Relatively low concentrations of TCE were also detected in several locations throughout the study area. These vapors appear to be related to wastes disposed in both the NRDWL and the SWL.

Perchloroethylene had the widest distribution and highest concentration of the contaminants detected. The distribution of PCE appears to be related to wastes disposed in the NRDWL chemical trenches and in sanitary trench 1N. Some PCE vapors may also originate from portions of the SWL outside of the soil-gas network. Perchloroethylene appears to be one of the more persistent organic chemicals detected in this study. The concentration of PCE vapors detected in soil gas outside the NRDWL boundary were at low levels.

Three chlorinated hydrocarbons detected in this study--1,1,1-TCA, PCE, and carbon tetrachloride--have been detected in low concentrations in groundwater collected from monitoring wells downgradient of the NRDWL. The source of these contaminants is not clear. Perchloroethylene and 1,1,1-TCA are detected in high concentrations in groundwater wells located downgradient of the SWL. The source of these groundwater contaminants is thought to be from liquid wastes disposed in the Phase I portion of the SWL (Fruland 1988). The shallow nature of this soil-gas study makes extrapolation of these data to sources of groundwater contamination inappropriate.

Most of the soil-gas probes used in this study were placed at a shallow depth (4 to 6 ft). The data represent the distribution of soil-gas contaminants in the shallow portions of the vadose zone only. It is not appropriate to attempt to predict the extent of vapor contamination in the deeper portions of the vadose zone. It is therefore not possible to draw conclusions about potential soil or groundwater contamination from these data. The limited distribution of soil-gas contaminants detected in this study

suggests the source of VOCs is confined to specific wastes disposed in the NRDWL.

Four sets of deep probes were installed around the borders of the study area. Three sets of deep probes were located along the interface between the SWL and the NRDWL. Concentrations of carbon dioxide and oxygen detected in these probes were characteristic of soil-gas collected near a landfill. Carbon dioxide levels were elevated and increased with depth. Oxygen levels were reduced and decreased with depth. The compound PCE was also detected in these probes. The concentrations of PCE appeared to increase with depth. This trend may be related to downward dispersion of this dense, persistent vapor. There is not sufficient data to evaluate the possibility of soil or groundwater contamination.

One set of deep probes was placed outside the NRDWL in the northwest corner of the study area. The PCE concentrations in these probes were less than the detection limits of the instruments used. The levels of carbon dioxide were slightly elevated, while the oxygen concentrations were slightly reduced. The levels of gases measured in these probes appear to represent ambient soil-gas levels in this study area.

Finally, based on the results of this study and the planned closure of the NRDWL, three recommendations for future study are presented.

- Additional shallow soil-gas probes should be installed along the centerline of trench 1N and the centerlines of trenches 28 through 34. The probes should be installed at close intervals, such as 25 ft apart, to better characterize volatile wastes disposed in these trenches.

- Permanent soil-gas monitoring stations should be installed at selected high-concentration sites near the chemical trenches. These stations may be vadose zone monitoring wells or soil-gas probes. If soil-gas probes are used, some of the probes should be installed at various depths to better characterize the vadose zone under the trenches.

- The soil-gas grid of the NRDWL study area should be extended south throughout the Phase I portion of the SWL. This action should help to determine the source of contaminants that do not appear to originate at the NRDWL.

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# APPENDIX A

## ANALYTICAL DATA FOR THE NONRADIOACTIVE DANGEROUS WASTE LANDFILL SOIL-GAS MONITORING NETWORK

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Table A-1. Photovac 10S Plus GC Results (ppm-v) for the NRDWL Soil-Gas Network. (sheet 1 of 4)

| Coordinates (ft) | | | Depth (ft) | PID | FID | Sample Date | HEIS Number | Acetone | Chloroform | Carbon tetrachloride | cis-1,2-DCE | TCE | 1,1,1-TCA | 1,1,2-TCA | PCE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| S | 150 W | 51 | 5.2 | ND | ND | 07/15/93 | B08KF6 | 0.037 | ND | ND | <0.010 | ND | ND | ND | ND |
| S | 150 E | 51 | 5.3 | ND | ND | 07/15/93 | B08KF5 | 0.31 | ND | ND | 0.028 | <0.010 | ND | ND | <0.010 |
| S | 151 E | 145 | 5.6 | 0.2 | NA | 06/21/93 | B08JV1 | 0.020 | ND | 0.13 | ND | 0.034 | ND | ND | 0.064 |
| S | 151 E | 227 | 5.5 | 0.1 | NA | 07/13/93 | B08K83 | 0.032 | ND | ND | <0.010 | 0.013 | ND | ND | 0.022 |
| S | 145 E | 329 | 5.7 | 0.2 | NA | 06/21/93 | B08JV0 | 0.014 | ND | 2.1 | ND | <0.010 | ND | ND | 0.024 |
| S | 151 E | 421 | 5.3 | ND | NA | 06/21/93 | B08JT9 | 0.039 | ND | ND | ND | 0.020 | ND | ND | 0.047 |
| S | 151 E | 513 | 5.5 | 0.3 | NA | 06/17/93 | B08JT6 | 0.031 | ND | ND | 0.012 | <0.010 | ND | ND | 0.065 |
| S | 151 E | 605 | 5.6 | 0.4 | NA | 06/17/93 | B08JT2 | 0.044 | ND | ND | 0.026 | 0.014 | ND | ND | 0.14 |
| S | 151 E | 697 | 5.6 | 0.3 | NA | 06/17/93 | B08JT1 | 0.018 | ND | ND | 0.011 | <0.010 | ND | ND | 0.082 |
| S | 151 E | 775 | 5.7 | 0.3 | NA | 06/17/93 | B08JT0 | 0.011 | ND | ND | 0.010 | 0.032 | ND | ND | 0.046 |
| S | 151 E | 881 | 5.7 | ND | NA | 06/17/93 | B08JS9 | ND | ND | ND | <0.010 | <0.010 | ND | ND | 0.018 |
| S | 151 E | 973 | 5.8 | 0.1 | NA | 06/17/93 | B08JS8 | ND | ND | ND | 0.015 | 0.022 | ND | ND | 0.023 |
| S | 151 E | 1060 | 5.3 | ND | 0.1 | 06/29/93 | B08K59 | 0.24 | ND | ND | <0.010 | 0.014 | ND | ND | <0.010 |
| S | 151 E | 1150 | 5.2 | ND | ND | 07/14/93 | B08KL0 | 0.020 | ND | ND | ND | <0.010 | ND | ND | ND |
| S | 50 W | 149 | 5.3 | ND | ND | 07/15/93 | B08KF8 | 0.079 | ND | ND | 0.024 | <0.010 | ND | ND | ND |
| S | 51 E | 50 | 5.5 | ND | ND | 07/15/93 | B08KF7 | 0.37 | ND | ND | 0.016 | ND | ND | ND | ND |
| S | 51 E | 145 | 5.7 | 0.2 | NA | 07/13/93 | B08K85 | 0.014 | ND | ND | <0.010 | 0.051 | 0.19 | ND | 0.053 |
| S | 51 E | 237 | 5.6 | 0.1 | NA | 07/13/93 | B08K84 | 0.024 | ND | ND | <0.010 | <0.010 | 0.099 | ND | 0.023 |
| S | 56 E | 329 | 5.6 | 0.3 | NA | 06/21/93 | B08JV9 | 0.058 | ND | 2.5 | ND | 0.021 | ND | ND | 0.036 |
| S | 51 E | 421 | 5.6 | 0.1 | NA | 06/21/93 | B08JV8 | 0.070 | ND | ND | ND | <0.010 | ND | ND | 0.033 |
| S | 51 E | 493 | 5.6 | 0.3 | NA | 06/21/93 | B08JV7 | ND | ND | ND | ND | 0.010 | ND | ND | 0.089 |
| S | 45 E | 697 | 5.6 | 1.5 | NA | 06/21/93 | B08JV5 | 0.026 | ND | ND | ND | 0.042 | ND | ND | 0.061 |
| S | 51 E | 805 | 5.6 | 0.5 | NA | 06/21/93 | B08JV4 | 0.039 | ND | ND | ND | 0.015 | ND | ND | 0.023 |
| S | 56 E | 885 | 4.7 | 0.5 | NA | 06/21/93 | B08JV3 | 0.077 | ND | ND | 0.028 | 0.043 | ND | ND | 0.084 |
| S | 51 E | 973 | 5.4 | 1.0 | NA | 06/21/93 | B08JV2 | ND | ND | ND | ND | 0.27 | ND | ND | 0.054 |
| S | 51 E | 1060 | 5.2 | ND | 0.4 | 07/14/93 | B08KK6 | 0.16 | ND | ND | 0.010 | 0.019 | ND | ND | 0.020 |
| S | 51 E | 1250 | 5.4 | ND | ND | 07/14/93 | B08KK9 | 0.088 | ND | ND | 0.030 | <0.010 | ND | ND | <0.010 |
| N | 49 W | 50 | 5.4 | ND | ND | 07/15/93 | B08KG0 | 0.084 | ND | ND | 0.025 | <0.010 | ND | ND | ND |
| N | 51 E | 50 | 5.4 | ND | ND | 07/15/93 | B08KF9 | 0.46 | ND | ND | 0.030 | <0.010 | ND | ND | <0.010 |
| N | 39 E | 145 | 5.2 | 0.2 | ND | 07/13/93 | B08K86 | 0.015 | ND | ND | <0.010 | ND | ND | ND | 0.015 |
| N | 39 E | 237 | 4.9 | 0.2 | ND | 07/13/93 | B08K87 | 0.017 | ND | ND | <0.010 | <0.010 | ND | ND | <0.010 |
| N | 37 E | 329 | 5.2 | ND | ND | 07/13/93 | B08K88 | 0.014 | ND | ND | <0.010 | ND | ND | ND | 0.021 |
| N | 24 E | 421 | 5.2 | 0.1 | ND | 07/13/93 | B08K89 | 0.014 | ND | ND | <0.010 | ND | ND | ND | 0.013 |
| N | 39 E | 513 | 5.1 | 0.3 | ND | 07/13/93 | B08K90 | 0.013 | 0.082 | ND | <0.010 | <0.010 | ND | ND | 0.038 |
| N | 39 E | 600 | 5.4 | 0.4 | 0.2 | 07/13/93 | B08K99 | 0.012 | 0.15 | ND | <0.010 | <0.010 | ND | ND | 0.10 |
| N | 39 E | 697 | 5.3 | 0.5 | 0.4 | 07/13/93 | B08K96 | 0.012 | 0.19 | ND | ND | <0.010 | ND | ND | 0.11 |
| N | 34 E | 789 | 5.0 | 0.3 | ND | 07/13/93 | B08K97 | 0.015 | ND | ND | ND | 0.017 | ND | ND | 0.032 |
| N | 20 E | 881 | 5.3 | 0.9 | ND | 07/13/93 | B08K96 | 0.017 | ND | ND | ND | 0.044 | ND | ND | 0.19 |
| N | 39 E | 973 | 4.9 | 0.2 | ND | 07/13/93 | B08K95 | 0.026 | 0.14 | ND | 0.011 | 0.017 | ND | ND | 0.043 |
| N | 37 E | 1062 | 4.9 | ND | ND | 07/14/93 | B08KK7 | 0.041 | ND | ND | <0.010 | <0.010 | ND | ND | 0.019 |

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Table A-1. Photovac 10S Plus GC Results (ppm-v) for the NRDWL Soil-Gas Network. (sheet 2 of 4)

| Coordinates (ft) | | | Depth (ft) | PID | FID | Sample Date | HEIS Number | Acetone | Chloroform | Carbon tetrachloride | cis-1,2-DCE | TCE | 1,1,1-TCA | 1,1,2-TCA | PCE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| N | 39 E | 1149 | 5.3 | ND | ND | 07/14/93 | B08KK8 | 0.077 | ND | ND | 0.014 | <0.010 | ND | ND | <0.010 |
| N | 150 W | 151 | 5.5 | ND | ND | 07/15/93 | B08KG2 | 0.038 | ND | ND | 0.030 | <0.010 | ND | ND | ND |
| N | 151 E | 50 | 5.2 | ND | ND | 07/15/93 | B08KG1 | 0.30 | ND | ND | ND | ND | ND | ND | ND |
| N | 147 E | 145 | 5.0 | 1.3 | 1.6 | 07/13/93 | B08K94 | 0.018 | 0.090 | ND | <0.010 | 0.017 | 0.19 | ND | 0.58 |
| N | 149 E | 237 | 5.1 | ND | ND | 07/13/93 | B08K93 | <0.010 | ND | ND | ND | ND | ND | ND | <0.010 |
| N | 159 E | 329 | 5.3 | ND | ND | 07/13/93 | B08K92 | 0.016 | 0.045 | ND | <0.010 | <0.010 | 0.35 | ND | <0.010 |
| N | 149 E | 409 | 5.2 | ND | ND | 07/13/93 | B08K91 | 0.030 | ND | ND | 0.014 | <0.010 | ND | ND | <0.010 |
| N | 149 E | 513 | 5.3 | ND | ND | 06/30/93 | B08K70 | ND | ND | ND | <0.010 | <0.010 | ND | ND | <0.010 |
| N | 159 E | 605 | 5.7 | ND | ND | 06/30/93 | B08K72 | 0.041 | ND | ND | 0.025 | <0.010 | ND | ND | <0.010 |
| N | 159 E | 651 | 5.3 | ND | ND | 06/30/93 | B08K71 | 0.053 | ND | ND | 0.029 | <0.010 | ND | ND | 0.011 |
| N | 149 E | 697 | 5.0 | ND | ND | 06/30/93 | B08K73 | 0.014 | ND | ND | <0.010 | <0.010 | ND | ND | 0.015 |
| N | 149 E | 743 | 5.4 | ND | ND | 06/30/93 | B08K75 | 0.016 | ND | ND | 0.017 | ND | ND | ND | 0.017 |
| N | 149 E | 789 | 5.3 | ND | 0.1 | 06/30/93 | B08K76 | 0.023 | 0.049 | 0.091 | 0.018 | 0.051 | 0.53 | ND | 0.042 |
| N | 159 E | 835 | 5.4 | ND | 2.6 | 06/30/93 | B08K77 | 0.080 | ND | 4.0 | 0.056 | 0.19 | 5.4 | 0.13 | ND |
| N | 154 E | 881 | 5.3 | ND | 1.0 | 06/30/93 | B08K78 | 0.018 | 0.80 | 0.090 | 0.012 | 0.038 | 1.1 | ND | 0.017 |
| N | 149 E | 927 | 5.2 | ND | ND | 06/30/93 | B08K79 | 0.038 | 0.44 | ND | 0.022 | 0.013 | ND | ND | 0.027 |
| N | 149 E | 973 | 4.8 | ND | ND | 06/30/93 | B08K80 | 0.096 | ND | ND | 0.027 | 0.013 | ND | ND | 0.27 |
| N | 151 E | 1060 | 5.4 | ND | ND | 07/14/93 | B08KC6 | 0.045 | ND | ND | 0.010 | <0.010 | ND | ND | <0.010 |
| N | 151 E | 1250 | 5.0 | ND | ND | 07/14/93 | B08KC7 | 0.046 | ND | ND | 0.016 | <0.010 | ND | ND | <0.010 |
| N | 250 W | 49 | 5.4 | ND | ND | 07/15/93 | B08KG4 | 0.013 | ND | ND | ND | ND | ND | ND | <0.010 |
| N | 250 E | 50 | 5.3 | ND | ND | 07/15/93 | B08KG3 | 0.25 | ND | ND | <0.010 | <0.010 | ND | ND | <0.010 |
| N | 239 E | 145 | 5.2 | ND | ND | 07/13/93 | B08KB4 | 0.030 | ND | ND | <0.010 | <0.010 | ND | ND | 0.23 |
| N | 239 E | 237 | 5.2 | ND | ND | 07/13/93 | B08KB3 | 0.073 | ND | ND | 0.034 | 0.012 | ND | ND | <0.010 |
| N | 254 E | 329 | 5.1 | ND | ND | 07/13/93 | B08KB2 | 0.065 | ND | ND | <0.010 | <0.010 | ND | ND | 0.010 |
| N | 249 E | 409 | 5.0 | ND | ND | 07/13/93 | B08KB1 | 0.056 | ND | ND | 0.019 | <0.010 | ND | ND | 0.015 |
| N | 249 E | 631 | 5.4 | ND | ND | 06/30/93 | B08K69 | 0.021 | ND | ND | <0.010 | <0.010 | ND | ND | 0.010 |
| N | 249 E | 651 | 5.3 | ND | ND | 06/30/93 | B08K68 | 0.031 | ND | ND | 0.015 | <0.010 | ND | ND | 0.015 |
| N | 249 E | 697 | 5.2 | ND | ND | 06/30/93 | B08K67 | ND | ND | ND | ND | <0.010 | ND | ND | 0.048 |
| N | 249 E | 743 | 5.3 | ND | ND | 06/30/93 | B08K66 | 0.069 | ND | ND | 0.017 | <0.010 | ND | ND | 0.087 |
| N | 249 E | 789 | 5.2 | ND | ND | 06/30/93 | B08K65 | 0.034 | ND | ND | 0.019 | 0.017 | ND | ND | 0.32 |
| N | 239 E | 835 | 5.0 | 10.2 | 2.7 | 06/30/93 | B08K64 | 0.019 | ND | ND | <0.010 | 0.028 | ND | ND | 5.0 |
| N | 249 E | 881 | 5.2 | ND | 2.3 | 06/30/93 | B08K63 | ND | 3.0 | 4.5 | ND | 0.018 | ND | ND | 0.39 |
| N | 249 E | 973 | 5.3 | ND | ND | 06/30/93 | B08K62 | ND | ND | ND | 0.014 | <0.010 | ND | ND | 0.018 |
| N | 251 E | 1060 | 5.4 | ND | ND | 07/14/93 | B08KC8 | 0.070 | ND | ND | 0.027 | <0.010 | ND | ND | <0.010 |
| N | 251 E | 1150 | 5.2 | ND | ND | 07/14/93 | B08KC9 | 0.065 | ND | ND | 0.027 | <0.010 | ND | ND | ND |
| N | 351 W | 50 | 5.2 | ND | ND | 07/15/93 | B08KG7 | 0.047 | ND | ND | <0.010 | <0.010 | ND | ND | ND |
| N | 349 E | 50 | 5.5 | ND | ND | 07/15/93 | B08KG5 | ND | ND | ND | ND | ND | ND | ND | <0.010 |
| N | 349 E | 145 | 5.2 | ND | ND | 07/13/93 | B08KB7 | 0.026 | 0.39 | ND | <0.010 | <0.010 | ND | ND | 0.064 |
| N | 339 E | 237 | 5.1 | ND | ND | 07/13/93 | B08KB6 | 0.024 | ND | ND | <0.010 | <0.010 | ND | ND | <0.010 |
| N | 339 E | 329 | 5.2 | ND | ND | 07/13/93 | B08KB5 | 0.057 | ND | ND | 0.020 | <0.010 | ND | ND | <0.010 |

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Table A-1. Photovac 10S Plus GC Results (ppm-v) for the NRDWL Soil-Gas Network. (Sheet 3 of 4)

| Coordinates (ft) | | | Depth (ft) | PID | FID | Sample Date | HEIS Number | Acetone | Chloroform | Carbon tetrachloride | cis-1,2-DCE | TCE | 1,1,1-TCA | 1,1,2-TCA | PCE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| N | 349 E | 409 | 4.8 | ND | ND | 06/28/93 | B08K21 | 0.060 | ND | ND | 0.027 | <0.010 | ND | ND | ND |
| N | 349 E | 628 | 5.8 | ND | 0.2 | 06/29/93 | B08K55 | 0.018 | ND | ND | <0.010 | <0.010 | 0.27 | ND | 0.013 |
| N | 349 E | 651 | 5.3 | ND | ND | 06/29/93 | B08K54 | 0.024 | ND | 0.46 | <0.010 | <0.010 | ND | ND | <0.010 |
| N | 349 E | 697 | 5.4 | ND | ND | 06/29/93 | B08K53 | 0.039 | ND | ND | 0.022 | ND | ND | ND | 0.042 |
| N | 349 E | 743 | 5.3 | ND | ND | 06/29/93 | B08K51 | 0.013 | 0.099 | 0.47 | 0.011 | <0.010 | 0.19 | ND | 0.027 |
| N | 359 E | 789 | 5.1 | ND | ND | 06/29/93 | B08K50 | 0.035 | ND | ND | 0.022 | <0.010 | ND | ND | 0.099 |
| N | 339 E | 835 | 5.2 | 0.1 | 0.5 | 06/29/93 | B08K49 | 0.046 | ND | 0.18 | <0.010 | <0.010 | ND | ND | 0.42 |
| N | 349 E | 881 | 5.1 | 0.2 | ND | 06/29/93 | B08K48 | 0.045 | ND | 0.62 | ND | <0.010 | ND | ND | 0.51 |
| N | 351 E | 1060 | 5.1 | ND | ND | 07/14/93 | B08KD0 | 0.032 | 0.070 | 0.38 | 0.011 | <0.010 | ND | ND | 0.011 |
| N | 351 E | 1250 | 5.1 | ND | ND | 07/14/93 | B08KD1 | 0.029 | 0.042 | ND | 0.012 | <0.010 | ND | ND | <0.010 |
| N | 450 W | 49 | 5.4 | ND | ND | 07/15/93 | B08KG8 | 0.033 | ND | ND | <0.010 | <0.010 | ND | ND | <0.010 |
| N | 450 E | 51 | 5.1 | ND | ND | 07/15/93 | B08KG6 | ND | ND | ND | 0.016 | <0.010 | ND | ND | <0.010 |
| N | 454 E | 145 | 5.1 | ND | 0.2 | 07/14/93 | B08KC5 | 0.20 | ND | ND | <0.010 | ND | ND | ND | 0.20 |
| N | 439 E | 237 | 5.3 | ND | ND | 07/14/93 | B08KC4 | 0.019 | ND | ND | <0.010 | ND | ND | ND | <0.010 |
| N | 429 E | 329 | 5.4 | ND | ND | 07/14/93 | B08KC3 | 0.23 | ND | ND | ND | ND | ND | ND | <0.010 |
| N | 449 E | 409 | 5.2 | ND | ND | 07/14/93 | B08KC2 | 0.26 | ND | ND | <0.010 | ND | ND | ND | <0.010 |
| N | 429 E | 628 | 5.6 | ND | 0.2 | 06/29/93 | B08K42 | 0.052 | ND | 1.1 | <0.010 | 0.075 | ND | 0.15 | 0.013 |
| N | 449 E | 651 | 5.5 | ND | ND | 06/29/93 | B08K41 | 0.036 | ND | ND | 0.016 | 0.017 | ND | ND | 0.010 |
| N | 449 E | 697 | 5.4 | ND | ND | 06/29/93 | B08K43 | 0.027 | ND | 2.7 | ND | | ND | ND | 0.042 |
| N | 449 E | 743 | 5.1 | ND | ND | 06/29/93 | B08K44 | 0.030 | 0.10 | 0.75 | ND | 0.006 | ND | ND | 0.046 |
| N | 449 E | 789 | 5.6 | 1.6 | 0.6 | 06/29/93 | B08K45 | 0.049 | ND | 1.1 | 0.014 | <0.010 | ND | ND | 0.54 |
| N | 449 E | 835 | 5.5 | 1.4 | 0.6 | 06/29/93 | B08K46 | 0.071 | ND | 0.14 | 0.028 | 0.15 | 0.18 | ND | 0.61 |
| N | 439 E | 881 | 4.8 | 4.7 | 2.5 | 06/29/93 | B08K47 | 0.034 | ND | ND | ND | 0.013 | 0.12 | ND | 0.62 |
| N | 450 E | 1061 | 5.2 | ND | ND | 07/14/93 | B08KD2 | 0.015 | 0.043 | ND | <0.010 | <0.010 | ND | ND | 0.049 |
| N | 451 E | 1150 | 5.3 | ND | ND | 07/14/93 | B08KD3 | 0.013 | ND | ND | ND | <0.010 | ND | ND | 0.010 |
| N | 551 W | 150 | 5.3 | ND | ND | 07/15/93 | B08KH0 | 0.067 | ND | ND | 0.028 | <0.010 | ND | ND | <0.010 |
| N | 551 E | 50 | 5.4 | ND | ND | 07/15/93 | B08KG9 | 0.028 | ND | ND | 0.020 | <0.010 | ND | ND | ND |
| N | 539 E | 145 | 5.2 | ND | ND | 06/28/93 | B08K22 | 0.053 | ND | ND | <0.010 | <0.010 | ND | ND | 0.044 |
| N | 549 E | 237 | 5.0 | ND | ND | 06/28/93 | B08K25 | 0.050 | ND | ND | ND | ND | ND | ND | ND |
| N | 549 E | 327 | 4.8 | ND | ND | 06/28/93 | B08K23 | 0.062 | ND | ND | <0.010 | <0.010 | ND | ND | <0.010 |
| N | 549 E | 409 | 5.3 | ND | ND | 06/28/93 | B08K26 | 0.060 | ND | ND | 0.028 | <0.010 | ND | ND | <0.010 |
| N | 549 E | 513 | 5.4 | ND | ND | 06/28/93 | B08K24 | 0.071 | ND | 2.9 | 0.015 | ND | ND | ND | <0.010 |
| N | 549 E | 605 | 5.6 | ND | ND | 06/28/93 | B08K27 | 0.029 | ND | ND | 0.016 | 0.002 | ND | ND | 0.041 |
| N | 549 E | 651 | 5.5 | ND | ND | 06/28/93 | B08K29 | 0.041 | ND | ND | 0.010 | 0.003 | ND | ND | <0.010 |
| N | 549 E | 697 | 5.4 | ND | ND | 06/28/93 | B08K28 | 0.021 | ND | ND | ND | ND | ND | ND | <0.010 |
| N | 549 E | 743 | 5.3 | ND | ND | 06/28/93 | B08K30 | 0.027 | ND | ND | 0.011 | <0.010 | ND | ND | <0.010 |
| N | 549 E | 789 | 5.3 | ND | ND | 06/28/93 | B08K32 | 0.036 | ND | 1.5 | <0.010 | ND | ND | ND | 0.024 |
| N | 549 E | 835 | 5.4 | ND | ND | 06/28/93 | B08K33 | 0.027 | ND | 0.12 | <0.010 | ND | ND | ND | 0.053 |
| N | 549 E | 881 | 5.4 | ND | ND | 06/28/93 | B08K34 | 0.047 | ND | 2.0 | 0.019 | ND | ND | ND | 0.085 |
| N | 549 E | 927 | 5.5 | ND | ND | 06/28/93 | B08K35 | 0.037 | ND | 0.66 | 0.018 | <0.010 | ND | ND | 0.075 |

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Table A-1. Photovac 10S Plus GC Results (ppm-v) for the NRDWL Soil-Gas Network. (sheet 4 of 4)

| Coordinates (ft) | | | Depth (ft) | PID | FID | Sample Date | HEIS Number | Acetone | Chloroform | Carbon tetrachloride | cis-1,2-DCE | TCE | 1,1,1-TCA | 1,1,2-TCA | PCE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| N | 549 E | 973 | 5.6 | ND | ND | 06/28/93 | B08K36 | 0.028 | ND | 2.1 | 0.027 | ND | ND | ND | 0.050 |
| N | 549 E | 1060 | 5.4 | ND | ND | 07/14/93 | B08KD4 | 0.010 | ND | ND | 0.045 | <0.010 | ND | ND | 0.021 |
| N | 550 E | 1150 | 5.3 | ND | ND | 07/14/93 | B08KD5 | 0.039 | ND | ND | 0.016 | <0.010 | ND | ND | <0.010 |
| N | 551 E | 1250 | 5.3 | ND | ND | 07/14/93 | B08KD6 | 0.024 | ND | ND | <0.010 | <0.010 | ND | ND | <0.010 |
| N | 650 W | 51 | 5.5 | ND | ND | 07/15/93 | B08KH1 | 0.070 | ND | ND | 0.031 | <0.010 | ND | ND | <0.010 |
| N | 650 E | 149 | 4.8 | ND | ND | 07/15/93 | B08KH5 | 0.023 | ND | ND | <0.010 | <0.010 | ND | ND | <0.010 |
| N | 650 E | 349 | 5.2 | ND | ND | 07/15/93 | B08KH7 | ND | ND | ND | 0.014 | <0.010 | ND | ND | <0.010 |
| N | 650 E | 549 | 5.2 | ND | ND | 07/15/93 | B08KH9 | 0.043 | ND | ND | 0.021 | <0.010 | ND | ND | <0.010 |
| N | 650 E | 749 | 5.6 | ND | ND | 07/15/93 | B08KJ1 | ND | ND | ND | <0.010 | <0.010 | ND | ND | <0.010 |
| N | 651 E | 850 | 5.4 | ND | ND | 07/15/93 | B08KJ2 | 0.068 | ND | ND | 0.036 | 0.010 | ND | ND | <0.010 |
| N | 650 E | 949 | 5.3 | ND | ND | 07/15/93 | B08JX6 | 0.069 | ND | ND | 0.047 | 0.012 | ND | ND | 0.030 |
| N | 650 E | 1051 | 5.5 | ND | ND | 07/15/93 | B08JX9 | <0.010 | ND | ND | ND | ND | ND | ND | 0.011 |
| N | 650 E | 1149 | 5.1 | ND | ND | 07/14/93 | B08KD9 | <0.010 | ND | ND | <0.010 | <0.010 | ND | ND | <0.010 |
| N | 750 W | 149 | 5.2 | ND | ND | 07/15/93 | B08KH2 | ND | ND | ND | 0.012 | <0.010 | ND | ND | <0.010 |
| N | 750 E | 51 | 5.3 | ND | ND | 07/15/93 | B08KH3 | 0.040 | ND | ND | 0.011 | <0.010 | ND | ND | <0.010 |
| N | 750 E | 249 | 5.3 | ND | ND | 07/15/93 | B08KH6 | ND | ND | ND | 0.014 | <0.010 | ND | ND | <0.010 |
| N | 750 E | 449 | 5.4 | ND | ND | 07/15/93 | B08KH8 | 0.046 | ND | ND | 0.025 | <0.010 | ND | ND | <0.010 |
| N | 749 E | 650 | 5.1 | ND | ND | 07/15/93 | B08KJ0 | 0.047 | ND | ND | 0.016 | <0.010 | ND | ND | <0.010 |
| N | 749 E | 850 | 5.2 | ND | ND | 07/15/93 | B08KJ3 | 0.033 | ND | ND | 0.029 | <0.010 | ND | ND | <0.010 |
| N | 750 E | 951 | 5.4 | ND | ND | 07/15/93 | B08JX8 | 0.021 | ND | ND | 0.016 | <0.010 | ND | ND | <0.010 |
| N | 750 E | 1049 | 4.0 | ND | ND | 07/14/93 | B08KD8 | 0.027 | ND | ND | 0.014 | <0.010 | ND | ND | <0.010 |
| N | 751 E | 1250 | 4.3 | ND | ND | 07/14/93 | B08KF0 | 0.013 | ND | ND | <0.010 | ND | ND | ND | <0.010 |

NA – Not Analyzed
ND – Not Detected

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Table A-2. QA/QC Results for the NRDWL Soil-Gas Network.

| Sample/Location | Sample Type | Sample Date | HEIS Number | Acetone | Chloroform | Carbon tetrachloride | cis-1,2-DCE | TCE | 1,1,1-TCA | 1,1,2-TCA | PCE |
|---|---|---|---|---|---|---|---|---|---|---|---|
| NRDWL Ambient Air | Ambient Air | 06/17/93 | B08JS6 | ND | ND | ND | ND | ND | ND | ND | <0.010 |
| Equipment Blank | Ambient Air | 06/17/93 | B08JS7 | ND | ND | ND | ND | ND | ND | ND | ND |
| DCE, TCE, PCE | Standard | 06/17/93 | B08JT5 | ND | ND | ND | 1.04 | 1.3 | ND | ND | 1.12 |
| S 151 E 973 | Duplicate | 06/17/93 | B08JT7 | 0.019 | ND | ND | <0.010 | 0.25 | ND | ND | 0.042 |
| Equipment Blank | Ambient Air | 06/21/93 | B08JT8 | ND | ND | ND | ND | ND | ND | ND | ND |
| GC Blank | Carrier Gas | 06/21/93 | B08JV6 | ND | ND | ND | ND | ND | ND | ND | ND |
| GC Blank | Carrier Gas | 06/22/93 | B08JW0 | ND | ND | ND | ND | ND | ND | ND | ND |
| S 56 E 329 | Duplicate | 06/22/93 | B08JW4 | 0.11 | ND | ND | 0.018 | 0.015 | ND | ND | 0.033 |
| GC Blank | Carrier Gas | 06/23/93 | B08JX6 | ND | ND | ND | ND | ND | ND | ND | ND |
| Equipment Blank | Ambient Air | 06/23/93 | B08JX7 | ND | ND | ND | ND | ND | ND | ND | ND |
| N 20 E 881 | Duplicate | 06/23/93 | B08JX8 | 0.060 | ND | ND | ND | 0.039 | ND | ND | 0.14 |
| N 159 E 835 | PNL Split | 06/23/93 | B08JY2 | ND | ND | ND | ND | 0.22 | 4.6 | ND | 0.22 |
| N 249 E 881 | PNL Split | 06/23/93 | B08JY3 | ND | 5.7 | 5.3 | ND | <0.010 | ND | ND | 0.43 |
| N 149 E 329 | Duplicate | 06/23/93 | B08JZ4 | 0.15 | ND | ND | ND | ND | ND | ND | <0.010 |
| GC Blank | Carrier Gas | 06/28/93 | B08K19 | ND | ND | ND | ND | ND | ND | ND | ND |
| Equipment Blank | Ambient Air | 06/28/93 | B08K20 | ND | ND | ND | ND | ND | ND | ND | ND |
| GC Blank | Carrier Gas | 06/28/93 | B08K31 | ND | ND | ND | ND | ND | ND | ND | ND |
| N 549 E 513 | Duplicate | 06/28/93 | B08K37 | 0.029 | ND | 0.26 | 0.017 | <0.010 | ND | ND | <0.010 |
| GC Blank | Carrier Gas | 06/29/93 | B08K38 | ND | ND | ND | ND | ND | ND | ND | ND |
| 1 ppm DCE, TCE, PCE | Standard | 06/29/93 | B08K39 | ND | ND | ND | 1.1 | 1.3 | ND | ND | 1.2 |
| Equipment Blank | Ambient Air | 06/29/93 | B08K40 | ND | ND | ND | ND | ND | ND | ND | ND |
| GC Blank | Carrier Gas | 06/29/93 | B08K52 | ND | ND | ND | ND | ND | ND | ND | ND |
| N 149 E 329 | Duplicate | 06/29/93 | B08K57 | 0.36 | ND | 1.1 | 0.016 | <0.010 | 0.26 | ND | 0.010 |
| Equipment Blank | Ambient Air | 06/30/93 | B08K61 | ND | ND | ND | ND | ND | ND | ND | ND |
| GC Blank | Carrier Gas | 06/30/93 | B08K74 | ND | ND | ND | ND | ND | ND | ND | ND |
| GC Blank | Carrier Gas | 07/13/93 | B08K81 | ND | ND | ND | ND | ND | ND | ND | ND |
| Equipment Blank | Ambient Air | 07/13/93 | B08K82 | <0.010 | ND | ND | ND | ND | ND | ND | ND |
| N 147 E 145 | Duplicate | 07/13/93 | B08KB0 | 0.022 | 0.13 | ND | <0.010 | 0.016 | 0.11 | ND | 0.56 |
| N 20 E 881 | Duplicate | 07/13/93 | B08KB8 | 0.022 | ND | ND | ND | 0.054 | ND | ND | 0.25 |
| GC Blank | Carrier Gas | 07/13/93 | B08KB9 | ND | ND | ND | ND | ND | ND | ND | ND |
| GC Blank | Carrier Gas | 07/14/93 | B08KC0 | ND | ND | ND | ND | ND | ND | ND | ND |
| Equipment Blank | Ambient Air | 07/14/93 | B08KC1 | 0.16 | ND | ND | <0.010 | ND | ND | ND | ND |
| N 450 E 1061 | Duplicate | 07/14/93 | B08KD7 | 0.011 | ND | ND | <0.010 | ND | ND | ND | ND |
| N 751 E 1250 | Duplicate | 07/14/93 | B08KP1 | 0.028 | ND | ND | <0.010 | <0.010 | ND | ND | <0.010 |
| GC Blank | Carrier Gas | 07/14/93 | B08KF2 | ND | ND | ND | ND | ND | ND | ND | ND |
| GC Blank | Carrier Gas | 07/15/93 | B08KP3 | ND | ND | ND | ND | ND | ND | ND | ND |
| Equipment Blank | Ambient Air | 07/15/93 | B08KP4 | 0.012 | ND | ND | ND | ND | ND | ND | ND |
| N 51 E 50 | Duplicate | 07/15/93 | B08KH4 | 0.010 | ND | ND | 0.043 | <0.010 | ND | ND | <0.010 |
| N 651 E 850 | Duplicate | 07/15/93 | B08JX7 | 0.022 | ND | ND | <0.010 | <0.010 | ND | ND | <0.010 |

ND- Not Detected

9413146.0884



Table A-3. PNL Duplicate Sample Results (ppm-v) for the NRDWL Soil-Gas Network.

| Sample/Location | Sample Type | Sample Date | HEIS Number | Acetone | Chloroform | Carbon tetrachloride | cis-1,2-DCE | TCE | 1,1,1-TCA | 1,1,2-TCA | PCE |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Equipment Blank | Ambient Air | 06/23/93 | B08KJ4 | ND | ND | ND | ND | ND | ND | ND | ND |
| N 159 E 835 | Duplicate | 06/23/93 | B08KJ5 | ND | 0.03 | 0.85 | ND | 0.07 | 7.31 | ND | 0.14 |
| N 56 E 885 | Duplicate | 06/23/93 | B08KJ6 | ND | ND | ND | ND | ND | ND | ND | 0.14 |
| N 249 E 881 | Duplicate | 06/23/93 | B08KJ7 | ND | 6.1 | 6.07 | ND | ND | ND | ND | 0.43 |
| DCE, TCE, PCE | Standard | 06/23/93 | B08KJ8 | ND | ND | ND | 1.41 | 1.32 | ND | ND | 1.18 |
| 1.1 ppm Carbon tet | Standard | 06/24/93 | B08KK4 | ND | ND | 2.97 | ND | ND | ND | ND | ND |
| Equipment Blank | Ambient Air | 06/24/93 | B08KJ9 | ND | ND | 0.13 | ND | ND | ND | ND | ND |
| S 151 E 775 | Duplicate | 06/24/93 | B08KK0 | ND | ND | 0.02 | ND | 0.07 | 0.18 | ND | ND |
| N 147 E 145 | Duplicate | 06/24/93 | B08KK1 | ND | ND | ND | ND | ND | ND | ND | 0.41 |
| N 339 E 329 | Duplicate | 06/24/93 | B08KK2 | ND | ND | ND | ND | ND | ND | ND | ND |
| N 449 E 697 | Duplicate | 06/24/93 | B08KK3 | ND | ND | ND | ND | ND | ND | ND | ND |
| 1.1 ppm Carbon tet | Standard | 06/28/93 | B08KL5 | ND | ND | 4.78 | ND | ND | ND | ND | ND |
| Equipment Blank | Ambient Air | 06/28/93 | B08KL4 | ND | ND | ND | ND | ND | ND | ND | ND |
| S 51 E 145 | Duplicate | 06/28/93 | B08KL3 | ND | ND | ND | ND | 0.03 | 0.47 | ND | 0.02 |
| N 250 W 49 | Duplicate | 06/28/93 | B08KL2 | ND | ND | ND | ND | ND | ND | ND | ND |
| N 349 E 409 | Duplicate | 06/28/93 | B08KK5 | ND | ND | ND | ND | ND | ND | ND | ND |
| N 550 E 1150 | Duplicate | 06/28/93 | B08KL1 | ND | ND | ND | ND | ND | ND | ND | ND |

WHC/PNL Split Analysis Results (ppm-v)

| Sample/Location | Sample Type | Sample Date | HEIS Number | Acetone | Chloroform | Carbon tetrachloride | cis-1,2-DCE | TCE | 1,1,1-TCA | 1,1,2-TCA | PCE |
|---|---|---|---|---|---|---|---|---|---|---|---|
| N 159 E 835 | WHC Split | 06/23/93 | B08JY2 | ND | ND | ND | ND | 0.22 | 4.6 | ND | 0.22 |
| N 159 E 835 | PNL Split | 06/23/93 | B08KJ5 | ND | 0.03 | 0.85 | ND | 0.07 | 7.31 | ND | 0.14 |
| N 249 E 881 | WHC Split | 06/23/93 | B08JY3 | ND | 5.7 | 5.3 | ND | <0.010 | ND | ND | 0.43 |
| N 249 E 881 | PNL Split | 06/23/93 | B08KJ7 | ND | 6.1 | 6.07 | ND | ND | ND | ND | 0.43 |

ND – Not Detected

Table A-4. Scentograph GC Results (ppm-v) for the NRDWL Soil-Gas Network.

| Coordinates (ft) | Sample Date | HEIS Number | Chloroform | Carbon tetrachloride | TCE | 1,1,1-TCA | 1,1,2-TCA | PCE |
|---|---|---|---|---|---|---|---|---|
| N 159 E 605 | 07/29/93 | B08K72-S | ND | ND | ND | ND | ND | ND |
| N 159 E 651 | 07/29/93 | B08K71-S | ND | ND | ND | ND | ND | ND |
| N 149 E 697 | 07/29/93 | B08K73-S | ND | ND | ND | ND | ND | ND |
| N 149 E 743 | 07/29/93 | B08K75-S | <0.010 | ND | <0.010 | 0.11 | ND | 0.18 |
| N 149 E 789 | 07/29/93 | B08K76-S | 0.064 | ND | 0.048 | 1.2 | ND | 0.064 |
| N 159 E 835 | 07/29/93 | B08K77-S | 0.14 | ND | 0.20 | 8.7 | ND | 0.050 |
| N 154 E 881 | 07/29/93 | B08K78-S | 0.93 | 1.6 | 0.022 | 2.1 | ND | 0.035 |
| N 149 E 927 | 07/29/93 | B08K79-S | 0.16 | ND | ND | 0.071 | ND | 0.073 |
| N 149 E 973 | 07/29/93 | B08K80-S | ND | ND | ND | ND | ND | 0.39 |
| N 249 E 631 | 07/29/93 | B08K69-S | ND | ND | ND | ND | ND | ND |
| N 249 E 651 | 07/30/93 | B08K68-S | ND | ND | <0.010 | ND | ND | 0.019 |
| N 249 E 697 | 07/30/93 | B08K67-S | ND | ND | <0.010 | ND | ND | 0.052 |
| N 249 E 743 | 07/30/93 | B08K66-S | ND | ND | <0.010 | ND | ND | 0.073 |
| N 249 E 789 | 07/30/93 | B08K65-S | 0.050 | ND | <0.010 | ND | ND | 0.16 |
| N 239 E 835 | 07/30/93 | B08K64-S | 0.56 | 0.30 | 0.035 | 0.12 | ND | 8.1 |
| N 249 E 881 | 07/30/93 | B08K63-S | 8.8 | 8.0 | 0.071 | ND | ND | 0.73 |
| N 249 E 973 | 07/30/93 | B08K62-S | 0.050 | ND | <0.010 | ND | ND | 0.021 |
| N 349 E 628 | 07/30/93 | B08K55-S | ND | ND | 0.15 | 5.9 | ND | 0.17 |
| N 349 E 651 | 07/30/93 | B08K54-S | ND | ND | ND | ND | ND | 0.13 |
| N 349 E 697 | 07/30/93 | B08K53-S | ND | ND | ND | ND | ND | 0.24 |
| N 349 E 743 | 07/30/93 | B08K51-S | ND | ND | ND | ND | ND | 0.27 |
| N 359 E 789 | 07/30/93 | B08K50-S | 0.017 | ND | ND | ND | ND | 0.38 |
| N 339 E 835 | 07/30/93 | B08K49-S | 0.086 | ND | ND | ND | ND | 0.66 |
| N 349 E 881 | 07/30/93 | B08K48-S | 0.12 | ND | <0.010 | ND | ND | ND |
| N 429 E 628 | 07/30/93 | B08K42-S | ND | 1.1 | 0.075 | ND | ND | 0.013 |
| N 449 E 651 | 07/30/93 | B08K41-S | ND | 0.016 | 0.010 | ND | ND | ND |
| N 444 E 697 | 08/02/93 | B08K43-S | ND | ND | ND | ND | ND | 0.028 |
| N 449 E 743 | 08/02/93 | B08K44-S | ND | ND | ND | ND | ND | 0.095 |
| N 449 E 789 | 08/02/93 | B08K45-S | ND | ND | ND | ND | ND | 0.92 |
| N 449 E 835 | 08/02/93 | B08K46-S | 0.24 | ND | 0.12 | ND | ND | 1.1 |
| N 439 E 881 | 08/02/93 | B08K47-S | 0.065 | ND | 0.025 | ND | ND | 2.38 |
| N 549 E 513 | 08/02/93 | B08K24-S | ND | <0.010 | <0.010 | ND | ND | 0.21 |
| N 549 E 605 | 08/02/93 | B08K27-S | ND | ND | <0.010 | ND | ND | 0.17 |
| N 549 E 651 | 08/02/93 | B08K29-S | ND | ND | ND | ND | ND | 0.13 |
| N 549 E 697 | 08/02/93 | B08K28-S | ND | ND | ND | ND | ND | 0.13 |
| N 549 E 743 | 08/02/93 | B08K30-S | ND | ND | ND | ND | ND | 0.18 |
| N 549 E 789 | 08/02/93 | B08K32-S | ND | ND | ND | ND | ND | 0.14 |
| N 549 E 835 | 08/02/93 | B08K33-S | ND | ND | ND | ND | ND | 0.16 |
| N 549 E 881 | 08/02/93 | B08K34-S | ND | ND | 0.033 | ND | <0.01 | 0.18 |
| N 549 E 927 | 08/02/93 | B08K35-S | ND | ND | 0.014 | ND | ND | 0.19 |
| N 549 E 973 | 08/02/93 | B08K36-S | ND | ND | <0.010 | ND | ND | 0.13 |

Quality Control Samples

| Sample/Location | Sample Date | HEIS Number | Chloroform | Carbon tetrachloride | TCE | 1,1,1-TCA | 1,1,2-TCA | PCE |
|---|---|---|---|---|---|---|---|---|
| NRDWL Ambient Air | 07/29/93 | B08JY2 | ND | ND | ND | ND | ND | ND |
| Equipment Blank | 07/29/93 | B08JY3 | ND | ND | ND | ND | ND | ND |
| N 159 E 835 | 07/30/93 | B08JY7 | 0.12 | ND | 0.15 | 5.8 | ND | 0.17 |
| NRDWL Ambient Air | 07/30/93 | B08JY5 | ND | ND | ND | ND | ND | ND |
| Equipment Blank | 07/30/93 | B08JY6 | ND | ND | ND | ND | ND | ND |
| N 249 E 881 | 07/30/93 | B08JY8 | 9.5 | 8.5 | ND | ND | ND | 0.47 |
| NRDWL Ambient Air | 08/02/93 | B08JZ0 | ND | ND | ND | ND | ND | ND |
| Equipment Blank | 08/02/93 | B08JZ1 | ND | ND | ND | ND | ND | ND |
| N 439 E 881 | 08/02/93 | B08JY9 | 0.082 | ND | ND | ND | ND | 2.6 |

ND = Not Detected



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Table A-5. Deep Soil-Gas Probe Results (ppm-v).

| Coordinates | | | Depth (ft) | CH4 (%) | CO2 (%) | O2 (%) | Sample Date | HEIS Number | Acetone (ppm-v) | cis-1,2-DCE (ppm-v) | TCE (ppm-v) | PCE (ppm-v) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| N | 39 E | 237 | 4.9 | 0.0 | 0.4 | 20.7 | 10/12/93 | B08K01 | ND | ND | ND | |
| N | 39 E | 237 | 9.0 | 0.0 | 0.9 | 20.2 | 10/12/93 | B08K02 | ND | ND | <0.010 | 0.024 |
| N | 39 E | 237 | 15.0 | 0.0 | 1.6 | 19.8 | 10/12/93 | B08K03 | ND | ND | <0.010 | 0.030 |
| N | 39 E | 513 | 5.1 | 0.0 | 3.0 | 18.5 | 10/12/93 | B08K04 | ND | ND | ND | 0.060 |
| N | 39 E | 513 | 9.0 | 0.0 | 4.2 | 17.8 | 10/12/93 | B08K05 | ND | ND | ND | 0.065 |
| N | 39 E | 513 | 15.0 | 0.0 | 4.8 | 17.2 | 10/12/93 | B08K06 | ND | ND | <0.010 | 0.094 |
| N | 20 E | 881 | 5.3 | 0.0 | 2.6 | 19.1 | 10/12/93 | B08K07 | ND | ND | 0.035 | 0.16 |
| N | 20 E | 881 | 9.0 | 0.0 | 3.4 | 18.5 | 10/12/93 | B08K08 | ND | ND | 0.037 | 0.21 |
| N | 20 E | 881 | 15.0 | 0.0 | 3.9 | 17.5 | 10/12/93 | B08K09 | ND | ND | 0.045 | 0.19 |
| N | 750 W | 149 | 5.2 | 0.0 | 0.1 | 20.7 | 10/12/93 | B08JZ8 | 0.026 | ND | ND | ND |
| N | 750 W | 149 | 9.0 | 0.0 | 0.2 | 20.2 | 10/12/93 | B08JZ9 | ND | ND | ND | <0.010 |
| N | 750 W | 149 | 15.0 | 0.0 | 0.2 | 19.9 | 10/12/93 | B08K00 | ND | ND | ND | <0.010 |

Quality Control Samples

| Sample/Location | Sample Type | Sample Date | HEIS Number | Acetone (ppm-v) | cis-1,2-DCE (ppm-v) | TCE (ppm-v) | PCE (ppm-v) |
|---|---|---|---|---|---|---|---|
| Equipment Blank | Ultra Pure Air | 10/12/93 | B08JZ6 | ND | ND | ND | ND |
| Method Blank | Ambient Air | 10/12/93 | B08JZ7 | ND | ND | ND | ND |
| Equipment Blank | Ultra Pure Air | 10/12/93 | B08K10 | ND | ND | ND | ND |
| 1 ppm DCE, TCE, PCE | Standard | 10/12/93 | B08K11 | ND | 1.1 | 1.2 | 1.2 |

ND - Not Detected

# DISTRIBUTION SHEET

| To | From | Page 1 of 1 |
|---|---|---|
| DISTRIBUTION | ENVIRONMENTAL RESTORATION | Date 12-17-93 |
| Project Title/Work Order | | EDT No. 600886 |
| Nonradioactive Dangerous Waste Landfill Soil-Gas Survey: Final Data Report WHC-SD-EN-TI-199 | | ECN No. |

| Name | MSIN | Text With All Attach. | Text Only | Attach./ Appendix Only | EDT/ECN Only |
|---|---|---|---|---|---|
| I.D. JACQUES | H6-04 | 8 | | | |
| R.C.ROOS | H6-04 | X | | | |
| R.L. HAND | H4-16 | X | | | |
| R.G. CICCONE | G4-01 | 3 | | | |
| W.G. COX | H6-23 | X | | | |
| D.J. HOFF | H6-23 | 6 | | | |
| R.B. KERKOW | H6-04 | X | | | |
| R.G. McLEOD | A5-19 | 3 | | | |
| R.G McCAIN | H6-04 | X | | | |
| P.D. MIX | H6-29 | X | | | |
| EDMC | H6-08 | ~~2~~ (1) | | | |
| CENTRAL FILES | L8-04 | 2 PLUS ORGINAL | | | |

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# DISTRIBUTION SHEET

| To | From | Page 1 of 1 |
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| Distribution | Geosciences | Date 12/15/93 |
| Project Title/Work Order | | EDT No. 160860 |
| Hydrogeology of the 100-N Area | | ECN No. N/A |

| Name | MSIN | Text With All Attach. | Text Only | Attach./ Appendix Only | EDT/ECN Only |
|---|---|---|---|---|---|
| M. R. Adams | H6-01 | X | | | |
| D. J. Alexander | H6-06 | X | | | |
| R. L. Biggerstaff | H6-02 | X | | | |
| K. J. Cantrell | K6-81 | X | | | |
| W. G. Cox | H6-23 | X | | | |
| J. W. Fasset | H6-06 | X | | | |
| K. R. Fecht | H6-06 | X | | | |
| M. J. Furman | R3-80 | X | | | |
| T. J. Gilmore | K6-84 | X | | | |
| F. W. Gustafson | H6-04 | X | | | |
| M. J. Hartman (12) | H6-06 | X | | | |
| G. C. Henckel | H6-04 | X | | | |
| R. P. Henckel | H6-02 | X | | | |
| D. J. Hoff | H6-23 | X | | | |
| D. G. Horton | H6-06 | X | | | |
| R. L. Jackson | H6-06 | X | | | |
| V. G. Johnson | H6-06 | X | | | |
| A. J. Knepp | H6-06 | X | | | |
| A. G. Law | H6-06 | X | | | |
| K. A. Lindsey (3) | H6-06 | X | | | |
| M. R. Morton | X5-55 | X | | | |
| C. J. Perkins | X0-21 | X | | | |
| R. E. Peterson | H6-06 | X | | | |
| R. K. Price | H6-06 | X | | | |
| S. M. Price | H6-23 | X | | | |
| R. F. Raidl | H6-06 | X | | | |
| F. A. Ruck III | H6-23 | X | | | |
| J. S. Schmid | H6-06 | X | | | |
| K. M. Thompson | A5-15 | X | | | |
| R. R. Thompson | H6-32 | X | | | |
| P. J. Valcich | H6-04 | X | | | |
| S.E. Vukelick (2) | H6-02 | X | | | |
| B. A. Williams | H6-06 | X | | | |
| M. T. York | H6-32 | X | | | |
| Central Files (2) | L8-04 | X | | | |
| EPIC ~~(2)~~ (1) | H6-08 | X | | | |
| ERC | H6-07 | X | | | |
| IRA (2) | H4-17 | X | | | |

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EXHIBIT K:

Groundwater Operable Unit PO-1:

(EXCERPTS FROM Hanford's Site Groundwater Monitoring Fiscal Year 2008 DOE/RL-2008-66)

DOE/RL-2008-66
Revision 0

# Hanford Site Groundwater Monitoring for Fiscal Year 2008

Document Type: TR Program/Project: SGW

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# Abstract

This report presents the results of groundwater monitoring for fiscal year 2008 on the U.S. Department of Energy's Hanford Site in southeastern Washington. Results of groundwater remediation and vadose zone studies are summarized.

Contaminant plumes occupy an area of ~183 $km^2$ at levels exceeding one or more drinking water standards, compared to the total area (1,500 $km^2$) of the Hanford Site. The most extensive contaminant plumes in groundwater are tritium, iodine-129, and nitrate. These contaminants originated from multiple sources and are mobile in groundwater. The largest portions of these plumes are migrating from the central Hanford Site to the southeast, toward the Columbia River, and concentrations generally are declining. Carbon tetrachloride and associated organic constituents form a large plume beneath the west-central part of the Site. Hexavalent chromium is present in plumes beneath the reactor areas along the river and beneath the central part of the Site. Strontium-90 concentrations exceed drinking water standards beneath portions of all but one of the reactor areas. Technetium-99 and uranium plumes exceeding standards are present in the 200 Area. A uranium plume exceeding standards also underlies part of the 300 Area. Small contaminant plumes with concentrations greater than standards include carbon-14, cesium-137, cis-1,2-dichloroethene, cyanide, fluoride, plutonium, and trichloroethene.

Levels of some contaminants exceed drinking water standards in water samples collected from aquifer sampling tubes along the river shore. The most significant exceedances were strontium-90 in the 100-N Area, chromium in the 100-D Area, and uranium in the 300 Area.

Highlights for fiscal year 2008 include the following:

- Expansion of pump-and-treat systems in the 100-K Area to clean up chromium contamination
- Installation of an innovative, in-ground barrier at the 100-N Area to immobilize strontium-90 before it reaches the Columbia River
- Approval of a final record of decision for carbon tetrachloride remediation in the 200-ZP-1 Operable Unit.

Monitoring for the *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* is conducted in 12 groundwater interest areas. The purpose of this monitoring is to define and track plumes and to monitor the effectiveness of remedial actions. One groundwater operable unit in the southern part of the Hanford Site (1100-EM-1 Operable Unit) was removed from the National Priorities List (40 CFR 300, Appendix B) because final remediation goals were reached. In fiscal year 2008, a final record of decision was approved for remediation of the 200-ZP-1 Operable Unit in the 200 West Area. This operable unit has been the subject of an interim remedial action for carbon tetrachloride. Interim groundwater remediation in the 100-K, 100-D, and 100-H Areas, using a combination of pump-and-treat and in situ methods, continued to reduce the amount of chromium reaching the Columbia River. An in situ treatment system for strontium-90 is being implemented in the 100-N Area. A pump-and-treat system for technetium-99 and uranium in the southern part of the 200 West Area also operated in fiscal year 2008.

This report meets annual reporting requirements for *Resource Conservation and Recovery Act of 1976* groundwater monitoring at 24 waste management areas:

- 15 under interim or final status detection programs, with the objective of determining whether or not they are adversely affecting groundwater (Monitoring results for Low-Level Waste Management Area 4 and the Nonradioactive Dangerous Waste Landfill exceeded a critical mean value. These two sites will be monitored under assessment programs in fiscal year 2009.)
- 7 under interim status groundwater quality assessment programs to assess contamination
- 2 under final status corrective-action programs.

During calendar year 2008, drillers completed 113 new wells for monitoring, remediation, or characterization, including six for *Resource Conservation and Recovery Act of 1976* requirements. One hundred three wells that could no longer be used were decommissioned (filled with grout).

This report is available on the Internet through the Hanford Site Groundwater Remediation Project (http://www.hanford.gov/cp/gpp).

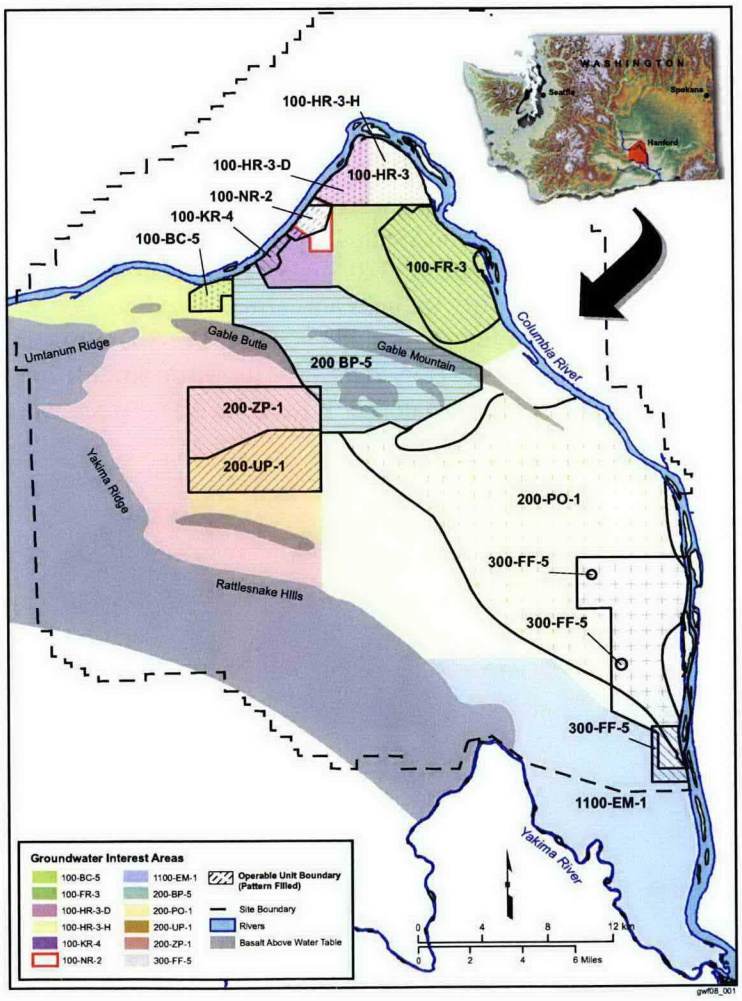
# Summary

## Introduction

The Hanford Site, part of the U.S. Department of Energy's (DOE) nuclear weapons complex, encompasses ~1,500 km$^2$ in southeastern Washington State. The Columbia River flows through the Site. The federal government acquired the Site in 1943, and until the 1980s used it to produce plutonium for national defense. Management of waste associated with plutonium production has been a major activity throughout the Site's history and continues today at a much reduced scale. Beginning in the 1990s, the DOE has focused on cleaning up the site.

The DOE is committed to protecting the Columbia River, human health, and the environment from the Site's contaminated groundwater. As part of this commitment, the DOE's groundwater management plan lays out steps for addressing groundwater and vadose zone contamination.

***The Hanford Site Groundwater Strategy focuses on three key areas: groundwater protection, groundwater monitoring, and remediation of contaminated groundwater.***



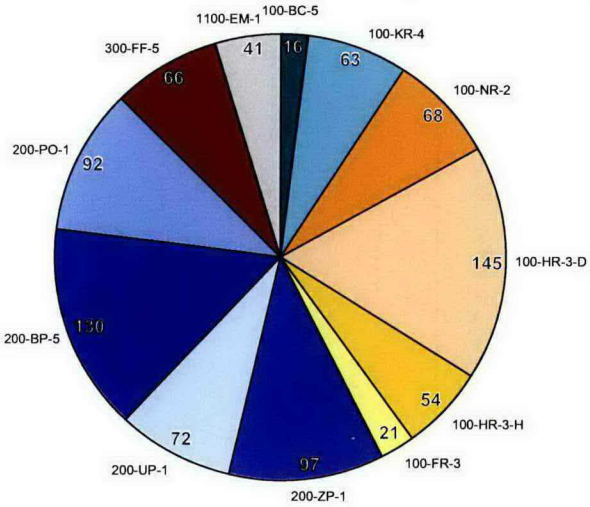

***Hanford Site groundwater monitoring is organized by areas of interest, which are informally named after the groundwater operable units. The areas of interest are useful for planning and scheduling groundwater monitoring and interpreting data.***

The DOE monitors groundwater at the Hanford Site to fulfill a variety of state and federal regulations, including the *Atomic Energy Act of 1954* (AEA), the *Resource Conservation and Recovery Act of 1976* (RCRA), the *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* (CERCLA), and *Washington Administrative Code*.

DOE Order 450.1, "Environmental Protection Program," implements requirements of the AEA. This Order requires environmental monitoring to detect, characterize, and respond to releases from the DOE activities, assess impacts, and characterize exposure pathways. The Order recommends implementing a site-wide approach for groundwater protection. The Order requires compliance with other applicable environmental protection requirements.

The Hanford Site has been divided into operable units, or groupings of similar waste units within a geographic area, so that the CERCLA process can be efficiently implemented. Most operable units are source operable units, but eleven are groundwater operable units. The concept of the groundwater operable unit was adopted to allow separate characterization of the waste sites and the groundwater. Separate characterization recognizes differences between localized contaminants in the soil column at the sources and the more widespread, mingled contamination in groundwater. Monitoring wells are located and sampled to define the nature and extent of the contaminant plumes. Groundwater also is monitored to assess the effectiveness of groundwater remediation.

The groundwater monitoring requirements for the Site's RCRA units fall into one of two categories: interim status or final status. A permitted RCRA unit requires final status monitoring, as specified in WAC 173-303-645, "Dangerous Waste Regulations; Releases from Regulated Units." RCRA units not currently incorporated into permits require interim-status monitoring, as specified in WAC 173-303-400, "Dangerous Waste Regulations; Interim Status Facility Standards" (based on 40 CFR 265, "Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities").

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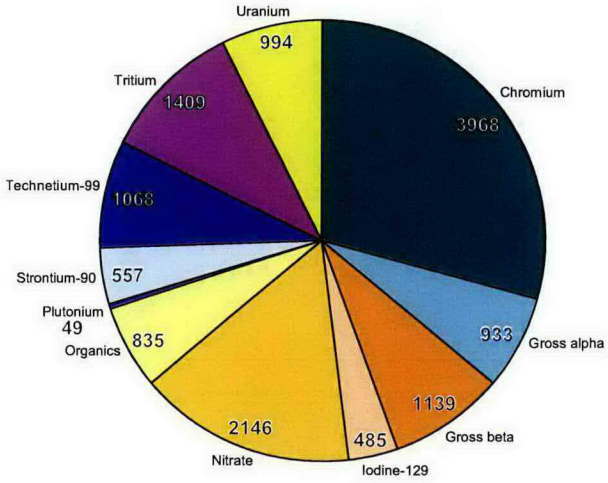
***This chart shows the number of wells sampled in each groundwater interest area in FY 2008.***

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***The groundwater project requests specific laboratory analyses based on the wells' locations, historical contaminant trends, and regulatory requirements. This graph shows the number of analyses for the most common constituents during FY 2008.***

RCRA groundwater monitoring is conducted under one of three possible phases.

**Indicator Parameter** (or final status detection). Initially, a detection program uses groundwater data to determine and monitor the impact, if any, of the facility on groundwater. Monitoring results for Low-Level Waste Management Area 4 and the Nonradioactive Dangerous Waste Landfill exceeded a critical mean value. These two sites will be monitored under assessment programs in FY 2009.

**Assessment** (or final status compliance). If the detection monitoring results indicate a statistically significant change in chemistry, then an assessment or compliance phase of monitoring begins.

**Corrective Action** (via administrative order for interim status sites or during final status). If the source of the contamination is determined to be the RCRA unit and the concentration exceeds applicable limits, then Washington State Department of Ecology (Ecology) may require corrective action. Groundwater is monitored to determine if the corrective action is effective.

***The DOE sampled 865 wells during FY 2008. Chromium, nitrate, and tritium are constituents most frequently analyzed.***

In fiscal year (FY) 2008, workers sampled 865 monitoring wells and 297 shoreline aquifer tubes to determine the distribution and movement of contaminants. Many of the wells and some of the aquifer tubes were sampled multiple times during the year.

A total of 3,968 samples of Hanford Site groundwater were analyzed for chromium, 2,146 for nitrate, and 1,409 for tritium. Other constituents frequently analyzed include gross beta (1,139), technetium-99 (1,068), uranium (994), gross alpha (933), and carbon tetrachloride (835). These totals include results for routinely sampled groundwater wells, pump-and-treat operational samples, and aquifer tube samples.

## Items of Interest

This section briefly describes some of the high-priority groundwater topics for FY 2008.

***The DOE is focusing remediation efforts on activities that protect the Columbia River.***

***River Corridor Baseline Risk Assessment.*** To support the decision-making process for final CERCLA remedial actions within the Columbia River Corridor, the DOE is conducting a CERCLA remedial investigation including a baseline risk assessment for the River Corridor portion of the Hanford Site. The risk assessment consists of three components: the 100 Area and 300 Area Component, the Inter-Area Component, and the Columbia River Component. The 100 Area and 300 Area Component and the Inter-Area Component will be integrated with groundwater into a series of final CERCLA remedial investigation reports for the operational areas of the River Corridor.

***Systematic Planning for the 100 Area.*** A systematic planning process uses a common sense, graded approach to ensure that the level of detail in planning is commensurate with the importance of the work being planned. The DOE, U.S. Environmental Protection Agency (EPA), Ecology, Tribal Nations, and stakeholders initiated the systematic planning process for the 100 Area in FY 2008. Using this process, the DOE is preparing a work plan for a remedial investigation and feasibility study to support selection of a final remedy under CERCLA for source and groundwater operable units in the 100 Area. The work plan will document how decisions are made and specify collection details for required data. It also

will describe the procedures for evaluating cleanup alternatives and identifying the preferred remedy.

***100-KR-4 Pump-and-Treat Expansion.*** The DOE installed new extraction and injection wells and constructed a new treatment system with a designed treatment capacity of 2,271 L/min. When it begins to operate in FY 2009, the expansion will allow the pump-and-treat for hexavalent chromium to capture more of the plume around the 116-K-2 Trench.

***100-N Apatite Barrier.*** Workers conducted a second round of injections of apatite-forming chemicals into a line of groundwater wells along the 100-N Area shoreline in FY 2008. Strontium-90 concentrations initially increased in many wells, but then declined as the remediation began to take effect. Tests are also being conducted to emplace apatite into the vadose zone by surface infiltration.

***100-HR-3 Characterization and Testing.*** The DOE continued characterization and research in the 100-D and 100-H Areas in FY 2008. The objectives were to characterize the chromium plume between 100-D and 100-H Areas; locate the source of the chromium plume in southern 100-D Area; characterize deep chromium contamination; test biostimulation, an in situ remediation method for chromium in the aquifer; test nanometer-size iron injection, a method to increase effectiveness of the redox barrier in 100-D Area; and test electrocoagulation, a water-treatment process.

***In FY 2008, the DOE, EPA, and Ecology signed a final record of decision for the 200-ZP-1 Operable Unit.***

***200-ZP-1 Record of Decision.*** In September 2008, the DOE, EPA, and Ecology (Tri-Parties) signed a final record of decision for groundwater remediation in the 200-ZP-1 Operable Unit. The selected remedy combines pump-and-treat, monitored natural attenuation, flow-path control, and institutional controls.

***300-FF-5 Studies.*** Scientists continued an aggressive campaign to investigate the uranium plume in the 300 Area in FY 2008. Recent work included updating computer simulations of groundwater flow and uranium transport; conducting a limited field investigation of uranium involving multiple characterization boreholes; updating to the human health and ecological risk assessment; and conducting an assessment of potential remedial action technologies for the 300 Area uranium plume.

***New Aquifer Tubes.*** The DOE installed 139 new aquifer tubes in 61 locations along the Columbia River shoreline from the 100-B/C Area to the 300 Area. The tube locations were chosen to fill gaps in the existing aquifer tube network. The section of the shoreline where the 200 Area tritium plume approaches the river now has 11 new monitoring locations. Early data from the new tubes confirm the known distribution of contaminants in groundwater near the river.

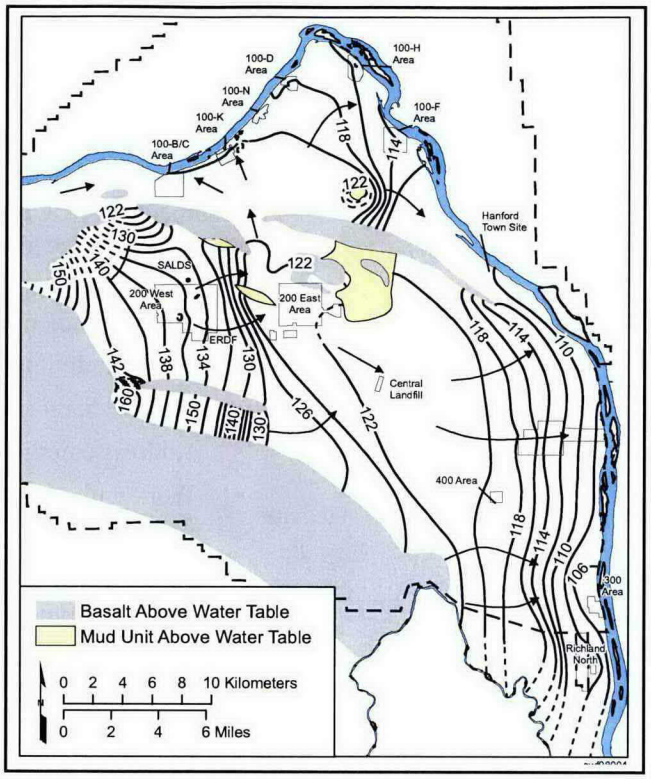
***Tri-Party Well Installation Agreement.*** The Tri-Parties approved an agreement in August 2008 that provides a three-year rolling, prioritized well drilling schedule through calendar year 2011. The Tri-Parties will hold discussions and update this milestone each year.

## Groundwater Flow

General directions of groundwater flow are illustrated on the water-table map for March 2008. The direction of groundwater flow is inferred from water-table elevations, barriers to flow (e.g., basalt or mud units at the water table), and the distribution of contaminants. Groundwater enters the unconfined aquifer from recharge areas to the west and eventually discharges to the Columbia River. Additional

water infiltrates through the vadose zone beneath the Hanford Site. Hydrologists estimate that the total discharge of groundwater from the Site aquifer to the Columbia River is in the range 1.1 to 2.5 $m^3$/sec. This rate of discharge is less than 0.075% of the average flow of the river (~3,400 $m^3$/sec).

The water table beneath the 200 East Area is relatively flat because of the presence of highly permeable sediment of the Hanford formation at the water table. Groundwater enters the vicinity of the 200 East Area from the west and southwest. The flow of water divides, with some flowing to the north through a gap between Gable Butte and Gable Mountain (Gable Gap) and some flowing southeast toward the central part of the Site. This groundwater divide may be located near the central part of the 200 East Area, but its precise location is unknown. Ongoing studies will help determine the direction of groundwater flow in this region. In the southern part of the Hanford Site, groundwater enters the 300 Area from the northwest, west, and southwest.




***This map shows the water table and inferred flow directions in March 2008.***

The natural pattern of groundwater flow was altered during the Hanford Site's operating years by water-table mounds. The mounds were created by the discharge of large volumes of wastewater to the ground and were present in each reactor area and beneath the 200 Area. Since effluent disposal decreased significantly in the 1990s, these mounds have dissipated in the reactor areas and have declined considerably in the 200 Area. Currently, wastewater is discharged to the ground at the State-Approved Land Disposal Site, north of the 200 West Area (67.8 million liters in 2008), and at the Treated Effluent Disposal Facility, east of the 200 East Area (2.76 million liters).

Groundwater flow in the unconfined aquifer is currently altered where extraction or injection wells are used for pump-and-treat systems. Extraction wells in the 100-K, 100-D, 100-H, and 200 West Areas capture contaminated water from the surrounding areas. Water flows away from injection wells, which are upgradient of the contaminant plumes, so the injection increases the hydraulic gradient toward the extraction wells.

A confined aquifer occurs within sand and gravel of the lowest sedimentary unit of the Ringold Formation. It is confined between basalt and the lower mud unit. The unconfined aquifer does not extend east of the 200 East Area due to the presence of Ringold Formation mud units at the water table (shaded tan on the water-table map), so the Ringold Formation confined aquifer is the uppermost aquifer in this area. Beneath the Ringold Formation confined aquifer is the upper basalt-confined aquifer, which exists mainly in the Rattlesnake Ridge interbed, the uppermost widespread sedimentary interbed between basalt flows. Groundwater within these confined aquifers is influenced by a residual recharge mound in the vicinity of the B Pond. Several wells north and east of the 200 East Area have shown evidence of intercommunication between the upper basalt-confined aquifer and the overlying aquifers. The intercommunication has been attributed to erosion of the upper Saddle

Mountains Basalt and a downward hydraulic gradient. Since an upward gradient exists elsewhere in the 200 East Area/Gable Gap region, the upper basalt-confined aquifer likely discharges to the overlying aquifers, especially within Gable Gap where the Elephant Mountain Basalt was removed by erosion.

## Groundwater Monitoring and Remediation

***The sampling and analysis of groundwater provides data to help characterize the nature, potential fate, and transport of contaminants in the environment.***

Some Hanford Site contaminants have moved downward from waste sites, through the vadose zone, into the groundwater, and then toward the Columbia River. Sampling groundwater helps determine how the contaminants move through the environment. The DOE works with regulatory agencies (e.g., the EPA and Ecology) to make cleanup decisions based on sound technical information.

The DOE has developed a plan with steps for cleaning up groundwater and the vadose zone. Key elements include the following.

- Continue to implement remedies that are working.
- Gather characterization data to help make informed decisions.
- Address emerging problems.
- Work with regulatory agencies to make remediation decisions.
- Identify new cleanup technologies.
- Continue to monitor groundwater to detect emerging problems and determine how well remedies are working.

Final groundwater cleanup remedies have been selected for two portions of the Hanford Site: the 200-ZP-1 and 1100-EM-1 Operable Units. Interim remedial actions are underway in other portions of the site: the 100-KR-4, 100-NR-2, 100-HR-3, 200-UP-1, and 300-FF-5 Operable Units. Records of decision for groundwater cleanup have not yet been established for the remaining portions of the site (the 100-BC-5, 100-FR-3, 200-BP-5, and 200-PO-1 Operable Units) because groundwater

**Major Groundwater Contaminants on the Hanford Site.**

| Contaminant | Primary Locations | Plume Area ($km^2$) | Drinking Water Standard | Remediation in Place? | Mobility and Half-Life |
|---|---|---|---|---|---|
| Carbon Tetrachloride | 200-ZP-1 | 11.2 | 5 µg/L | Yes | Mobile (denser than water) |
| Chromium | 100-KR-4, 100-HR-3 | 2.1 | 100 µg/L | Yes | Mobile (hexavalent) |
| Cyanide | 200-BP-5 | 0.3 | 200 µg/L | No | Mobile |
| Iodine-129 | 200-BP-5, 200-PO-1, 200-UP-1 | 65.5 | 1 pCi/L | No | Mobile; 15.7 million years |
| Nitrate (as $NO_3$) | 100-FR-3, 200 Area | 36.3 | 45 mg/L | No | Mobile |
| Strontium-90 | 100-NR-2, 200-BP-5 | 2.2 | 8 pCi/L | Yes, 100-NR-2 | Moderate; 28.8 years |
| Technetium-99 | 200-BP-5, 200-UP-1 | 2.4 | 900 pCi/L | Yes, 200-UP-1 | Mobile; 211,000 years |
| Trichloroethene | 100-FR-3, 200-ZP-1 | 0.7 | 5 µg/L | Yes, 200-ZP-1 | Mobile |
| Tritium | 200 Area, 300-FF-5 | 127 | 20,000 pCi/L | No | Mobile; 12.3 years |
| Uranium | 200-UP-1, 200-BP-5, 300-FF-5 | 1.5 | 30 µg/L | Yes, 200-UP-1 | Moderate; 246,000 years (U-234), 4.5 billion years (U-238) |
| Combined plumes | | 183 | | | |

| Groundwater Remediation. | | |
|---|---|---|
| **Remedial Action Site** | **Dates Active** | **Progress from Start to September 2008** |
| 100-K Area - 100-KR-4 Pump-and-Treat System | 1997-present | Decreases chromium to river; 330 kg removed. System being expanded. |
| 100-K Area - KW Pump-and-Treat System | 2007-present | Decreases chromium to river; 31 kg removed. System being expanded. |
| 100-N Area - 100-NR-2 Pump-and-Treat System | 1995-2006 | 1.8 Ci of strontium-90 removed |
| 100-N Area - Apatite Barrier | 2006-present | Test injections of low- and high-concentration solutions; apatite barrier beginning to form |
| 100-D Area - 100-HR-3 Pump-and-Treat System | 1997-present | Decreases chromium to river; 287 kg removed |
| 100-D Area – 100-DR-5 Pump-and-Treat System | 2004-present | Decreases chromium to river; 211 kg removed |
| 100-D Area - In Situ Redox | 1999-present | Decreases chromium concentrations downgradient of barrier. Showing breakthrough; amendments being tested. |
| 100-H Area - 100-HR-3 Pump-and-Treat System | 1997-present | Decreases chromium to river; 51 kg removed. |
| 200 West Area - 200-ZP-1 Pump-and-Treat System | 1994-present | Prevents high-concentration portion of carbon tetrachloride plume from spreading; 11,415 kg removed. System being expanded to implement final ROD. |
| 200 West Area - Soil-Vapor Extraction | 1992-present | Reduces carbon tetrachloride movement to groundwater; 79,400 kg removed from vadose zone. |
| 200 West Area - WMA T Pump-and-Treat System | 2007-present | Removes technetium-99 from the aquifer. 23.8 g (0.4 Ci) removed. |
| 200 West Area - 200-UP-1 Pump-and-Treat System | 1994-2005<br>2007-present | Decreases lateral migration of contaminants; 141.6 g technetium-99 (2.4 Ci) and 218.2 kg of uranium removed. |
| 200 West Area - WMA S-SX Pump-and-Treat System | 2003-present | Decreases technetium-99 concentrations; 0.38 g (0.0064 Ci) removed. |
| 300 Area - 300-FF-5 Natural Attenuation | ongoing | Trichloroethene concentrations in upper aquifer below target level; uranium concentrations above target level |
| 1100-EM-1 Natural Attenuation | complete | Trichloroethene concentrations below 5 µg/L since 2001 |

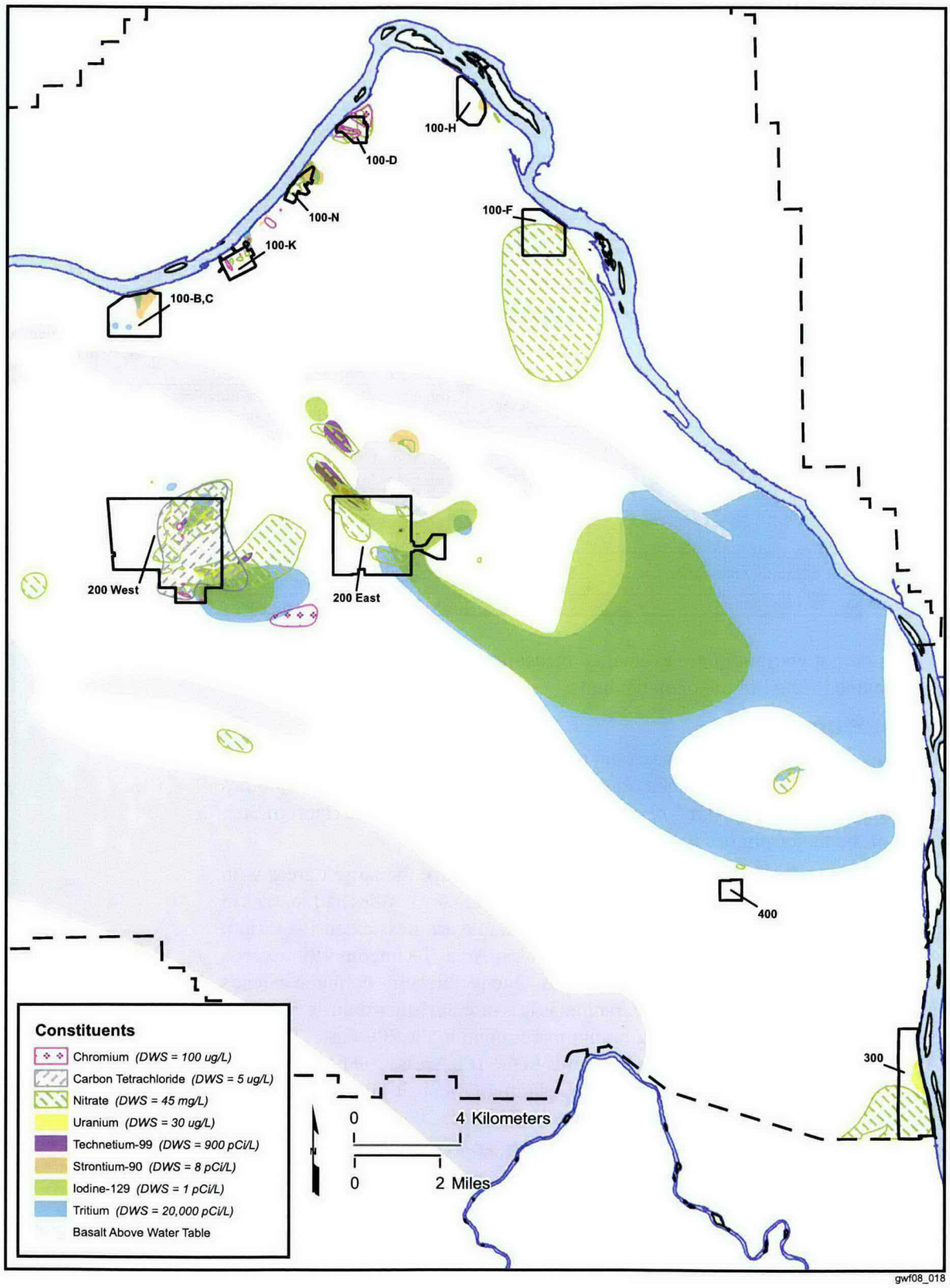
conditions do not warrant interim remedial measures. However, final remedies are being developed for all of the operable units.

## Sitewide Plumes

The map on page xviii shows the extent of eight groundwater contaminant plumes in the upper part of the unconfined aquifer. The footprint of the combine plumes occupies approximately 183 km$^2$, or about 12% of the total area of the Hanford Site. The area of the major plumes is declining gradually.

Of the radionuclide plumes, tritium and iodine-129 have the largest areas with concentrations above drinking water standards. The dominant plumes had sources in the 200 East Area and extend toward the east and southeast. Less extensive tritium and iodine-129 plumes also are present in 200 West Area. Technetium-99 exceeds its standard in the 200 East and 200 West Areas. One technetium-99 plume extends northward, beyond the 200 East Area. Uranium is less mobile than tritium, iodine-129, or technetium-99; plumes containing uranium are found in the 200 East, 200 West, and 300 Areas. Strontium-90 exceeds standards in the 100 Areas, 200 East Area, and beneath the former Gable Mountain Pond. Cesium-137, cobalt-60, and plutonium exceed drinking water standards in only a few wells in the 200 East Area.

Nitrate is a widespread chemical contaminant in Hanford Site groundwater; plumes originate from the 100 and 200 Areas and from offsite industry and agriculture. Carbon tetrachloride is the most widespread organic contaminant on the Hanford Site, forming a large plume beneath the 200 West Area. Other organic contaminants include chloroform (found in 200 West Area) and trichloroethene. The 100-F Area has a plume of trichloroethene and the 100-K Area has one well that exceeded the trichloroethene standard. Wells completed in a fine-grained layer beneath the 300 Area also detected trichloroethene at levels above the drinking water standard. Chromium at levels




***This map shows the distribution of the major contaminant plumes at concentrations above the drinking water standard during FY 2008 in the upper part of the unconfined aquifer.***

not exceed critical mean values, but specific conductance in one well is very close to the critical mean.

## 200-PO-1 Operable Unit

This operable unit encompasses the southern portion of the 200 East Area and a large region to the east and southeast that is contaminated with plumes of tritium and iodine-129. Concentrations of tritium continued to decline as the plume attenuates naturally because of radioactive decay and dispersion. Nitrate forms a large plume but mostly at levels below the drinking water standard. Other contaminants include strontium-90 and technetium-99, but these are limited to smaller areas.

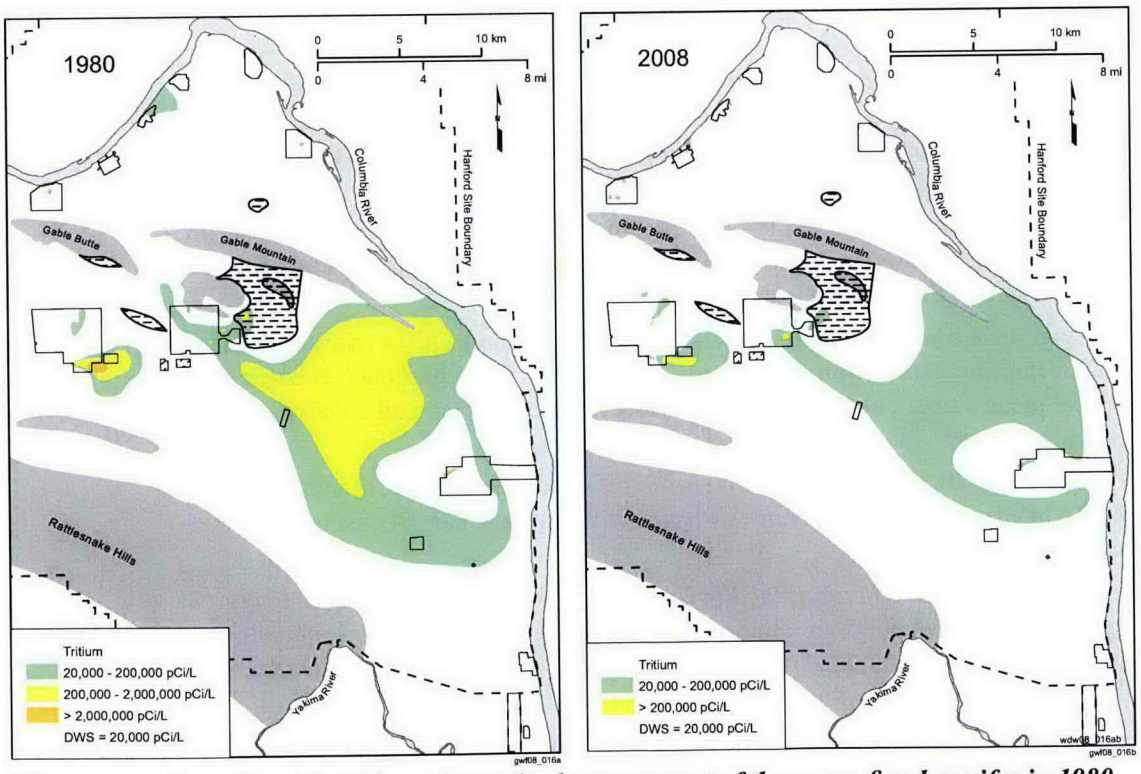
***The PUREX cribs contributed to plumes of iodine-129, nitrate, and tritium. Nitrate and tritium concentrations are generally declining.***

During FY 2008, the remedial investigation/feasibility study process generated a work plan. The document includes a sampling and analysis plan for routine groundwater monitoring of wells and a characterization sampling and analysis plan.

Groundwater is monitored at eight regulated units in the 200-PO-1 Operable Unit. Water supply wells in the 400 Area, which falls within the footprint of the 200-PO-1 Operable Unit, also are monitored.

***Integrated Disposal Facility.*** This facility will be an expandable, lined, RCRA-compliant landfill that will be used for disposal of low-level radioactive waste and hazardous waste. Until the facility begins to operate, results from semiannual monitoring will be added to the background data set.

***PUREX Cribs.*** The 216-A-10, 216-A-36B, and 216-A-37-1 Cribs are monitored jointly under a RCRA interim status assessment program, CERCLA, and AEA. The




***These maps show site-wide tritium plumes in the upper part of the unconfined aquifer in 1980 and 2008. Concentrations in the core of the plume have decreased over the years and the south margin is no longer spreading.***

cribs have contributed to widespread contaminant plumes in the area, including nitrate, tritium, and iodine-129. The nitrate and tritium plumes are generally attenuating throughout most of their area.

***Waste Management Area A-AX.*** RCRA assessment monitoring continued in FY 2008. Technetium-99 concentrations continued to exceed the drinking water standard (900 pCi/L) in two wells. A new downgradient well was installed in FY 2008 to replace two wells that had corroded, and were decommissioned.

***216-A-29 Ditch.*** The groundwater beneath this site continued to be monitored as required by RCRA interim status detection regulations, with no indication that it has affected groundwater quality adversely. Specific conductance remains elevated in three downgradient wells, but is consistent with regional groundwater chemistry.

***216-B-3 Pond.*** The groundwater beneath this site continued to be monitored as required by RCRA interim status detection regulations, with no indication that it has affected groundwater quality adversely.

***200 Area Treated Effluent Disposal Facility.*** A state waste discharge permit governs groundwater sampling and analysis in the three monitoring wells at this facility. No permit criteria for constituents in groundwater were exceeded in FY 2008. Because no unconfined aquifer exists beneath the facility, groundwater monitoring wells are installed in the locally confined aquifer below the Ringold Formation lower mud unit.

***Nonradioactive Dangerous Waste Landfill.*** This RCRA site is located in the 600 Area, within the footprint of the 200-PO-1 Operable Unit regional plume. Interim status detection monitoring continued FY 2008. Total organic carbon concentrations in one downgradient well exceeded the critical mean value in August 2008 and in a confirmatory sample in October 2008. Groundwater will be monitored under an assessment program in FY 2009.

***Solid Waste Landfill.*** This facility is adjacent to the Nonradioactive Dangerous Waste Landfill and is regulated under state solid waste regulations. As in previous years, some downgradient wells showed higher chemical oxygen demand, chloride, coliform bacteria, specific conductance, sulfate, total organic carbon, and lower pH than upgradient wells. Some of these constituents may be related to past disposal of sewage materials to the landfill.

***400 Area Water Supply Wells.*** Three water supply wells provide drinking water and emergency supply water for the 400 Area. Because the 400 Area is in the path of the site-wide tritium plume, the wells are routinely monitored for tritium. Tritium concentrations in all samples were below the drinking water standard in FY 2008.

## 300-FF-5 Operable Unit

***The DOE is investigating remediation methods for uranium in the 300 Area.***

This operable unit includes three geographic regions: the 300 Area, the 618-11 Burial Ground region, and the 618-10 Burial Ground/316-4 Cribs region. The operable unit is currently regulated under an interim record of decision that calls for groundwater monitoring and institutional controls on the use of groundwater. In FY 2008, the DOE installed 35 wells to characterize uranium geochemistry and mobility, and 3 wells to define trichloroethene distribution.

Recent work in this operable unit included updating computer simulations of groundwater flow and uranium transport; conducting a limited field investigation of uranium involving multiple characterization boreholes; updating to the human health and ecological risk assessment; and conducting an assessment of potential remedial

### Confined Aquifers

Although most of the Hanford Site's groundwater contamination is in the unconfined aquifer, the DOE monitors wells in deeper aquifers because of the potential for downward migration of contamination and the potential migration of contamination off Site through the basalt confined aquifer. No evidence of offsite migration via the confined aquifer has been detected.

*Technetium-99, cyanide, and nitrate were elevated in a new basalt-confined well. The contamination migrated down an old, poorly-constructed well nearby, in the past.*

The Ringold Formation confined aquifer occurs within fluvial sand and gravel comprising the lowest sedimentary unit of the Ringold Formation. It is confined below by basalt and above by the Ringold lower mud unit. While effluent disposal was occurring at the B Pond System, mounding within the unconfined aquifer in this area led to downward migration of groundwater into the Ringold Formation confined aquifer. During FY 2008, seven wells were sampled that are completed in the Ringold Formation confined aquifer. No contaminants exceeded primary drinking water standards.

Within the upper basalt-confined aquifer system, groundwater occurs within basalt fractures and joints, interflow contacts, and sedimentary interbeds. In FY 2008, six basalt-confined aquifer wells were sampled. Tritium continued to be detected at low levels in some basalt-confined wells. One elevated tritium concentration near the 200 East Area is associated with intercommunication between the upper basalt-confined aquifer and the overlying unconfined aquifer. Iodine-129, strontium-90, gamma-emitting isotopes, and uranium isotopes were not detected above the minimum detection limits in the upper basalt-confined aquifer. One new well monitoring the upper basalt-confined aquifer in the northwestern part of the 200 East Area shows contamination with technetium-99, cyanide, and nitrate. Migration of high-salt waste from the vadose zone or unconfined aquifer via an older, poorly-constructed well nearby is responsible for this contamination. The old well has been sealed.

## Shoreline Monitoring

The DOE monitors groundwater near the Columbia River via aquifer tubes, which are small diameter, flexible tubes that are implanted in the shallow aquifer and natural seep points or springs.

*The DOE samples groundwater near the Columbia River via aquifer tubes and springs.*

Concentrations of strontium-90 continued to exceed the 8 pCi/L drinking water standard in aquifer tubes in the 100-B/C, 100-N, and 100-H Areas. Levels exceed the 1,000 pCi/L derived concentration guide in 100-N Area tubes, reaching 75,000 pCi/L in one tube in July 2008. This high concentration represented a brief spike in response to the nearby injection of apatite-forming chemicals.

Tritium concentrations exceeded the 20,000 pCi/L drinking water standard in one tube at the upstream end of 100-D Area. The source is believed to be the 100-N Area plume. Tritium also exceeded the standard in springs and aquifer tubes at the Hanford townsite.

Uranium concentrations exceed the 30 μg/L drinking water standard in aquifer tubes and springs in the 300 Area.

Hexavalent chromium concentrations exceeded the 100 μg/L drinking water standard in 100-D Area aquifer tubes. Concentrations in aquifer tubes or springs exceeded the 10 μg/L aquatic standard in the 100-B/C, 100-K, 100-D, 100-H, and 100-F Areas.

Nitrate concentrations exceeded the 45 mg/L drinking water standard in aquifer tubes in the 100-K, 100-N, and 100-H Areas. An aquifer tube in the southern 300 Area also exceeded the standard; the source of this nitrate is a plume from sources off the Hanford Site.

Trichloroethene is detected in several aquifer tubes in the 300 Area and continued to exceed the 5 μg/L drinking water standard in some tubes that monitor a fine-grained unit.

## Vadose Zone

Vadose zone activities in FY 2008 included leachate monitoring, soil-vapor extraction and monitoring, surface geophysics, and borehole geophysical logging.

***Leachate Monitoring at Environmental Restoration Disposal Facility.*** This facility is used for disposal of radioactive and mixed waste generated during waste management and remediation activities at the Hanford Site. Leachate is collected and sent to the Effluent Treatment Facility. The composite leachate samples contained detectable concentration of common metals, anions, and mobile radionuclides. Constituents that were generally increasing in concentration include gross alpha and total uranium. Gross alpha concentrations in groundwater show a slight long-term decrease and gross beta concentrations show an increase in most downgradient wells. Gross alpha and gross beta in groundwater will be closely monitored in the future.

***Leachate and Soil-Gas Monitoring at the Solid Waste Landfill.*** Leachate is sampled and tested quarterly. Concentrations in the past year were similar to previous concentrations and did not identify any areas of concern. Soil gas is monitored quarterly to determine concentrations of oxygen, carbon dioxide, methane, and several key volatile organic compounds. Results were consistent with previous years. Contaminants of concern were near or below detection limits.

***Soil-Vapor Extraction.*** This remedial action is being used to remove carbon tetrachloride from the vadose zone in the 200 West Area. As of September 2008, ~79,400 kg of carbon tetrachloride have been removed from the vadose zone since extraction operations started in 1991.

***As of September 2008, ~79,400 kg of carbon tetrachloride have been removed from the vadose zone since extraction operations started in 1991.***

***Tank Farm Vadose Zone Activities.*** The Vadose Zone Integration Program is responsible for implementing the Tank Farm RCRA Corrective Action Program through field characterization, laboratory analyses, technical analyses, risk assessment for past tank leaks, and application of interim measures that will reduce the threat from contaminants until permanent solutions can be found. In FY 2008, the Vadose Zone Integration Program installed several direct push boreholes for soil sampling and geophysical logging in the C and TY Tank Farms, completed surface geophysical surveys at Waste Management Area TX-TY, and conducted a well-to-well geophysical survey of the SX Tank Farm. An interim surface barrier was completed over a portion of the T Tank Farm to reduce the infiltration of precipitation through the remnants of a 1973 tank leak.

## Well Installation, Maintenance, and Decommissioning

***During FY 2008, the DOE installed 113 new wells and decommissioned 103 wells.***

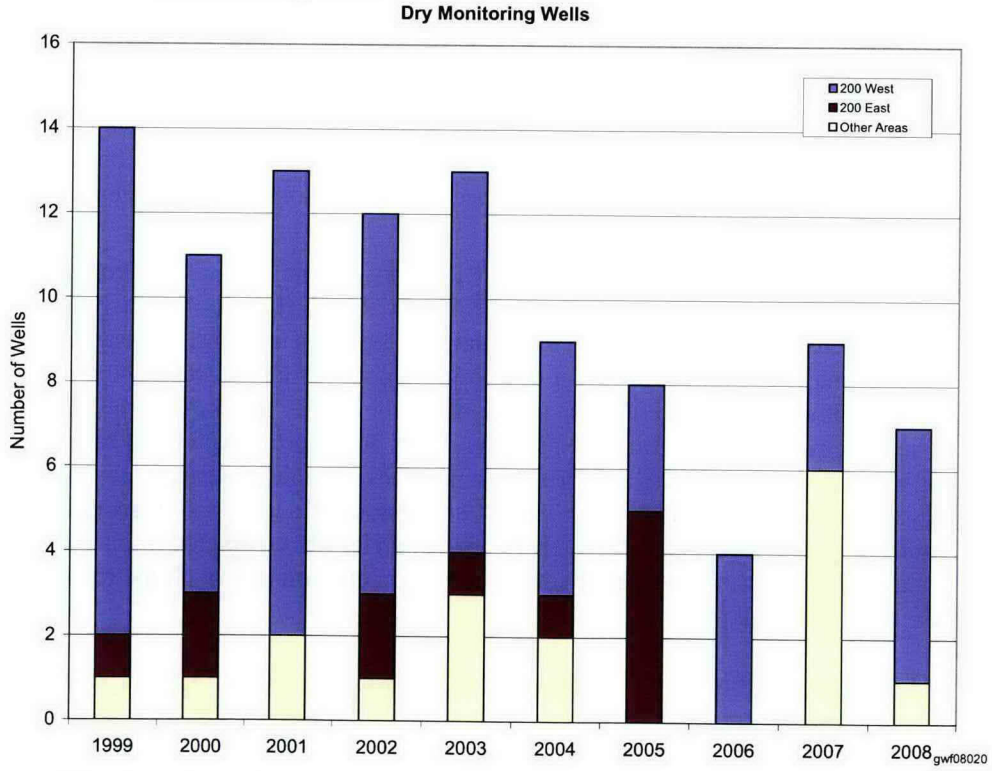
The DOE installs new wells when needed for monitoring or characterization, maintains wells to repair problems, and decommissions wells that could no longer be used. Ecology, EPA, and DOE worked together to develop a prioritized list of new

wells needed to meet requirements of various groundwater monitoring regulations. In FY 2008, the DOE installed 113 new wells.

During FY 2008, 386 temporary characterization boreholes were installed around the Hanford Site to support various projects. The temporary boreholes are installed for subsurface characterization of radiological constituents, volatile organics (e.g., carbon tetrachloride), or hydrogeologic property determination (e.g., moisture, grain size distribution). While typically installed to characterize the vadose zone, borings can be drilled to groundwater to obtain a one-time sample and then be decommissioned.

| Wells Installed in FY 2008. | |
|---|---|
| **Location (Facility)** | **Number of New Wells** |
| 100-FR-3 | 1 |
| 100-HR-3 Horn | 15 |
| 100-HR-3-D | 4 |
| 100-KR-4 | 27 |
| 100-NR-2 | 6 |
| 200-BP-5 | 8 |
| 200-BP-5 (LERF) | 1 |
| 200-PO-1 (WMA A-AX) | 1 |
| 200-UP-1 | 4 |
| 200-UP-1 (216-S-10) | 2 |
| 200-UP-1 (ERDF) | 2 |
| 200-ZP-1 | 3 |
| 200-PW-1 (soil-vapor) | 1 |
| 300-FF-5 | 38 |
| Total | 113 |

Approximately 9,695 unique well identification numbers have been identified within the Hanford Site. These include all wells, characterization boreholes, aquifer tubes, soil gas probes, piezometers, or other subsurface installations. To date, 4,272 (~44%) of these have been either administratively removed from the well inventory or decommissioned (sealed with grout). Wells are decommissioned when they are no longer needed; are in poor condition; are in the path of intended remediation or construction activities; or pose an environmental, safety, or public health hazard. The DOE maintains a list of wells that are candidates for decommissioning. All candidate wells must be reviewed and approved by potential well users prior to decommissioning. During FY 2008, a total of 3,384 unique well identification numbers were documented as "in use." A total of 103 wells were physically decommissioned during FY 2008 and 221 temporary boreholes were administratively decommissioned by records management.




***This chart shows the number of monitoring wells that went dry each year since 1999. Most of the wells were in the 200 West Area, where the water table declined the most.***

Staff performed maintenance on 275 wells in FY 2008. Surface maintenance includes labeling wells, maintaining well caps, and repairing surface casing, wiring, or pump-discharge fittings. Subsurface tasks include repairing and replacing sampling pumps, performing camera surveys, retrieving pumps and equipment, and replacing tubing.

## Continued Monitoring

The DOE will continue to monitor groundwater to meet the requirements of AEA, CERCLA, RCRA, and DOE Orders. During ongoing groundwater remediation, the groundwater project will monitor, assess, and report on activities at groundwater operable units. Both the unconfined and upper-confined aquifers are monitored and data are maintained and managed in a centralized database. Monitoring well locations, frequencies, and analytical constituents will continue to be documented each year. Water-level monitoring will continue to be performed to characterize groundwater flow and to determine the impact of Hanford Site operations on the flow system.

Groundwater monitoring remains a part of the Hanford Site baseline throughout the cleanup mission and will remain a component of long-term stewardship after remediation is completed.

Details about the Hanford Site Groundwater Remediation Project can be found online at http://www.hanford.gov/cp/gpp/.

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# 1.0 Introduction

***M. J. Hartman***

The Hanford Site, part of the U.S. Department of Energy's (DOE) nuclear weapons complex, encompasses ~1,500 km$^2$ in southeastern Washington State. The Columbia River flows through the Site. The federal government acquired the Hanford Site in 1943 and until the 1980s used it to produce plutonium for national defense. Management of waste associated with plutonium production has been a major activity throughout the Site's history and continues today at a much reduced scale. Beginning in the 1990s, the DOE has focused on cleaning up the Site.

***The DOE's groundwater strategy focuses on protecting groundwater from contaminants, monitoring groundwater conditions, and cleaning up contaminated groundwater.***

The DOE is committed to protecting the Columbia River from the Site's contaminated groundwater. Groundwater is the primary exposure route for Site contaminants to reach human and environmental receptors. DOE/RL-2007-20, *Hanford Integrated Groundwater and Vadose Zone Management Plan*, lays out steps for addressing groundwater and vadose zone contamination. The DOE developed the plan in consultation with the U.S. Environmental Protection Agency (EPA) and the Washington State Department of Ecology (Ecology). The primary elements associated with managing the Hanford Site's groundwater and vadose zone are (a) to protect the Columbia River and groundwater; (b) to develop a cleanup decision process, and (c) to attain final cleanup.

***Protect the Columbia River and groundwater***. Many actions have already been taken to address principal threats to the Columbia River and groundwater. These actions include the following:

- Cease discharge of all unpermitted liquids in the central Hanford Site
- Remediate the former liquid waste sites in the 100 and 300 Areas to reduce potential for future contamination to groundwater
- Contain groundwater plumes and reduce mass of primary contaminants through remedial actions such as pump-and-treat.

***Develop a process for cleanup decisions***. Final decisions will be based on processes outlined in *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* (CERCLA) and/or *Resource Conservation and Recovery Act of 1976* (RCRA). The following five key elements will support final decisions:

- Gather sufficient characterization data, focusing on waste sites with deep contamination that post a future risk to groundwater

***This report is designed to meet the following objectives.***

- ***Provide a comprehensive report of groundwater conditions on the Hanford Site.***
- ***Fulfill the reporting requirements of RCRA, CERCLA, AEA, and Washington Administrative Code.***
- ***Summarize the results of groundwater monitoring conducted to assess the effects of interim remedial actions conducted under CERCLA.***
- ***Describe the results of monitoring the vadose zone.***
- ***Summarize the installation, maintenance, and decommissioning of Hanford Site monitoring wells.***

- Evaluate the performance of early actions (waste site remediation along the River Corridor and groundwater interim actions) to help guide future cleanup
- Identify cleanup goals for waste sites that support long-term groundwater remediation
- Identify new technologies to reduce mobility of deep contamination and limit its movement to groundwater
- Improve integration of cleanup decisions for waste sites and groundwater.

***Attain final cleanup***. The DOE, EPA, and Ecology are committed to completing cleanup of past-practice waste sites by September 2024. Substantial progress has been made toward cleanup of the 100 and 300 Areas. Strategies used for making final decisions in the 100 and 300 Areas will provide a basis for attaining similar final decisions for the 200 Area.

Groundwater monitoring fulfills a variety of state and federal regulations, including the *Atomic Energy Act to 1954* (AEA), CERCLA, RCRA, and *Washington Administrative Code*.

## 1.1 Purpose and Scope

This document presents results of groundwater monitoring to meet the requirements of the AEA, RCRA, and those CERCLA groundwater operable units where cleanup decisions have not yet been made (Table 1.0-1). Other CERCLA groundwater operable units have independent reporting requirements and this document summarizes results reported elsewhere. This report also summarizes vadose zone monitoring and well installation activities. The report covers the period from October 1, 2007, through September 0, 2008 (i.e., fiscal year [FY] 2008). Appendix A lists supporting information for CERCLA monitoring. Appendix B contains tables and figures that support RCRA and other facility monitoring. Table 1.0-2 lists the status of RCRA monitoring for each monitored unit in FY 2008.

Background information, including descriptions of regulatory requirements, waste sites, analytical methods, regional geology, and statistics is published separately in a companion volume, PNNL-13080, *Hanford Site Groundwater: Settings, Sources, and Methods*, and in the most recent update, which was provided in PNNL-13788, *Hanford Site Groundwater Monitoring for Fiscal Year 2001*, Appendix C.

***During FY 2008, staff sampled 865 wells and 297 aquifer tubes for radiological and chemical constituents.***

## 1.2 Groundwater Monitoring

Waste sites are grouped into source operable units, and the groundwater is divided into groundwater operable units. The concept of operable units is to group the waste sites into manageable components for investigation and to prioritize the cleanup work. The groundwater operable units do not cover the entire Hanford Site. To provide scheduling, data review, and interpretation for the entire Site, groundwater staff have defined informal groundwater interest areas that include the groundwater operable units and intervening regions. Figure 1.0-1 illustrates these interest areas and the operable unit boundaries.

Various documents (i.e., monitoring plans or sampling and analysis plans) define which wells to sample, how frequently, and which constituents to analyze.

These choices are based on the data needs for various monitoring purposes, such as complying with regulations, evaluating the performance of remediation, defining plumes and concentration trends, or identifying emerging problems.

During FY 2008, Hanford Site staff sampled 865 wells, approximately the same number as in FY 2007. Staff sampled 297 aquifer tubes in FY 2008, a 50% increase from FY 2007. Many of the sites were sampled multiple times, for a total of 2,601 sampling trips. These numbers do not include special groundwater sampling associated with remediation and research (e.g., treatability tests).

Most of the monitoring wells on the Hanford Site are screened near the top of the unconfined aquifer. In most regions, the shallow part of the aquifer is the most contaminated. Contaminant plume maps and plume area calculations in this report are based on data from the top of the aquifer. Some contaminants, most notably carbon tetrachloride, are denser than water and can be more widespread deeper in the aquifer. Downward hydraulic gradients also may increase contamination at depth. Studies of contaminant distribution with depth are beginning to be conducted for some plumes, especially those in the 200 West Area.

***Tritium, nitrate, and iodine-129 are the most widespread contaminants on the Hanford Site.***

Chromium (total or hexavalent) was the most frequently analyzed constituent. Anions, tritium, gross alpha, gross beta, iodine-129, metals, technetium-99, strontium-90, and volatile organic compounds were other commonly analyzed constituents (Table 1.0-3).

Tritium, nitrate, and iodine-129 are the most widespread contaminants associated with past Hanford Site operations. Figures 1.0-2 through 1.0-4 show their distribution in the upper unconfined aquifer. The most prominent portions of these plumes originated at waste sites in the 200 Area and spread toward the southeast. Nitrate and tritium also had significant sources in the 100 Area.

Table 1.0-4 lists maximum concentrations of selected groundwater contaminants in each groundwater interest area. Electronic data files accompany this report and include FY 2008 and historical data.

Groundwater monitoring objectives of RCRA, CERCLA, and AEA often differ slightly, and the contaminants monitored are not always the same. For RCRA-regulated units, monitoring focuses on nonradioactive dangerous waste constituents. Radionuclides (source, special nuclear, and by-product materials) may be monitored in some RCRA unit wells to support objectives of monitoring under AEA and/or CERCLA. Please note that pursuant to RCRA, the source, special nuclear, and by-product material components of radioactive mixed waste are not regulated under RCRA and are regulated by the DOE acting pursuant to its AEA authority. Therefore, while this report may be used to satisfy RCRA reporting requirements, the inclusion of information on radionuclides in such a context is for information only and may not be used to create conditions or other restrictions set forth in any RCRA permit.

## 1.3 Shoreline Monitoring

The DOE monitors groundwater quality along the river by collecting samples from aquifer tubes and riverbank seeps (springs). Hydrologists estimate that groundwater currently flows from the Hanford Site aquifer to the Columbia River at a rate between 1.1 and 2.5 $m^3$/sec (PNNL-13447; PNNL-14753). This rate is less than 0.075% of the average flow of the Columbia River, ~3,400 $m^3$/sec.

**Table 1.0-1. Reporting Requirements for Groundwater Monitoring.**

| Operable Unit or Facility | Formal Report | Supplemental Reports or Summaries |
|---|---|---|
| **CERCLA** | | |
| Operable units without RODs (100-BC-5, 100-FR-3, 200-BP-5, 200-PO-1) | This report | Unit manager's meeting presentations |
| Operable units with interim action RODs (100-KR-4, 100-NR-2, 100-HR-3, 200-UP-1, 200-ZP-1) | Interim action annual reports (summarized in this report) | Unit manager's meeting presentations; this report |
| Operable unit with interim action ROD (300-FF-5) | This report | Unit manager's meeting presentations; this report |
| Operable unit with final ROD (1100-EM-1) | This report | None |
| ERDF | Separate annual report covers groundwater and leachate (summarized in this report) | This report |
| **RCRA Units** | | |
| Operating RCRA units (IDF, LERF, LLBG) | This report | Informal quarterly reports |
| Closure RCRA units (116-N-1 and -3; 120-N-1 and -2) | This report | Informal quarterly reports |
| Post-closure RCRA units (116-H-6 and 316-5) | Semiannual reports to Ecology; this report | Informal quarterly reports |
| Interim-status assessment RCRA sites (PUREX Cribs, WMA A-AX, B-BX-BY, S-SX, T, TX-TY, and U) | This report; also occasional assessment reports | Informal quarterly reports |
| Interim-status detection (216-A-29, 216-B-63, 216-S-10 Pond, NRDWL, and WMA C) | This report | Informal quarterly reports |
| **Other Facilities** | | |
| AEA sites (K Basins, 400 Area water supply wells) | This report | Unit manager's meeting presentation |
| SALDS (WAC 173-216) | Separate annual report | This report |
| TEDF (WAC 173-216) | This report | None |
| SWL (WAC 173-304) | This report for groundwater; separate report for leachate and soil gas | None |

AEA = *Atomic Energy Act of 1954*.
CERCLA = *Comprehensive Environmental Response, Compensation, and Liability Act of 1980*.
Ecology = Washington State Department of Ecology.
ERDF = Environmental Restoration Disposal Facility.
IDF = Integrated Disposal Facility (planned).
LERF = Liquid Effluent Retention Facility.
LLBG = low-level burial grounds.
NRDWL = Nonradioactive Dangerous Waste Landfill.
PUREX = Plutonium-Uranium Extraction Plant.
RCRA = *Resource Conservation and Recovery Act of 1976*.
ROD = record of decision.
SALDS = State-Approved Land Disposal Site.
SWL = Solid Waste Landfill.
TEDF = Treated Effluent Disposal Facility.
WAC = *Washington Administrative Code*.
WMA = waste management area.

**Table 1.0-2. Fiscal Year 2008 RCRA Monitoring Status.**

| RCRA Unit | Report Section | FY 2008 Status |
|---|---|---|
| 116-N-1 (1301-N) Facility | 2.4.3.1 | Continued detection* |
| 120-N-1, (1324-NA) 120-N-2 (1324-N) Facilities | 2.4.3.2 | Continued detection;* one new well completed early FY 2009 to replace seasonally dry well. |
| 116-N-3 (1325-N) facility | 2.4.3.3 | Continued detection* |
| 116-H-6 (183-H) Evaporation Basins | 2.6.3 | Corrective action alternative program during interim remedial action. Chromium, nitrate. |
| 216-A-29 Ditch | 2.11.3.4 | Continued detection* |
| 216-B-3 Pond | 2.11.3.5 | Continued detection* |
| 216-B-63 Trench | 2.10.3.2 | Continued detection* |
| 216-S-10 Pond and Ditch | 2.9.3.3 | Continued detection;* three new wells. |
| 316-5 (300 Area) Process Trenches | 2.12.3 | Compliance/corrective action; organics. |
| Integrated Disposal Facility | 2.11.3.1 | Not yet in use; monitoring results added to background data set. |
| LERF | 2.10.3.5 | Two new wells monitor fractured basalt flow-top. DOE and Ecology pursuing agreement for monitoring. |
| LLWMA 1 | 2.10.3.3 | Continued detection* |
| LLWMA 2 | 2.10.3.4 | Continued detection* |
| LLWMA 3 | 2.8.3.1 | Statistical evaluations suspended until upgradient wells installed and background values established. |
| LLWMA 4 | 2.8.3.2 | TOC exceeded critical mean value in August 2008; beginning assessment FY 2009; remaining upgradient wells went dry. |
| NRDWL | 2.11.3.6 | TOC exceeded critical mean value in August 2008; beginning assessment FY 2009. |
| PUREX Cribs | 2.11.3.2 | Continued assessment: nitrate. |
| SST WMA A-AX | 2.11.3.3 | Continued assessment (first determination); new well. |
| SST WMA B-BX-BY | 2.10.3.1 | Continued assessment: nitrate. |
| SST WMA C | 2.10.3.6 | Continued detection* |
| SST WMA S-SX | 2.9.3.2 | Continued assessment: chromium, nitrate. |
| SST WMA T | 2.8.3.3 | Continued assessment: chromium, nitrate. |
| SST WMA TX-TY | 2.8.3.4 | Continued assessment: chromium, nitrate. |
| SST WMA U | 2.9.3.1 | Continued assessment: nitrate. |

* Analysis of RCRA contamination indicator parameters provided no evidence of groundwater contamination with hazardous constituents from the unit.

FY = fiscal year.
LERF = Liquid Effluent Retention Facility.
LLWMA = Low Level Waste Management Area.
NRDWL = Nonradioactive Dangerous Waste Landfill.
PUREX = Plutonium-Uranium Extraction Plant.
RCRA = *Resource Conservation and Recovery Act of 1976.*
SST = single-shell tanks.
TOC = total organic carbon.
WMA = Waste Management Area.

**Table 1.0-3. Number of Groundwater Analyses, Fiscal Year 2008.**

| Constituent | Site Total |
|---|---|
| Chromium (total and hexavalent) | 3,968 |
| Gross alpha | 933 |
| Gross beta | 1,139 |
| Iodine-129 | 485 |
| Nitrate | 2,146 |
| Organics (carbon tetrachloride, trichloroethene) | 835 |
| Plutonium-239/240 | 49 |
| Strontium-90 | 557 |
| Technetium-99 | 1,068 |
| Tritium | 1,409 |
| Uranium | 994 |

## Table 1.0-4. Maximum Concentrations of Selected Groundwater Contaminants in Groundwater Interest Areas, Fiscal Year 2008.

| Contaminant, units (alphabetical order) | DWS (DCG)[a] | 100-BC-5 | | 100-KR-4 | | 100-NR-2 | | 100-HR-3-D | | 100-HR-3-H | | 100-FR-3 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Wells | Aquifer Tubes | Wells | Aquifer Tubes | Wells | Aquifer Tubes | Wells | Aquifer Tubes | Wells | Aquifer Tubes | Wells | Aquifer Tubes |
| Arsenic[b] (filtered) (µg/L) | 10 | | | | 2.59 | | | 4.87 | 0.761 | | | | |
| Arsenic[b] (µg/L) | 10 | | | 8.04 | 2.85 | | | 5 | 0.678 | | | | |
| Carbon tetrachloride (µg/L) | 5 | | | | | | | | | | | | |
| Carbon-14 (pCi/L) | 2,000 (70,000) | | | **6,740** | 349 | 10.7 | | | | | | | |
| Cesium-137 (Ci/L) | 200 (3,000) | | | | | | | | | | | | |
| Chloroform (µg/L) | 100 | | | 0.4 | | 0.91 | | | | | | | |
| Chromium,[b] total (filtered) (µg/L) | 100 | 50.5 | | **3,350** | 79.7 | **172** | 13.2 | **10,500** | **364** | **100** | | 42.5 | 11.7 |
| Chromium,[b] total (µg/L) | 100 | 52.5 | | **3,550** | 72.4 | **493** | 15.7 | **9,970** | **362** | 93.8 | | 51.8 | 17.3 |
| Chromium,[b] hexavalent (filtered) (µg/L) | 100 | | | | | | | **296** | | | | | |
| Chromium,[b] hexavalent (µg/L) | 100 | 54.8 | 46.3 | **3,540** | 80.9 | 87 | 64.9[c] | **39,900** | **422** | **157** | 73.7 | 10.9 | 11.9 |
| cis-1,2-Dichloroethylene (µg/L) | 70 | | | | | | | | | | | | |
| Cobalt-60 (pCi/L) | 100 (5,000) | | | | | | | | | | | | |
| Cyanide (µg/L) | 200 | | | | | | | | | | | | |
| Fluoride (mg/L) | 4 | 0.23 | 0.181 | 0.44 | 0.303 | 0.686 | 0.434 | 0.508 | 0.191 | 0.5 | 0.182 | 0.681 | 0.21 |
| Gross alpha (pCi/L) | 15 | 1.57 | 2.4 | **24.1** | 2.58 | 5.7 | 4.6 | 3.34 | | 4.3 | 3.67 | 12 | 2.9 |
| Gross beta (pCi/L) | 50 | **87** | 40 | **3,000** | 6.96 | **51,000**[d] | **150,000**[d] | **152** | 15 | **57.2** | 24.3 | **51.2** | 6.2 |
| Iodine-129 (pCi/L) | 1 (500) | | | | | | | | | | | | |
| Nitrate (mg/L) | 45 | 39.5 | 22.3 | **139** | **52.7** | **259** | **54** | **116** | 35.4 | 44.3 | **45.6** | **114** | 40.9 |
| Nitrite (mg/L) | 3.3 | 0.414 | | 0.371 | 0.053 | 0.805 | 0.079 | **5.42** | | 0.453 | 0.049 | | 0.039 |
| Plutonium-239/240 (pCi/L) | 1.2[e] (30) | | | | | | | | | | | | |
| Strontium-90 (pCi/L) | 8 (1,000) | **44.7** | **16** | ***1,610*** | 3.3 | ***17,000*** | ***75,000***[d] | 7.7 | 2.56 | **24.8** | **11.6** | **25.8** | 4.4 |
| Technetium-99 (pCi/L) | 900 (100,000) | 11.4 | 45.4 | 63 | | | | 87 | | 31 | | | |
| Tetrachloroethene (µg/L) | 5 | | | | | | | | | | | | |
| Trichloroethene (µg/L) | 5 | | | **7.7** | | | | | | | | **9.7** | |
| Tritium (pCi/L) | 20,000 (2,000,000) | **57,000** | 20,000 | **621,000** | 8,300 | **22,000** | 12,000 | **27,000** | **23,000** | 5,500 | | 15,000 | 920 |
| Uranium (µg/L) | 30 | | | 6.93 | | | | 3.89 | | 8.38 | 2.32 | 17.6 | |

## Table 1.0-4. (cont.)

| Contaminant, units (alphabetical order) | DWS (DCG)[a] | 200-ZP-1 | 200-UP-1 | 200-BP-5 | | 200-PO-1 | | 300-FF-5 | | 1100-EM-1 |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Wells | Wells | Wells | Aquifer Tubes | Wells | Aquifer Tubes | Wells | Aquifer Tubes | Wells |
| Arsenic[b] (filtered) (µg/L) | 10 | **10.8** | 6.19 | **17.4** | | **10.2** | | | 3.07 | |
| Arsenic[b] (µg/L) | 10 | **14.2** | 5.8 | **23.4** | | **10.5** | | | 2.56 | |
| Carbon tetrachloride (µg/L) | 5 | **4,900** | **1,400** | 3.4 | | 1 | | 3.5 | 1.4 | 2.9 |
| Carbon-14 (pCi/L) | 2,000 (70,000) | | 32.9 | 141 | | | | | | |
| Cesium-137 (Ci/L) | 200 (3,000) | | | **1,650** | | | | | | |
| Chloroform (µg/L) | 100 | 32 | 17 | 0.52 | | 0.3 | | 2.1 | 2.8 | |
| Chromium,[b] total (filtered) (µg/L) | **100** | **640** | **823** | **233** | | 47.1 | 3.2 | 90.7 | 7 | 6.6 |
| Chromium,[b] total (µg/L) | **100** | **670** | **846** | **140** | 8.1 | 71.2 | 3.3 | 86.3 | 12.9 | 16.5 |
| Chromium,[b] hexavalent (filtered) (µg/L) | 100 | | | | | | | | | |
| Chromium,[b] hexavalent (µg/L) | 100 | 50 | 61 | 43.2 | 16 | | 3.7 | | | |
| cis-1,2-Dichloroethylene (µg/L) | 70 | | | | | | | **190** | 4.8 | |
| Cobalt-60 (pCi/L) | 100 (5,000) | | | **1,040** [f] | | | | | | |
| Cyanide (µg/L) | 200 | | 4.1 | **7,180** [f] | | | | | | |
| Fluoride (mg/L) | 4 | **4.56** | 0.55 | **107** | 0.316 | **9.09** | 0.16 | **16.7** | 0.717 | 1.24 |
| Gross alpha (pCi/L) | 15 | 8.3 | 8.27 | **1,800** | 1.93 | **30** | 5.03 | **110** | **54** | 7.6 |
| Gross beta (pCi/L) | 50 | **5,200** | **10,400** | **34,000** | 40.6 | **4,400** | 6.32 | **160** | **53** | 9.4 |
| Iodine-129 (pCi/L) | 1 (500) | **37.6** | **37.1** | **5.63** | | **10.4** | | | | |
| Nitrate (mg/L) | 45 | **2,820** | **868** | **17,800**[f] | 28.4 | **127** | 33 | **293** | **52.2**[g] | **307**[g] |
| Nitrite (mg/L) | 3.3 | 0.907 | 0.545 | **18.6** | | 0.552 | | 0.69 | 0.161 | |
| Plutonium-239/240 (pCi/L) | 1.2 [e] (30) | 0.021 | | **27** | | | | | | |
| Strontium-90 (pCi/L) | 8 (1,000) | 3.8 | 2.8 | ***3,740*** | | **20.2** | 1.9 | | | |
| Technetium-99 (pCi/L) | 900 (100,000) | **18,000** | **67,000** | **100,000** [f] | 114 | **8,000** | | 225 | | |
| Tetrachloroethene (µg/L) | 5 | 2.1 | | | | 2.6 | | | 4.7 | |
| Trichloroethene (µg/L) | 5 | **11** | **9.6** | | | 1.7 | | 4.2 | **530** | |
| Tritium (pCi/L) | 20,000 (2,000,000) | **1,200,000** | **290,000** | **170,000** [f] | 13,000 | **650,000** | **35,000** | **940,000** | 9,100 | 1,500 |
| Uranium (µg/L) | 30 | **48.8** | **391** | **3,910** | | 30 | | **225** | **180** | 26.5 |

Note: Table lists highest value for fiscal year 2008 in each groundwater interest area, excluding those flagged "R" or "Y" or special (non-routine) samples (except as noted).
Concentrations in bold exceed DWS. Those in bold italics exceed DCG.
Blank cells indicate a constituent was not detected or not analyzed.

[a] DWS = drinking water standard; DCG = derived concentration guide. See Table 1.0-5 and 1.0-6 for more information.

[b] Most metals analyses are run both unfiltered and field-filtered samples. Higher concentrations in unfiltered samples indicate particulate matter in the sample. Note that analyses specifically for hexavalent chromium usually are not filtered in the field.

[c] Value from aquifer tube on boundary of 100-KR-4 groundwater interest area. 100-N Area aquifer tubes have lower chromium.

[d] Results from special sampling for apatite treatability test. Strontium-90 value was calculated as one-half the maximum gross beta value.

[e] There is no DWS for plutonium-239/240. The 4 mrem/yr effective dose equivalent is 1.2 pCi/L.

[f] Sample from well 299-E33-4, which is nearly dry.

[g] Nitrate from offsite sources.

**Table 1.0-5. Selected Drinking Water Standards and Groundwater Cleanup Levels.**

| Constituent | DWS | Agency[a] | MTCA[b] |
|---|---|---|---|
| Aluminum (µg/L) | 50 to 200[c] | EPA | 16,000 |
| Antimony (µg/L) | 6 | EPA, DOH | 6.4 |
| Arsenic (µg/L) | 10 | EPA, DOH | 0.058 |
| Barium (µg/L) | 2,000 | EPA, DOH | 3,200 |
| Cadmium (µg/L) | 5 | EPA, DOH | 8.0 |
| Carbon tetrachloride (µg/L) | 5 | EPA, DOH | 0.337 |
| Chloride (mg/L) | 250[c] | EPA, DOH | |
| Chloroform (THM)[d] (µg/L) | 70 | EPA, DOH | 7.17 |
| Chromium (µg/L) | 100[e] | EPA, DOH | 48[f] |
| cis-1,2-Dichloroethene (µg/L) | 70 | EPA, DOH | 80 |
| Copper (µg/L) | 1,300[g] | EPA, DOH | 640 |
| | 1,000[c] | EPA | |
| Cyanide (µg/L) | 200 | EPA, DOH | 0.104 |
| Fluoride (mg/L) | 4 | EPA, DOH | 0.960 |
| | 2[c] | EPA, DOH | |
| Iron (µg/L) | 300[c] | EPA, DOH | 11,200 |
| Lead (µg/L) | 15[g] | EPA, DOH | |
| Manganese (µg/L) | 50[c] | EPA, DOH | 752 |
| Mercury (inorganic) (µg/L) | 2 | EPA, DOH | 4.8 |
| Methylene chloride (Dichloromethane) (µg/L) | 5 | EPA | 5.83 |
| Nitrate, as $NO_3^-$ (mg/L) | 45[h] | EPA, DOH | 115 |
| Nitrite, as $NO_2^-$ (mg/L) | 3.3[i] | EPA, DOH | 5.3 |
| pH | 6.5 to 8.5[c] | EPA | |
| Selenium (µg/L) | 50 | EPA, DOH | 80 |
| Silver (µg/L) | 100[c] | EPA, DOH | 80 |
| Sulfate (mg/L) | 250[c] | EPA, DOH | |
| Tetrachloroethene (µg/L) | 5 | EPA, DOH | 80 |
| Thallium (µg/L) | 2 | EPA, DOH | 1.12 |
| Total dissolved solids (mg/L) | 500[c] | EPA, DOH | |
| 1,1,1-Trichloroethane (µg/L) | 200 | EPA, DOH | 16,000 |
| Trichloroethene (µg/L) | 5 | EPA, DOH | 0.49 |
| Zinc (µg/L) | 5,000[c] | EPA, DOH | 4,800 |
| Antimony-125 (pCi/L) | 300[j] | EPA | |
| Beta particle and photon activity (mrem/yr) | 4[k] | EPA, DOH | |
| Carbon-14 (pCi/L) | 2,000[j] | EPA | |
| Cesium-137 (pCi/L) | 200[j] | EPA | |
| Cobalt-60 (pCi/L) | 100 pCi/L[j] | EPA | |
| Iodine-129 (pCi/L) | 1 pCi/L[j] | EPA | |
| Ruthenium-106 (pCi/L) | 30 pCi/L[j] | EPA | |
| Strontium-90 (pCi/L) | 8 pCi/L[j] | EPA, DOH | |
| Technetium-99 (pCi/L) | 900 pCi/L[j] | EPA | |

**Table 1.0-5. (cont.)**

| Constituent | DWS | Agency[a] | MTCA[b] |
|---|---|---|---|
| Total alpha (excluding uranium) (pCi/L) | 15[j] | EPA, DOH | |
| Tritium (pCi/L) | 20,000[j] | EPA, DOH | |
| Uranium (µg/L) | 30 | EPA, DOH | 48 |

[a] DOH = Washington State Department of Health at WAC 246-290; EPA = U.S. Environmental Protection Agency at 40 CFR 141, 40 CFR 143, and EPA/822/R-96/001.
[b] Model Toxics Control Act, Method B cleanup levels for groundwater (WAC 173-340).
[c] Secondary standards are not associated with health effects, but with taste, odor, staining, or other aesthetic qualities.
[d] Standard is for total trihalomethanes.
[e] Total chromium.
[f] Hexavalent chromium.
[g] Action level.
[h] 45 mg/L as $NO_3$- is equivalent to 10 mg/L as N.
[i] 3.3 mg/L as $NO_2$- is equivalent to 1 mg/L as N.
[j] EPA drinking water standards for radionuclides were derived based on a 4-mrem/yr dose standard using maximum permissible concentrations in water specified in NBS Handbook 69 (U.S. Department of Commerce, as amended August 1963).
[k] Beta and gamma radioactivity from anthropogenic radionuclides. Annual average concentration shall not produce an annual dose from anthropogenic radionuclides equivalent to the total body or any internal organ dose >4 mrem/yr. If two or more radionuclides are present, the sum of their annual dose equivalents shall not exceed 4 mrem/yr. Compliance may be assumed if annual average concentrations of total beta, tritium, and strontium-90 are <50, 20,000, and 8 pCi/L, respectively.

DWS = drinking water standard (maximum contaminant level for drinking water supplies).

**Table 1.0-6. Derived Concentration Guides, 4 mrem Effective Dose Equivalent Concentrations, for Drinking Water Standards, and Risk-based Concentrations for Hanford Site Radionuclides in Groundwater.**

| Radionuclide | Derived Concentration Guide [a,b,c] (pCi/L) | 4-mrem Effective Dose Equivalent [d] (pCi/L) | Drinking Water Standard (pCi/L) | Risk-Based Concentration [e] (pCi/L) Industrial | Risk-Based Concentration (pCi/L) Residential |
|---|---|---|---|---|---|
| Carbon-14 | 70,000 | 2,800 | 2,000 | 1,030 | 34 |
| Cesium-137 | 3,000 | 120 | 200 | 60 | 1.7 |
| Cobalt-60 | 5,000 | 200 | 100 | 102 | 3.4 |
| Iodine-129 | 500 | 20 | 1 | 11 | 0.36 |
| Plutonium-239/240 | 30 | 1.2 | None | 12 | 0.39 |
| Strontium-90 | 1,000 | 40 | 8 | 29 | 0.95 |
| Technetium-99 | 100,000 | 4,000 | 900 | 580 | 19 |
| Tritium | 2,000,000 | 80,000 | 20,000 | 2,600 | 160 |
| Uranium-234 [f] | 500 | 20 | None | 23 | 0.75 |
| Uranium-235 [f] | 600 | 24 | None | 23 | 0.76 |
| Uranium-238 [f] | 600 | 24 | None | 25 | 0.83 |

[a] Concentration of a specific radionuclide in water that could be continuously consumed at average annual rates and not exceed an effective dose equivalent of 100 mrem/yr.
[b] Values in this column represent the lowest, most conservative derived concentration guides considered potentially applicable to Hanford Site operations, and may be adjusted upward (larger) if accurate solubility information is available.
[c] From DOE O 5400.5.
[d] Concentration of a specific radionuclide in water that would produce an effective dose equivalent of 4 mrem/year if consumed at average annual rates. EPA drinking water standards for radionuclides listed in Table 1.1-5 were derived based on a 4-mrem/year dose standard using maximum permissible concentrations in water specified in National Bureau of Standards Handbook 69 (U.S. Department of Commerce, as amended August 1963). The 4-mrem/yr dose standard listed in this table was calculated using a more recent dosimetry system adopted by DOE and other regulatory agencies (as implemented in DOE O 5400.5 in 1993).
[e] Based on slope factors from EPA's risk website: "Radionuclide Carcinogenicity Slope Factors," http://epa.gov/radiation/heast/index.html, in turn based on FGR-13 (EPA/402/R-99/001). These slope factors represent the risk of getting cancer if a person ingested water contaminated with each radionuclide over a lifetime (residential) or over a working lifetime (industrial). The tritium calculation also considers inhalation of tritium in air; for the other radionuclides this path is insignificant.
[f] See Table 1.1-5 for total uranium.

DOE = U.S. Department of Energy.
EPA = U.S. Environmental Protection Agency.

# 2.11 200-PO-1 Operable Unit

***J. W. Lindberg***

This section describes groundwater flow and contaminant plumes within the 200-PO-1 groundwater interest area, which includes the 200-PO-1 Operable Unit (Figure 1.0-1). The area is roughly defined by the large tritium plume emanating from the southeastern portion of the 200 East Area and includes the southern portion of the 200 East Area and a large triangle-shaped portion of the Hanford Site extending to the Hanford townsite (to the east) and to the 300-FF-5 groundwater interest area (to the southeast). Although the 216-B-3 Pond (B Pond) straddles the northern boundary with the 200-BP-5 Operable Unit, it is considered part of the 200-PO-1 groundwater interest area. The BC Cribs and Trenches are completely outside of the 200-PO-1 Operable Unit, but potential groundwater contamination there is discussed in this section because of proximity to the 200-PO-1 Operable Unit.

Wells located in the 200 East Area near the major sources for groundwater contamination are in the near-field area; whereas wells located in the 600 Area to the east and southeast are considered far-field wells. Figure 2.11-1 shows the location of local facilities and wells used in near-field monitoring. Figures 2.11-1 and 2.11-2 provide the locations of wells used in the remainder of the 200-PO-1 Operable Unit far-field area and Columbia River shoreline monitoring sites within the 600 Area.

Groundwater in the unconfined aquifer flows primarily to the southeast in the west portion of the operable unit (200 East Area) in response to higher heads to the west and the large paleochannel incised in the top of the underlying Ringold Formation that trends the same direction. In the central to eastern portion of the operable unit, groundwater flow fans outward and flows northeast, east, and southeast as it approaches the Columbia River. Vertical head differences in the 200-PO-1 Operable Unit are generally increasing with depth forming an upward gradient. In the 200 East Area, the difference between the aquifers below the Ringold Formation lower mud unit and the unconfined aquifer ranges from a few centimeters to about one meter. Along the Columbia River near well 699-20-E12 the vertical head difference is about 10 m with the 600 Area between the two areas having intermediate head differences. The exception to the general upward gradient is near B Pond where the heads decrease with depth, possibly a condition remaining from the time that the B Pond System was in operation. Section 2.14 contains additional information about the hydraulic head values and vertical gradients in the confined aquifers. PNNL-12261 provides a detailed discussion of 200 East Area hydrogeology and groundwater flow characteristics.

Tritium, nitrate, and iodine-129 are the contaminants with the largest groundwater plumes and are largely the result of the two periods of PUREX (Plutonium-Uranium Extraction Plant) operation. Other contaminants of concern in more localized areas include strontium-90 near the 216-A-36B Crib (a PUREX crib) and technetium-99 in Waste Management Area (WMA) A-AX. Contaminants of potential concern include arsenic, chromium, manganese, vanadium, cobalt-60, cyanide, and uranium.

Groundwater monitoring in the 200-PO-1 groundwater interest area is designed to meet requirements for the *Atomic Energy Act of 1954* (AEA), *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* (CERCLA), *Resource Conservation and Recovery Act of 1976* (RCRA), and *Washington*

*Administrative Code*, as directed in U.S. Department of Energy (DOE) Orders. The immediate goal for the 200-PO-1 Operable Unit is to monitor the contaminants of concern (and potential concern) under the CERCLA remedial investigation/feasibility study process until final cleanup decisions are made. The operable unit has six RCRA units that are monitored under separate groundwater monitoring plans. The RCRA units include Integrated Disposal Facility, the PUREX Cribs (or RCRA PUREX Cribs[1]), WMA A-AX (single-shell tanks), 216-A-29 Ditch, 216-B-3 Pond Facility (B Pond), and the Nonradioactive Dangerous Waste Landfill. Although not regulated under RCRA, the Solid Waste Landfill and 200 Area Treated Effluent Disposal Facility are subject to *Washington Administrative Code*, requirements. Water supply wells in the 400 Area are monitored for tritium under AEA.

Some of the main concepts associated with the 200-PO-1 Operable Unit include the following.

- Principal sources of groundwater contamination included cribs, ponds, and single-shell tanks that formerly leaked. These facilities are currently inactive, and pumpable liquids have been removed from the tanks. However, the waste sites have not yet been remediated and contamination remains in the vadose zone.
- Characterization of vadose zone contamination continued during fiscal year (FY) 2008 with the drilling of exploratory boreholes. Groundwater samples were collected from each of these boreholes and results were consistent with surrounding groundwater monitoring wells.
- Tritium, nitrate, and iodine-129 are the principal groundwater contaminants of concern because of their widespread plumes. The area of the iodine-129 plume is stable and the tritium and nitrate plumes are shrinking.
- Small plumes of strontium-90 and technetium-99 exceed their respective drinking water standards, but concentrations are stable to decreasing.
- There is no active groundwater remediation in the 200-PO-1 Operable Unit. A record of decision has not yet been established.
- The 200-PO-1 Operable Unit is in the characterization phase of a CERCLA remedial investigation and feasibility study. During FY 2008, DOE released a work plan that identifies a 2-year process for collecting additional characterization data.
- Six RCRA sites are located in the 200-PO-1 Operable Unit. At the Nonradioactive Dangerous Waste Landfill, total organic carbon concentrations in one downgradient well exceeded the critical mean value. The site will begin an assessment monitoring program in FY 2009. The other RCRA sites continued to be monitored under previously-established monitoring programs.
- One new well was installed at WMA A-AX as required by the RCRA groundwater monitoring plan.
- Groundwater flow directions in the 200 East Area are difficult to interpret from water-table maps because of the low hydraulic gradient. Preliminary efforts to refine the water-table map were partially successful, and efforts will continue during FY 2009.

1 The term "PUREX Cribs" refers to all the cribs in the southeast part of the 200 East Area and east of the 200 East Area where PUREX wastewater was discharged. Three of these cribs are monitored under RCRA and termed the "RCRA PUREX Cribs" (Section 2.11.3.2).

- Most of the monitoring wells are screened at the top of the unconfined aquifer. No groundwater constituents exceed drinking water standards in 26 deeper wells.

The following sections provide details about groundwater monitoring in the 200-PO-1 groundwater interest are during FY 2008. Section 2.11.1 describes contaminant plumes and concentration trends. Section 2.11.2 summarizes operable unit activities. Section 2.11.3 describes monitoring of the RCRA-regulated facilities and facilities monitored to meet *Washington Administrative Code* requirements.

## 2.11.1 Groundwater Contaminants

This section describes the major contaminants of concern within the 200-PO-1 Operable Unit: tritium, iodine-129, nitrate, strontium-90, technetium-90, and other contaminants of potential concern.

***Plume areas (square kilometers) in the 200-PO-1 Operable Unit:***

***Iodine-129, 1 pCi/L — 53.80***
***Nitrate, 45 mg/L — 0.66***
***Strontium-90, 8 pCi/L — 0.01***
***Technetium-99, 900 pCi/L — <0.01***
***Tritium, 20,000 pCi/L — 117.48***
***Tritium, 80,000 pCi/L — 17.69***
***Uranium, 30 µg/L — 0.09***

The cribs, ponds, and ditches surrounding the PUREX Plant are responsible for most of the groundwater contamination in the 200-PO-1 Operable Unit. The PUREX Plant started operation in 1956, eventually replacing the Reduction-Oxidation (REDOX) Plant as the plutonium separations facility. The first PUREX operational campaign was from 1956 to 1972. Following an 11-year shutdown, the PUREX Plant operation restarted in 1983 and shut down in December 1988 when the weapons production mission ended. Plant operation briefly restarted in December 1989 to stabilize material in the system. The plumes primarily contain those species associated with process condensates, including tritium, iodine-129, and nitrate. Some strontium-90 and technetium-99 also are associated with PUREX waste disposal, though technetium-99 is not found above the 900 pCi/L drinking water standard in contaminant plumes from PUREX Cribs. Technetium-99 exceeds the drinking water standard beneath WMA A-AX.

### 2.11.1.1 Tritium

The principal source for the large tritium plume extending from the southeastern portion of the 200 East Area to the Columbia River (Figures 1.0-2 and 2.11-3) is in the vicinity of the PUREX Cribs. The highest concentrations of tritium (drinking water standard 20,000 pCi/L) in this plume remain near these cribs (Figure 2.11-4). The highest reported level of tritium during FY 2008 was 650,000 pCi/L for samples collected in April 2008 at well 299-E17-14 near the 216-A-36B Crib.

***Tritium, nitrate, and iodine-129 are the contaminants of greatest significance in this operable unit.***

Concentrations of tritium generally continue to decline in the far-field area as the plume attenuates naturally due to radioactive decay and dispersion, along with the generally decreasing source that resulted from the termination of PUREX Plant operations. Wells in the eastern portion of the 200-PO-1 Operable Unit have tritium concentrations above 80,000 pCi/L (Figure 2.11-3) from an early period of discharge to the PUREX Cribs (PNNL-11141, *Hanford Site Ground-Water Monitoring for 1995*). The area of the tritium plume with concentrations above the 80,000 pCi/L in the eastern portion of the Hanford Site is ~18 km$^2$. In FY 1997, this portion of the plume was over ~60 km$^2$. The concentrations in wells within this portion of the plume are expected to continue decreasing as areas with higher concentrations (representing the two periods of PUREX Plant operations) move beyond the wells into the river or decay and disperse. Groundwater at this location likely will continue

to be contaminated with tritium at levels greater than the drinking water standard for 40 to 50 years. Wells more distant from the source are sampled once every three years (most were sampled during FY 2007). Wells in the south of the 200-PO-1 Operable Unit (immediately north of the 300 Area) also have decreasing tritium concentrations indicating that the southward migration of the plume has slowed or stopped because of the effects of dispersion and radioactive decay (Section 2.12.1.3).

***Concentrations of tritium continue to generally decline in the far-field area as the plume attenuates naturally.***

Tritium concentrations in the aquifer tubes are similar to nearby groundwater monitoring wells. The aquifer tubes with the highest concentrations of tritium (35,000 pCi/L in C6353 and 24,000 pCi/L in C6383) are located southeast of the Hanford townsite corresponding to the tritium plume with concentrations greater than 80,000 pCi/L (Figure 2.11-3).

***Wells in the near-field area show steady to rising tritium trends.***

Because they are closer to the source of the tritium, wells in the near-field area have higher tritium concentrations than wells in the far-field area and have shown steady to rising trends since FY 2005 (Figure 2.11-5). Well 299-E17-14 (near the 216-A-36B Crib) had a decreasing trend until FY 2005, then concentrations began to rise. Well 299-E24-16 (near the 216-A-10 Crib) had a decreasing trend until FY 2002, then concentrations began to rise. Tritium concentrations at well 299-E25-19 (near the 216-A-37-1 Crib) have been stable since FY 1998. It is possible that the vadose zone near the 216-A-10 and 216-A-36B Cribs is still contributing tritium to the unconfined aquifer. However, another potential scenario for the changing tritium concentrations in these near-field wells is changing groundwater flow directions after the cessation of wastewater discharges at B Pond. Determining a precise groundwater flow direction in the vicinity of the PUREX Cribs is difficult because of the extremely flat water table. Section 2.11.2.2 provides information about refining the water-table map near the PUREX Cribs.

The zone of lower tritium concentrations near the Energy Northwest Complex (Figure 2.11-3) likely is the result of the effect of a zone of lower hydraulic conductivity in the unconfined aquifer. In this area, the water table is within the upper portion of the Ringold Formation that may have a greater degree of local cementation. Section 2.12.1.3 discusses tritium at the 618-11 Burial Grounds, located just west of the Energy Northwest Complex.

The 200-PO-1 Operable Unit wells screened in the middle or lower portions of the unconfined aquifer (or deeper in confined aquifers) generally show very little tritium groundwater contamination. Tritium was either not detected or detected at very low concentrations (10 pCi/L) at the 200 Area Treated Effluent Disposal Facility during FY 2008. The wells are screened at the first occurrence of groundwater below the Ringold Formation lower mud unit where the aquifer is locally confined (i.e., potentiometric surface is within the lower mud unit). Well 499-S1-8J (a water-supply well in the 400 Area) is screened in the lower portion of the Ringold Formation (but not confined) and during FY 2008 had tritium levels ranging from 2,100 to 2,500 pCi/L. Nearby well 499-S0-7, screened at the water table had tritium values that ranged from 7,900 to 9,700 pCi/L during FY 2008. Tritium was not detected in the Laser Interferometer Gravitational Wave Observatory well (699-S2-34B), which is screened in basalt-confined aquifer system. Similarly, five other deep 200-PO-1 Operable Unit wells screened in basalt-confined aquifer system (and sampled once every three years) showed no detectable tritium during FY 2006, the last time they were sampled. Section 2.14 provides more information of the upper basalt-confined aquifer system results.

### 2.11.1.2 Iodine-129

The iodine-129 plume (Figure 1.0-4 and 2.11-6) extends southeast into the 600 Area from the 200 East Area and appears to coincide with the northern portions of the tritium and nitrate plumes (Figures 1.0-2, 1.0-3, 2.11-3, and 2.11-7). The plume has changed very little over the last 14 years (PNL-10698, *Hanford Site Ground-Water Monitoring For 1994*, Figure 5.3). The unusual geometry of the plume where the 1.0 pCi/L isopleth appears to turn 90° northward may be a result of the lower than expected iodine-129 concentration (less than 0.31 pCi/L) at well 699-31-31 and the lack of any wells in the area immediately north of well 699-31-31.

***The iodine-129 plume has changed very little in 14 years.***

During FY 2008, the highest concentrations of the iodine-129 plume were near the sources of the plume in the southeastern portion of the 200 East Area. The concentrations in this area ranged from undetected to 10.4 pCi/L in well 299-E17-14 (near the 216-A-36B Crib). The generally decreasing to stable trend for iodine-129 at well 299-E17-14 (Figure 2.11-8) is typical of the gradually decreasing trend for iodine-129 in the vicinity of the PUREX Cribs. The contribution of iodine-129 from the vadose zone near the PUREX Cribs is most likely similar to the amount dispersed on the eastern edges of the plume, based on the high mobility of iodine-129, the continued detection of iodine-129 near the PUREX Cribs, and the long half-life of the iodine-129 isotope. During FY 2008, iodine-129 was not detected in the wells sampled deeper in the unconfined aquifer or in the 200-PO-1 Operable Unit aquifer tubes.

### 2.11.1.3 Nitrate

The extent of the nitrate plume originating in the 200 East Area (Figures 1.1-3 and 2.11-7) is nearly identical to the tritium plume. However, the area with concentrations above the 45 mg/L nitrate drinking water standard is smaller than the area with concentrations above the 20,000 pCi/L tritium drinking water standard. Nitrate at levels above the drinking water standard north of the 400 Area and at the Energy Northwest Complex (within the area impacted by the PUREX Cribs) can be attributed to wastewater disposal activities in those areas. In FY 2008, the highest nitrate concentration (127 mg/L) within the 200-PO-1 Operable Unit was at well 299-E17-14 (Figure 2.11-9). The nitrate plume (Figure 2.11-7), with sources in the 200 Area, appears to have receded slightly over previous years, except in the immediate vicinity of the PUREX Cribs (PNNL-15670; DOE/RL-2008-01) and WMA A-AX. Another nitrate plume, with offsite sources, exists near the 300 Area (Section 2.12.1.4). The highest nitrate concentration in the aquifer tubes was 33 mg/L in C6353 near the Hanford townsite.

***The overall nitrate plume has receded slightly, except for portions near the PUREX Cribs and WMA A-AX.***

Wells near the PUREX Cribs in the southeastern portion of the 200 East Area had increasing nitrate concentrations in recent years. The trend at well 299-E24-16 (near the 216-A-10 Crib) is typical of the increasing trend (Figure 2.11-10). Increasing nitrate concentrations also were observed at WMA A-AX (Section 2.11.3.3). The cause of the increase in nitrate at some of the wells in the southeastern portion of the 200 East Area is unknown, but it may be a result of shifting groundwater flow directions related to the cessation of wastewater discharges at B Pond or to groundwater contamination from PUREX Cribs and WMA A-AX.

Nitrate was detected in wells deeper in the Ringold Formation unconfined aquifer or lower confined aquifer. However, none of the deeper wells had reported nitrate concentrations exceeding the drinking water standard (45 mg/L). At the

Nonradioactive Dangerous Waste Landfill, nitrate concentrations were as high as 19.4 mg/L in well 699-26-35C and 11.1 mg/L in well 699-25-33A. These wells are screened at the top of the low permeability unit (bottom of the unconfined aquifer) in the Ringold Formation. Beneath the Ringold Formation lower mud unit at B Pond and the 200 Area Treated Effluent Disposal Facility (the uppermost aquifer), nitrate concentrations continue to be lower (less than 6.9 mg/L). In the lower portions of the unconfined aquifer beneath the 216-A-29 Ditch (well 299-E25-28) the nitrate level was 2.1 mg/L. Nitrate was not detected (i.e., less than 0.044 mg/L) in water supply well 499-S1-8J in the 400 Area (screened in the lower portion of the Ringold Formation). Nitrate remains undetected in well 699-S2-34B (at the Laser Interferometer Gravitational Wave Observatory) and in three other wells screened in the basalt-confined aquifer system beneath the 200-PO1-1 Operable Unit.

*The strontium-90 plume near the 216-A-36 Crib is very localized.*

#### 2.11.1.4 Strontium-90

A localized area of strontium-90 (a beta-emitter) contamination exists near the 216-A-36B Crib (a PUREX Crib). Well 299-E171-14 was the only well with strontium-90 concentrations above the 8 pCi/L drinking water standard during FY 2008, with a maximum concentration of 20.2 pCi/L. The trend for strontium-90 in well 299-E17-14 shows an increasing trend from 1997 to 2001, and then a fluctuating trend that is neither overall increasing nor decreasing. Results since FY 2006 have ranged from 14 to 21 pCi/L. The contaminant impact is localized because of the low mobility of strontium-90 compared to tritium, nitrate, or iodine-129.

*Technetium-99 exceeds the 900 pCi/L drinking water standard at one upgradient and one downgradient well.*

#### 2.11.1.5 Technetium-99

Technetium-99 (a beta-emitter) continues to be detected at WMA A-AX at levels far above the drinking water standard (900 pCi/L) and was detected indirectly (from gross beta measurements) at the PUREX Cribs. It also was detected in four aquifer tubes with a maximum concentration of 77 pCi/L. Although most wells at WMA A-AX had technetium-99 levels below the drinking water standard, groundwater samples from downgradient well 299-E25-93 had technetium-99 concentrations ranging from 6,200 to 8,000 pCi/L during FY 2008. Upgradient well 299-E24-33 had technetium-99 concentrations ranging from 1,000 to 1,100 pCi/L. Concentrations for technetium-99 at these two wells have been steady since FY 2006 (Figure 2.11-11). Section 2.11.3.3 provides more information about technetium-99 at WMA A-AX.

#### 2.11.1.6 Other Constituents

Other constituents (i.e., arsenic, chromium, manganese, vanadium, and uranium) are contaminants of concern or potential concern at various facilities within the 200-PO-1 Operable Unit (DOE/RL-2003-04, *Sampling and Analysis Plan for the 200-PO-1 Groundwater Operable Unit*). Chromium, cobalt-60, cyanide, and uranium are contaminants of potential concern at the BC Cribs and Trenches. Arsenic was detected at nearly every well analyzed in the 200-PO-1 Operable Unit, in concentrations ranging from 1.9 (the method detection limit) to 10.5 μg/L (unfiltered sample at well 299-E25-42) during FY 2008. However, these concentrations are not significantly different from Hanford Site groundwater background values (less than 11.8 μg/L at the 95% confidence level; DOE/RL-96-61).

During FY 2008, the highest chromium concentration in the 200-PO-1 Operable Unit was 113 μg/L (for an unfiltered sample) at well 299-E18-1, (located near the former 2101-M Pond on the west side of the operable unit). A filtered sample collected at the same time from this well was 9.7 μg/L. The primary drinking water standard

for chromium is 100 μg/L. Chromium concentrations in wells on the western side of the 200-PO-1 Operable Unit may be influenced by a plume of chromium entering the area from the west or southwest (Section 2.9).

Well 299-E25-19 near the 216-A-37-1 Crib had manganese concentrations that exceeded the 50 μg/L secondary drinking water standard during FY 2008. The source of the manganese is unknown. It may be related to wastewater discharged to the 216-A-37-1 Crib or to the deterioration of the well screen or casing. The trend for manganese in this well has been stable to increasing since FY 2005. Seven of the new aquifer tubes had elevated manganese concentrations (with a maximum concentration of 743 μg/L at C6378), but these elevated values are most likely related to the drilling process.

Vanadium concentrations ranged in the 200-PO-1 Operable Unit from 7 (the method detection limit) to 45 μg/L (unfiltered sample from well 299-E25-28) and 55 μg/L (filtered sample from well 699-43-45) during FY 2008. Both wells are located at the 216-A-29 Ditch. Except for the elevated vanadium results in early FY 2008, the trends for vanadium at these wells are stable (ranging from ~30 to 34 μg/L). There is no drinking water standard for vanadium.

***In recent years, uranium has been increasing in concentration near the PUREX Cribs.***

In recent years, uranium concentrations have reached the drinking water standard (30 μg/L) near the PUREX Cribs. The highest concentration during FY 2008 was 30 μg/L at well 299-E17-14. Overall, the trend for uranium in this well has increased since the well was first monitored for uranium in 2005 (Figure 2.11-12). Because the uranium concentration increases (or the indicator parameter gross alpha) are observed only in the wells near the PUREX Cribs, the PUREX Cribs are the most likely source.

Groundwater monitoring routinely occurs at two wells in the BC Cribs and Trenches (299-E13-5 and 299-E13-14). Results from these well showed that the contaminants of potential concern (chromium, cobalt-60, cyanide, and uranium), as well as the 200-PO-1 Operable Unit contaminants of concern, were either not detected or were similar to background (upgradient) concentrations in the BC Cribs and Trenches.

***During FY 2008, contaminants of potential concern at the BC Cribs and Trenches were either undetected or similar to background concentrations.***

Although not a contaminant of concern in the 200-PO-1 Operable Unit, the fluoride concentration (9.09 mg/L) in well 699-S2-34B (at the Laser Interferometer Gravitational-Wave Observatory) was above the 4 mg/L primary drinking water standard. The result is typical of the historical trend for this well. Well 699-S2-34B is screened in the upper basalt-confined aquifer system known to have elevated concentrations of fluoride.

## 2.11.2 Operable Unit Activities

The 200-PO-1 Operable Unit contains a large portion of the Hanford Site (Figures 1.0-1 and 2.11-2). The operable unit boundaries generally are defined by tritium, the largest contaminant plume of the operable unit. Although outside the 200-PO-1 Operable Unit boundary, wells at the BC Cribs and Trenches, (Figures 2.11-1 and 2.11-2) are included in the 200-PO-1 Operable Unit.

*In FY 2008, the remedial investigation/ feasibility study work plan for the 200-PO-1 Operable Unit was released.*

### 2.11.2.1 Status of CERCLA Five-Year Review Action Items

The second CERCLA five-year review was published in November 2006 (DOE/RL-2006-20). The review identified one issue and an associated action pertaining to the 200-PO-1 Operable Unit.

- **Issue 15.** Soil resistivity measurements have detected large regions of anomalously high soil conductivity in the area south of the PUREX Plant around the 216-A-4 Crib and near the BC Cribs and Trenches.
- **Action 15-1.** Complete data quality objective process and sampling plan to further characterize the high soil conductivity measurements detected at the BC Cribs and Trenches (December 2007).

In FY 2007, the data quality objective process was completed and the report was released (SGW-34011, *Data Quality Objectives Summary report Supporting the 200-PO-1 Groundwater Operable Unit*).

In FY 2008, DOE/RL-2007-31, *RI/FS Work Plan for the 200-PO-1 Groundwater Operable Unit*, was released. Appendix A of the work plan includes a characterization sampling and analysis plan, a portion of which contains plans to further characterize the high soil conductivity measurements detected at the BC Cribs and Trenches.

*The remedial investigation/ feasibility study work plan contains two sampling and analysis plans, one for routine groundwater monitoring, and another for characterization activities.*

### 2.11.2.2 Remedial Investigation/Feasibility Study

Groundwater monitoring at the 200-PO-1 Operable Unit supports the remedial investigation/feasibility study process for the 200-PO-1 Groundwater Operable Unit. During FY 2008, the remedial investigation/feasibility study process generated a work plan (DOE/RL-2007-31) containing two sampling and analysis plans (one for routine groundwater monitoring of wells within the 200-PO-1 Groundwater Operable, and another for groundwater characterization within the 200-PO-1 Operable Unit). The routine sampling and analysis plan (also released earlier as DOE/RL-2003-04) contains plans for general groundwater monitoring in the 200-PO-1 Operable Unit to track the extent, movement, and concentration of groundwater contamination. Groundwater monitoring under this plan is a continuation of earlier groundwater monitoring plans in the operable unit for CERCLA, AEA, and *Washington Administrative Code*, compliance. The characterization sampling and analysis plan identifies a two-year process specifically for collecting additional data for the remedial investigation (including groundwater data) that are not already covered under the routine sampling and analysis plan.

*Wells sampled under the characterization sampling and analysis plan are analyzed for a comprehensive list of 44 analytes.*

The work plan (DOE/RL-2007-31) was released too late in FY 2008 to schedule and collect groundwater samples (with a few exceptions) to address the new characterization sampling and analysis plan or any changes identified in the routine sampling and analysis plan. By the time the work plan was released, many of the wells had been sampled for FY 2008. Groundwater samples collected for the new characterization sampling and analysis plan included existing well 299-E17-14 (at the 216-A-36B Crib) and grab samples from exploratory boreholes C6552, C5941, and C5923. These exploratory boreholes are located at the 216-A-5 Crib, 216-A-30 Crib, and the BC Cribs and Trenches (respectively) (Figure 2.11-1). Exploratory borehole C5923 was completed as a groundwater monitoring well with the number 299-E13-62. The groundwater samples collected at well 299-E17-14 and exploratory boreholes were analyzed for a larger list of analytes (Table 2.11-1), compared to the shorter list of required analytes in the routine sampling and analysis plan (Appendix A). Sections 2.11.2.1 and 2.11.2.3 include the results of groundwater sampling at well 299-E17-14 and the exploratory boreholes.

Included in the characterization sampling and analysis plan is an effort to refine the water-table map in the southeastern 200 East Area. Refinement of the water-table map for this area would help determine groundwater flow directions and flow rate because of the low water-table gradient. The gradient is so low that errors in measuring the depth to water can be larger than the differences in water-table elevations between wells. Refining the water-table map for the southeastern portion of the 200 East Area also will assist in determining groundwater flow directions at RCRA sites at the Integrated Disposal Facility (Section 2.11.3.1) and PUREX Cribs (Section 2.11.3.2). The solution is to decrease the amount of measurement error in determining water-table elevations at wells. Other than measurement variation caused by barometric effects, the two potential sources of significant error are the surveys that provided well locations and elevations and the deviation of the wells from vertical. When a 100 m deep well is deviated ~2.6° from vertical, the depth to water measurement will have an error of 0.1 m. An error of 0.1 m is greater than the relief on the water table across the southeastern portion of the 200 East Area.

***Revising the water-table map of the southeastern portion of the 200 East Area and interpreting groundwater flow directions was attempted using a three-step process.***

Producing a corrected water-table map of the southeastern portion of the 200 East Area and interpreting groundwater flow directions was attempted using the following three steps.

- Twelve wells in the southeastern portion of the 200 East Area were resurveyed to a known datum. The vertical error was reduced to approximately +/- 1 mm.
- The depth to water measurements were corrected for borehole deviation in the 12 wells to +/-0.003 m using a down-hole gyroscope.
- Trend surface analyses were conducted of resulting water-table maps to separate local from regional variability and determine any regional trends on the water-table surface (Davis, 2002, *Statistics and Data Analysis in Geology*).

***Efforts to refine the water-table map in the southeastern portion of the 200 East Area were not definitive. Results of flow direction ranged from northeast to south.***

Results to refine the water-table map were not definitive. The expectation was that by increasing the precision of known surface elevations and correction factor for the degree of tilting (from perfectly vertical) at each of the 12 well locations that trend surface analyses of the resulting water-table surfaces would provide definitive groundwater flow directions. Four new sets of water-level measurements were collected during the summer months, after the wells were resurveyed for location, elevation, and degree of tilting from vertical. The new data sets resulted in directions ranging from northeast to south (61 to 173° of azimuth), and water-table gradients ranged from $1.7 \times 10^{-5}$ to $2.9 \times 10^{-5}$. Each trend surface analysis was run several times. Each run removed the well with the highest residual (deviation from the trend surface) from the analysis, until all the residuals were less than 1 cm, the trend surface fit was statistically significant, and the direction changed by less than 10°. The variability in results could be caused by barometric pressure fluctuations. Automated water-level data will be collected at the site during FY 2009 to help resolve barometric effects. Monthly depth-to-water measurements will continue to be collected for additional trend surface analyses.

***Aquifer tubes were installed at an additional 11 sites along the Columbia River between the Hanford town site and the 300 Area.***

The characterization sampling and analysis plan required the installation of aquifer tubes at 11 locations along the Columbia River between the Hanford townsite and the 300 Area. A shallow, medium, and deep aquifer tube were planned at each of the locations. Installation was difficult because partially cemented Ringold Formation

impeded the drilling operations. With the installation difficulties, only the shallow tubes were installed at most of the locations. The medium depth aquifer tube was installed at only two of the 11 sites. Figure 2.11-13 shows the locations of the new aquifer tubes along the Columbia River. Ten of the sites were sampled during FY 2008.

The characterization sampling and analysis plan also required geophysical surveys to support geologic structure and stratigraphy characterization at the 200-PO-1 Operable Unit. Fifteen line miles of seismic reflection and airborne magnetic surveys over 336.7 $km^2$ were conducted in FY 2008. Data analysis will occur in FY 2009 to identify possible preferential groundwater flow paths from the 200 East Area to the Columbia River.

### 2.11.2.3 Results of Operable Unit Monitoring for FY 2008

***The only constituents exceeding drinking water standards at the southeast transect during FY 2008 were iodine-129, iron, and tritium.***

The 200-PO-1 Operable Unit routine sampling and analysis plan (DOE/RL-2003-04) specifies annual sampling of two lines of guard wells to screen for a comprehensive list of analytes. One of these lines of guard wells (the Southeast Transect) is located southeast of the 200 East Area (Figure 2.11-2) and ensures that unexpected contaminants do not migrate from the 200 East Area undetected. The other line (the River Transect) is located along the Columbia River to assess the concentration of any groundwater contamination that may reach the river. The comprehensive list of analytes for both transects includes iodine-129, tritium, anions (including nitrate), gross alpha and beta, gamma scan, metals, strontium-90, and volatile organic compounds.

At the southeast transect, the following 24 groundwater constituents were detected in groundwater samples during FY 2008:

| | | |
|---|---|---|
| Barium | Iron | Silver |
| Calcium | Magnesium | Sodium |
| Chloride | Manganese | Strontium |
| Chromium | Methylene chloride | Sulfate |
| Cobalt | Nickel | Tetrachloroethene |
| Copper | Nitrate | Tritium |
| Fluoride | Potassium | Vanadium |
| Iodine-129 | Potassium-40 | Zinc. |

***Tritium, iron, and pH exceeded drinking water standards at the River Transect during FY 2008.***

Many of these groundwater constituents occur naturally (e.g., potassium-40) or are consistent with background values. Iodine-129, iron, and tritium are the only groundwater constituents exceeding drinking water standards. The tritium and iodine-129 concentrations are consistent with their respective plumes (Figures 2.11-3 and 2.11-6) along the Southeast Transect. Unfiltered and filtered iron in wells 699-41-23 and 699-24-46 and unfiltered iron in well 699-26-33 exceeded the 300 µg/L secondary drinking water standard. All three of these wells have carbon steel casings that are likely responsible for the elevated iron. Two volatile organic compounds (methylene chloride and tetrachloroethene) were detected in well 699-26-33 at the Nonradioactive Dangerous Waste Landfill, where low levels of volatile organic compounds previously have been detected. The recent detections in this well are estimated and questionable because the results were close to the method detection limit. Section 2.11.3.6 provides more information about volatile organic compounds at the Nonradioactive Dangerous Waste Landfill.

At the River Transect, 18 of the same groundwater constituents were detected (excluding iodine-129, magnesium, manganese, methylene chloride, potassium-40, and tetrachloroethene) and a high pH was recorded for one well. Like the Southeast Transect, most of these either are naturally occurring constituents or are groundwater contaminants with concentrations consistent with upgradient wells or typical of their respective plumes. The unfiltered iron concentration and pH exceeded drinking water standards (300 μg/L and 8.5, respectively) in well 699-20-E12O (1,010 μg/L and 9.1, respectively). The filtered iron result was 230 μg/L. Wells 699-41-1A and 699-46-4 had tritium concentrations exceeding the 20,000 pCi/L drinking water standard (60,000 and 53,000 pCi/L, respectively). Both wells are located near the Hanford townsite where the known concentration of the tritium plume is similar (Section 2.11.1.1). The elevated pH at well 699-20-E12O is anomalous for the region, and the reason for the elevated concentration is unknown.

***Manganese and tritium were detected at levels above their respective drinking water standards in the new aquifer tubes installed along the Columbia River in the 200-PO-1 Operable Unit.***

Sampling of 10 of the new aquifer tubes (Figure 2.11-13) between the Hanford townsite and the 300 Area was accomplished late in FY 2008. Only part of the results were received at the time this report was written. Results to date indicate that fluoride, manganese, neptunium-237, nitrate, pH, protactinium-231, strontium-90, technetium-99, tritium, uranium, and zinc were detected in the aquifer tube samples collected. Manganese and tritium were detected at levels above their respective drinking water standards, and pH was lower than the 6.5 drinking water standard at one aquifer tube. The remainder of the results were either at natural background levels for naturally occurring constituents or very low levels. Manganese (both filtered and non-filtered) exceeded the 50 μg/L drinking water standard in almost all the tubes sampled, indicating the elevated levels were related to the tube installation process. The highest level reported was 743 μg/L at C6378. Tritium at aquifer tubes C6353 and C6383 had concentrations exceeding the 20,000 pCi/L drinking water (35,000 and 24,000 pCi/L, respectively). These tritium results are similar to wells in the area (considering partial dilution by river water). The single occurrence of pH below the 6.5 drinking water standard was 6.45 at tube C6368. A pH value this low is not typical of the river or nearby wells and is under review.

***The highest tritium and nitrate concentrations in the existing aquifer tubes (original) were 7,000 pCi/L and 8.5 mb/L, respectively.***

Two of the original six aquifer tube locations near the Hanford townsite (Figure 2.11-2) were sampled as scheduled during FY 2008. Samples were collected from location AT-82-M and AT-86-D. Aquifer tubes at locations 81 and 83 were not found at the time of sampling. Aquifer tubes at locations 84 and 85 had specific conductance values too low to consider that the samples would have enough groundwater mixed with them to be meaningful. As the river portion of river-groundwater mixtures increases, the specific conductance decreases. Columbia River water typically has specific conductance ranging from 120 to 150 μS/cm. Groundwater in the unconfined aquifer near the river generally has specific conductance values ranging from 350 to 500 μS/cm. Aquifer tube samples are retained only when the specific conductance is clearly above the normal range for river water. Even so, the samples collected at locations 82 and 86 had relatively low specific conductance values (217 and 298 μS/cm, respectively). Detected groundwater constituents included chloride, fluoride, hexavalent chromium nitrate, sulfate, and tritium. None of these detected constituents had concentrations exceeding drinking water standards. The highest tritium and nitrate concentrations were 7,000 pCi/L and 8.5 mg/L, respectively.

During FY 2008, grab samples of groundwater were collected from three exploratory boreholes (C6552, C4951, and C5923[2]) as the boreholes reached the water table. The exploratory boreholes were at the 216-A-5 Crib, 216-A-30 Crib, and at the BC Cribs and Trenches (Figure 2.11-1). Because collecting groundwater from an exploratory borehole lacks the benefit of well development, the technique produces groundwater samples of high turbidity that must be filtered at the collection site. Therefore, the groundwater aliquots for all the analyses methods were filtered from these three boreholes. The 200-PO-1 Operable Unit characterization samples also were collected from well 299-E17-14 (located near the 216-A-36B Crib). The constituents analyzed in the groundwater samples from the exploratory borehole and well 299-E17-14 included an extensive list of 44 constituents (Table 2.11-1), and currently some of the results for the more unusual analysis methods (pesticides) had not been received from the laboratories.

***Manganese and tritium were detected at levels above drinking water standards in grab samples taken from three exploratory boreholes near the 216-A-5 Crib, 216-A-30 Crib, and at the BC Cribs and Trenches.***

Results from the exploratory boreholes at the 216-A-5 Crib, 216-A-30 Crib, and the BC Cribs have similar results. Nothing unusual was discovered with the increased number of groundwater constituents analyzed in these exploratory boreholes, and results were typical of nearby wells. About 20 constituents were detected with most being natural-occurring constituents or constituents with concentrations similar to background or upgradient areas. Constituents exceeding drinking water standards at the exploratory boreholes near the 216-A-5 and 216-A-30 Cribs included manganese and tritium. The tritium concentration at those two boreholes was (250,000 and 47,000 pCi/L, respectively). Manganese at the BC Cribs borehole also exceeded the 50 μg/L drinking water standard, but tritium was not detected. Manganese concentrations are typically elevated in the first few samples collected from new wells or boreholes.

Well 299-E17-14 (at the 216-A-36B Crib) had results that were similar to those at the exploratory boreholes. Nothing unusual was discovered with the increased number of groundwater constituents analyzed in this existing well, and results of detected analytes were typical of historical trends. Along with elevated tritium, gross beta (drinking water standard of 50 pCi/L), iodine-129 (drinking water standard of 1.0 pCi/L), nitrate (drinking water standard of 45 mg/L), and strontium-90 (drinking water standard of 8 pCi/L) exceeded their respective drinking water standards. Results for these constituents were as follows: tritium, 590,000 pCi/L; gross beta, 63 pCi/L: iodine-129, 9.5 pCi/L; nitrate, 124 mg/L; and strontium-90, 14 pCi/L. Because technetium-99 was discovered at low concentrations, the constituent responsible for the elevated gross beta is most likely strontium-90.

## 2.11.3 Facility Monitoring

This section describes results of monitoring at individual units (i.e., treatment, storage, and disposal units or tank farms). Some of these facilities are monitored under the requirements of RCRA for hazardous waste constituents and AEA for source, special nuclear, and by-product materials. Data from facility-specific monitoring also are integrated into the CERCLA groundwater investigations. Hazardous constituents and radionuclides are discussed jointly in this section to provide comprehensive interpretations of groundwater contamination for each facility. Pursuant to RCRA,

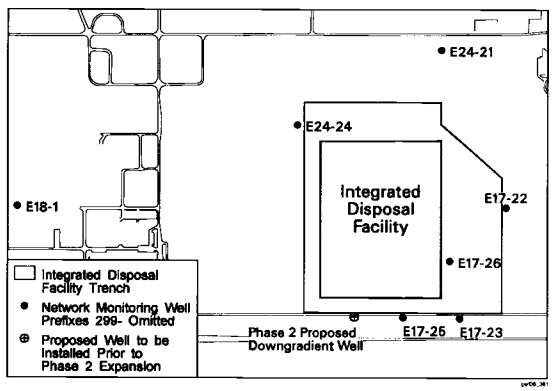
2 Exploratory borehole C5923 was converted to a vadose zone vapor injection well named 299-E13-62 after groundwater samples were collected at the water table. The borehole was backfilled up to a level of 20 m of depth before setting the screens for vapor injection. Groundwater sample analysis results are identified in HEIS as 299-E13-62, rather than C5923.

the source, special nuclear, and by-product material components of radioactive mixed waste are not regulated under RCRA and are regulated by the DOE, acting pursuant to its AEA authority. Therefore, while this report may satisfy RCRA reporting requirements, the inclusion of information on radionuclides in such a context is for information only and may not be used to create conditions or other restrictions set forth in any RCRA permit.

The 200-PO-1 Operable Unit contains six RCRA sites with groundwater monitoring requirements: Integrated Disposal Facility, RCRA PUREX Cribs, WMA A-AX, 216-A-29 Ditch, 216-B-3 Pond Facility, and the Nonradioactive Dangerous Waste Landfill. Also included in the 200-PO-1 Operable Unit are the Solid Waste Landfill (regulated by Washington State Department of Ecology [Ecology] under WAC 173-304), the 200 Area Treated Effluent Disposal Facility (monitored under waste discharge permit WAC 173-216), and three 400 Area water supply wells monitored for the AEA. This section summarizes results of statistical comparisons, assessment studies, and other developments for FY 2008. Groundwater data are available in the Hanford Environmental Information System database and on the data files accompanying this report. Appendix B provides additional information (including well and constituent lists, maps, flow rates, and statistical tables).

### 2.11.3.1 Integrated Disposal Facility

***D. G. Horton***




Construction of the Integrated Disposal Facility began in September 2004 and was completed in April 2006. The DOE submitted a Part B RCRA permit application to the Ecology, and it was incorporated into the Hanford Facility RCRA Permit (WA7890008967) on April 9, 2006. The future start date for operations at the Integrated Disposal Facility has not been determined.

The objective of RCRA and operational monitoring at the Integrated Disposal Facility is to determine whether the facility has impacted groundwater quality. The facility is not yet operational, and the current monitoring is directed at obtaining background values for monitored constituents. The current groundwater-monitoring network consists of seven wells (Appendix B). Another well remains to be installed at a future date when required by facility expansion.

***Current monitoring at the Integrated Disposal Facility is directed at obtaining background values for monitoring constituents.***

The Integrated Disposal Facility consists of an expandable, double-lined landfill with ~7 ha of liner. The facility is located in the south-central part of the 200 East Area (Figure 2.11-1). Appendix B lists the network wells, their locations, and groundwater constituents monitored. The landfill is divided lengthwise (north/south) into two distinct cells: the east cell for the disposal of low-level radioactive waste and the west cell for the disposal of mixed waste. The facility is a RCRA-compliant landfill (i.e., a double high-density polyethylene-lined trench with leachate collection and leak detection system). The constructed liner is ~442 m wide by 160 m long and up to 15 m deep. The landfill will have four layers of waste containers separated vertically by 0.9 m of soil. The current waste disposal capacity is ~163,000 $m^3$. The waste will be segregated into a RCRA-permitted side and a non-RCRA-permitted side.

The delineation of groundwater flow directions and water-table gradients are difficult to estimate for the 200 East Area from water-level data because of a flat water table. Based on the geometry of existing contaminant plumes and on regional

water-level measurements, the groundwater flow direction is estimated to be toward the east to southeast at rates between 0.002 and 0.0075 m/day (Appendix B).

Work began in FY 2008 to better understand the groundwater flow direction beneath the Integrated Disposal Facility. Gyroscope surveys were completed on four of the monitoring wells and well 299-E17-21 (wells 299-E17-26 and 299-E24-24 had gyroscope surveys completed in FY 2005). A gyroscope survey could not be completed in well 299-E18-1 because the well has a bent section preventing tool access. Also, new vertical elevation surveys were done on all seven wells in the network. Several sets of water level measurements were made and trend surface analyses were applied to the measurements. The results to date were inconclusive (Sections 2.1.3 and 2.11.2.2). To determine water levels, pressure transducers have been installed in two of the Integrated Disposal Facility monitoring wells to determine the response of each well to changes in barometric pressure. This detailed work will continue in FY 2009 and will allow better definition of the water table in the area.

***Groundwater monitoring at the Integrated Disposal Facility during FY 2008 included semiannual sampling (four independent sampling events each 6-month period).***

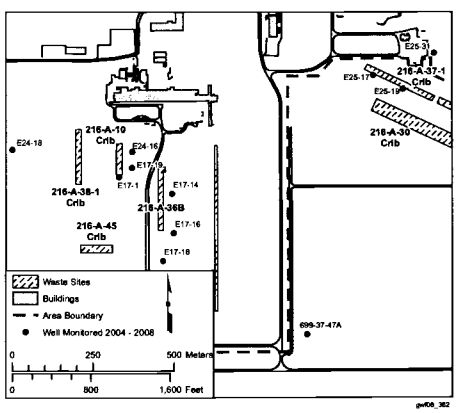
The Integrated Disposal Facility operational monitoring plan was published in FY 2005 (RPP-PLAN-26534, *Integrated Disposal facility Operational Monitoring Plan to Meet DOE Order 435.1*). That plan called for analyses of gross alpha, gross beta, technetium-99, and iodine-129 in groundwater. Therefore, these constituents were added to the list of RCRA indicator parameters (specific conductance, pH, total organic carbon, and total organic halides) and supplemental groundwater quality parameters (alkalinity, anions, metals, temperature, and turbidity) for analysis. Appendix B includes the complete sampling schedule of constituents and sampling frequency.

All groundwater monitoring wells in the Integrated Disposal Facility monitoring network initially were sampled twice quarterly for one year (June 2005 through May 2006) to determine baseline conditions. This was followed by collection of semiannual samples (four independent sampling events each 6-month period) and semiannual sampling continued throughout FY 2008.

***Only nitrate exceeded drinking water standards at the Integrated Disposal Facility during FY 2008.***

Only nitrate exceeded the drinking water standard (45 mg/L) during FY 2008 in wells at the Integrated Disposal Facility. The average annual nitrate concentration was 45 mg/L in well 299-E24-21, with the highest concentration of 46 mg/L. The average annual nitrate concentration was 64 mg/L in well 299-E24-24, and the highest concentration was 66 mg/L. These wells are in the regional 200 East nitrate plume that is presumed to originate from the RCRA PUREX Cribs east of the Integrated Disposal Facility (Section 2.11.3.2).

### 2.11.3.2 RCRA PUREX Cribs




The RCRA PUREX Cribs are located in the southeastern part of the 200 East Area and include the 216-A-10, 216-A-36B, and 216-A-37-1 Cribs (Figure 2.11-1) monitored under RCRA interim status to assess groundwater quality. Other nearby cribs also received PUREX waste (e.g., 216-A-45 Crib) but are not regulated as RCRA treatment, storage, or disposal units. They are monitored collectively under the 200-PO-1 Operable Unit.

The objective of RCRA monitoring at these cribs is to assess the nature and extent of groundwater contamination with hazardous constituents and determine their rate of movement in the aquifer (40 CFR 265.93(d) as referenced by WAC 173-303-400). Groundwater monitoring under AEA tracks radionuclides at the cribs and surrounding vicinity, and is reported

under the 200-PO-1 Operable Unit (Section 2.11.1). Appendix B lists the wells, their locations, and groundwater constituents monitored for the RCRA PUREX Cribs. The RCRA PUREX Cribs groundwater-monitoring plan is PNNL-11523, *Combination RCRA Groundwater Monitoring Plan for the 216-A-10, 216-A-36B, and 216-A-37-1 PUREX Cribs*. The 11 RCRA wells near the PUREX Cribs (Appendix B) monitor contaminant plumes in the near-field area close to the cribs. More distant portions (or the far-field area) of the contaminant plumes are monitored by the 200-PO-1 Operable Unit (Appendix A). Section 2.11.1 provides concentrations of the major plumes in both the near- and far-field areas.

Groundwater flow direction in the vicinity of the 216-A-10 and 216-A-36B Cribs (west cribs) is most likely toward the southeast; in the vicinity of the 216-A-37-1 Crib, it is estimated to be to the south or southwest. These flow directions are supported mainly by the distribution of the tritium, nitrate, and iodine-129 plumes emanating from the vicinity of these cribs. Appendix B provides more information on flow direction and rate and Section 2.11.2.2 includes information on efforts to refine the water-table map in the southeastern portion of the 200 East Area. The RCRA PUREX cribs are located in a region where several groundwater contamination plumes contain constituents that exceed drinking water standards. The similarities in effluent constituents disposed to these cribs and the 216-A-45 Crib make determining the contribution of the RCRA PUREX Cribs difficult.

***The objective of RCRA monitoring at the PUREX Cribs is to assess the nature and extent of groundwater contamination with hazardous constituents and determine their rate of movement in the aquifer.***

During FY 2008, all groundwater samples were collected as scheduled. Nitrate, non-filtered iron, and non-filtered manganese were the only hazardous waste constituents exceeding drinking water standards (for the metals, secondary drinking water standards). The nitrate drinking water standard (45 mg/L) was exceeded at seven near-field monitoring wells during FY 2008, including upgradient well 299-E24-18 to the west of the 216-A-10 Crib. The highest concentration of nitrate in the RCRA PUREX Cribs near-field monitoring network (and of the entire 200-PO-1 Operable Unit) was 127 mg/L at well 299-E17-14, located near the 216-A-36B Crib.

Nitrate trends vary depending on location. At wells near the 216-A-36B Crib (Figure 2.11-14), nitrate appears to be relatively stable at wells 299-E17-14 and 299-E17-16, but at well 299-E17-18 the trend has been rising slightly since FY 2004. At the 216-A-10 Crib, nitrate trends have been rising in earlier years, but during FY 2008 were relatively steady (Figure 2.11-15). Nitrate trends near the 216-A-37-1 Crib have been rising slightly since FY 2005, with a pulse of higher nitrate concentration passing through the site around October 2007 (Figure 2.11-16). This same higher-concentration pulse was not detected in upgradient well 299-E25-31 or in wells near the other two cribs, possibly indicating a local source near the 216-A-37-1 Crib. After flowing away from the immediate vicinity of the RCRA PUREX Cribs, the nitrate plume blends with the larger nitrate plume emanating generally from the southeast portion of the 200 East Area. Figure 2.11-9 shows the nitrate plume in the southeast portion of the 200 East Area and Figure 2.11-7 shows the plume for the entire 200-PO-1 Operable Unit.

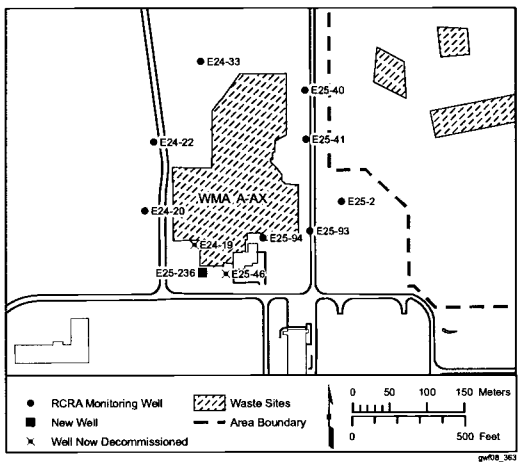
***Nitrate, iron, and manganese were the only hazardous waste constituents to exceed drinking water standards at the PUREX Cribs during FY 2008.***

The secondary drinking water standards for iron (300 μg/L) and manganese (50 μg/L) were exceeded in non-filtered samples from wells 299-E25-17 and 299-E25-19 located near the 216-A-37-1 Crib. The highest iron concentration (661 μg/L) and the highest manganese concentration (55.9 μg/L) were in well 299-E25-19. Filtered results for iron and manganese from well 299-E25-19 were 153 and 47.9 μg/L, respectively. These wells are not compliant with WAC 173-160,

and the exceedances likely were caused by unfiltered particulates from the corroded or rusted carbon-steel casings.

Groundwater quality constituents required by WAC 173-303-400 (chloride, iron, manganese, phenols, sodium, and sulfate) continued to be lower than their respective drinking water standards during FY 2008, except for the anomalously elevated iron and manganese values in wells 299-E25-17 and 299-E25-19 at the 216-A-37-1 Crib. Phenols were not detected.

### 2.11.3.3 Waste Management Area A-AX




WMA A-AX is located on the east-central border of the 200 East Area (Figure 2.11-1) and consists of the A and AX Tank Farms, the 244-AR Vault and ancillary equipment (seven diversion boxes and waste transfer lines). The tank farms contain ten 3.79 million-liter tanks constructed from 1954 to 1964. Some of the tanks are suspected to have leaked. Appendix B provides a well location map and a table of wells and analytes for this WMA.

WMA A-AX was placed in RCRA assessment monitoring (40 CFR 265.93(d) as referenced by WAC 173-303-400) because of elevated specific conductance in downgradient well 299-E25-93 during June 2005. The objective of the current groundwater assessment plan (PNNL-15315, *RCRA Assessment Plan for Single-Shell Tank Waste Management Area A-AX at the Hanford Site*) is to determine whether dangerous waste or dangerous waste constituents from the tank farms have compromised groundwater quality (40 CFR 265.93(d)(5)) beneath WMA A-AX. During FY 2008, all groundwater samples were collected as scheduled.

***The objective of the current groundwater monitoring plan at WMA A-AX is to determine whether dangerous waste constituents from the facility have effected groundwater quality.***

A new well (299-E25-236) was installed in FY 2008, as required by the groundwater assessment plan, near the southwestern corner of the site. Well 299-E25-236 replaced two wells that were damaged by corrosion, and is compliant with WAC 173-160. Sampling of the new well will start in FY 2009. This new well was required by the RCRA assessment plan (PNNL-15315) to complete the monitoring network.

The groundwater-monitoring network for WMA A-AX consists of eight wells that are compliant with WAC 173-160 and one well that is not compliant (well 299-E25-2). All are screened or perforated at the water table. Aquifer thickness is ~27 m, while the saturated screened intervals range from 1.5 to 10.4 m in compliant wells. Based on projections of water-table decline, replacement of older wells will not be required for at least 14 years. During FY 2008, groundwater flow direction did not change. Estimated flow rate was reduced slightly from FY 2007, based on a more recent estimate of water-table gradient (Appendix B). The flow direction, determined mainly from plume tracking, is most likely toward the southeast. Determining flow direction from water-table maps is difficult because of the extremely low gradient (estimated 0.00002).

***The only RCRA-regulated contaminant exceeding its drinking water standard (45mg/L) was nitrate, and that exceedance was at well 299-E25-93.***

Nitrate, sodium, sulfate, total organic carbon, chromium, and lead are the principal site-specific constituents analyzed in groundwater samples at WMA A-AX (PNNL-15315). Technetium-99, as well as other anions and metals are supporting constituents. Technetium-99 is not a RCRA constituent, but is helpful to track potential groundwater contamination sources within the WMA A-AX. Only nitrate and technetium-99 exceeded their drinking water standards (45 mg/L and 900 pCi/L, respectively) during FY 2008.

Figure 2.11-9 shows the nitrate plume near the WMA A-AX and southeast 200 East Area. Only downgradient well 299-E25-93 exceeded the nitrate drinking standard (Figure 2.11-17) with a concentration of 54.4 mg/L. This higher concentration indicates a nitrate source within the WMA A-AX, although there is a nitrate contribution from the upgradient groundwater flow direction (northwest). The nitrate trend for well 299-E25-93 has been stable since FY 2006. The trend at upgradient well 299-E24-33 is similar. Downgradient well 299-E25-94 and upgradient well 299-E24-20 show generally decreasing trends. Downgradient wells 299-E25-40, 299-E25-41, and 299-E25-2 have generally increasing trends. The wells with stable to increasing trends are to the north and east of the WMA A-AX, whereas wells with declining trends are to the southwest and south.

Like nitrate, technetium-99 is more concentrated at downgradient well 299-E25-93 than any other well at WMA A-AX, suggesting a local source (Figure 2.11-18). During FY 2008, the technetium-99 drinking water standard (900 pCi/L) was exceeded in two wells (upgradient well 299-E24-33 and downgradient well 299-E25-93). Downgradient well 299-E25-93 had the highest concentrations ranging from 6,200 to 8,000 pCi/L, and a relatively stable concentration since FY 2006 (Figure 2.11-11). During FY 2008, upgradient well 299-E24-33 had a concentration range of 1,000 to 1,100 pCi/L. The elevated concentrations indicate that an upgradient source of technetium-99 (e.g., WMA C) is likely.

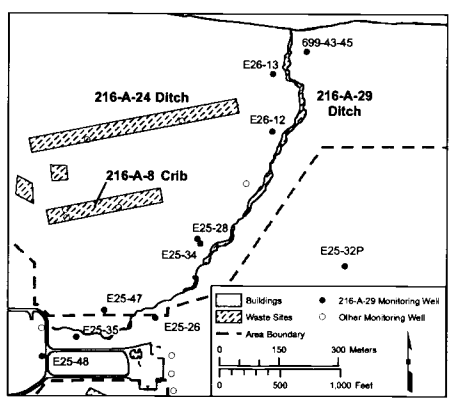
***Elevated levels of nitrate and technetium-99 at downgradient well 299-E25-93 may indicate a local source of groundwater contamination.***

The sulfate secondary drinking water standard (250 mg/L) was not exceeded at WMA A-AX during FY 2008, with the highest concentrations in wells 299-E24-33 and 299-E25-93. Both upgradient well 299-E24-33 and downgradient well 299-E25-93 had similar sulfate values (121 to 137 mg/L) and similar overall increasing trends (Figure 2.11-19). Upgradient well 299-E24-20 (in the western portion of WMA A-AX) had lower levels of sulfate concentration ranging from 60.6 to 70.5 mg/L. Figure 2.10-9 indicates that the increasing trend for sulfate at WMA A-AX may be from upgradient areas to the northwest or north.

Sodium and chromium also were detected at WMA A-AX wells, but neither exceeded their respective drinking water standards. Upgradient and downgradient concentrations were comparable. Lead in unfiltered samples was detected at low concentrations in two upgradient wells and three downgradient wells. Concentrations ranged from 0.1 to 0.5 μg/L. Filtered lead was not detected. Detected total organic carbon results during FY 2008 ranged from 300 to 1,100 μg/L in WMA A-AX wells. Upgradient wells were responsible for all the reported values above 500 μg/L, indicating there are probably no local sources of groundwater contamination that would raise total organic carbon results at WMA A-AX.

### 2.11.3.4 216-A-29 Ditch

***C. J. Martin***




The groundwater beneath the 216-A-29 Ditch is monitored under RCRA (40 CFR 265.93(d), as referenced by WAC 173-303-400) for detection of hazardous waste/hazardous waste constituent impact to groundwater. The nine wells of the groundwater-monitoring network are sampled semiannually for contamination indicator parameters and annually for groundwater quality parameters and site-specific constituents (PNNL-13047, *Groundwater Monitoring Plan for the 216-A-29 Ditch*). Appendix B lists the network wells, their locations, and groundwater constituents monitored. The well

network is adequate for the current groundwater flow direction. During FY 2008, all groundwater samples were collected as scheduled.

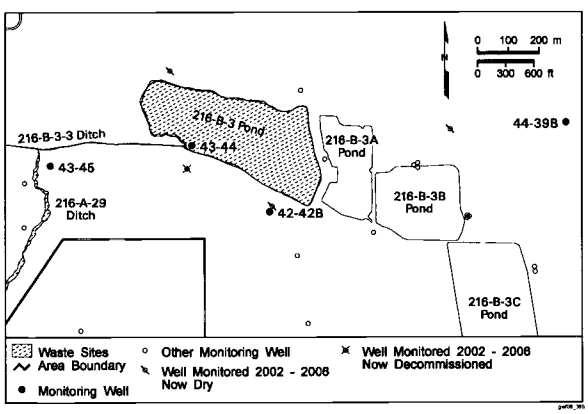
Specific conductance continues to remain above the critical mean in downgradient wells 299-E25-35, 299-E25-48, and 299-E26-13 during both semiannual sampling events (Appendix B). The continued increasing trend in specific conductance coincides with similar increases in sulfate, nitrate, chloride, and the major soil cations (i.e., calcium) in these wells. Wells 299-E25-28 (deep completion) and 299-E25-34 appear to be least affected by these trends. The cause of this rise is unknown, but appears to coincide with a general, multi-year increase in ionic strength throughout much of the 200 East Area and adjacent areas, and cannot be attributed solely to discharge practices at the 216-A-29 Ditch. None of the increasing constituents exceed drinking water standards. The remaining three contamination-indicator parameters (pH, total organic carbon, and total organic halides) were below critical means for all wells in the 216-A-29 Ditch network during FY 2008.

***Specific conductance continued to remain above the critical mean in downgradient wells at the 216-A-29 Ditch during FY 2008.***

Based on a general interpretation of the water-table map in the 200 East Area and measured head differences between network wells, the direction of groundwater flow near the 216-A-29 Ditch is estimated to be to the south or southeast. The water-table gradient at the 216-A-29 Ditch is estimated at $7.35 \times 10^{-4}$ and yields a groundwater flow velocity of 0.053 m/d. Because of a variety of potential measurement errors that could exceed the head differences between wells and the very flat gradient, confidence in the estimates of flow direction and rate is low.

### 2.11.3.5 216-B-3 Pond Facility (B Pond)

***C. J. Martin***




The original B Pond System included the main pond and three expansion ponds (Figure 2.11-1). The main pond and an adjacent portion of the 216-B-3-3 Ditch are now regulated under RCRA and require groundwater monitoring under the interim status RCRA regulations (40 CFR 265.93(d), as referenced by WAC 173-303-400). These features are the regulated remnants of the more expansive system of ponds and ditches, which have been clean closed. The B Pond System continued in an interim status, indicator parameter evaluation program during FY 2008. The monitoring plan (including the well network, constituents of concern, sampling and analysis procedure, and a conceptual model) is detailed in PNNL-15479, *Groundwater Monitoring Plan for the Hanford Site 216-B-3 Pond RCRA Facility*.

As required under RCRA and *Washington Administrative Code*, procedures for interim status facility indicator parameter monitoring the required indicator parameters (pH, specific conductance, total organic carbon, and total organic halides) are compared between upgradient and downgradient wells using the most recent data. The current network wells and hydraulic gradient configuration allow for adequate determination of groundwater flow directions and allow the specified upgradient/downgradient comparisons to be made. Figure 2.11-1 shows the locations of the four wells (699-44-39B, 699-42-42B, 699-43-44, and 699-43-45) in the groundwater monitoring well network for the B Pond System. Well 699-44-39B is upgradient, and the other three wells are downgradient. The wells are sampled semiannually for the required indicator parameters, with four samples collected during each event.

In addition, general groundwater quality parameters, metals, phenols, and anions are collected annually. During FY 2008, all groundwater samples were collected as scheduled.

During FY 2008, critical mean values for the indicator parameters were not exceeded except for total organic carbon at well 699-43-44. The well was resampled, and concentrations were less than the critical mean.

***During FY 2008, none of the indicator parameters exceeded their critical means at the 216-B-3 Pond Facility.***

Nitrate, which had been rising in well 699-42-42B since 1998, declined from 7.04 to 6.82 mg/L. Sulfate continued a steady increasing trend in all wells at B Pond during FY 2008, with the highest concentration of 32.1 mg/L in well 699-42-39B. Levels of both nitrate and sulfate remain below estimates of site-wide groundwater background concentrations. The cause of the low-levels for nitrate and sulfate may be the large volume of wastewater discharged to the B Pond, which may have caused dilution of these constituents. During FY 2008, well 699-44-39B had the largest changes in concentration for chloride, nitrate, and sulfate, with increases of 20 percent, 44 percent, and 24 percent, respectively. Similar double-digit increases were seen in common soil cations in this well.

Gross beta in well 699-43-45 increased abruptly to 15.1 pCi/L in April 2007 before declining to 11.0 pCi/L in July 2007. Gross beta concentrations in this well continued to decrease during FY 2008, falling to below the detection level of 4 pCi/L in April 2008. Upgradient well 699-44-39B also is displaying an upward trend in low levels of gross beta that began in early FY 2005. In FY 2008, gross beta concentration increased from 10.0 pCi/L (July 2007) to 13 pCi/L. The reason for these small departures from historical trends is unknown. However, other wells in the B Pond network, which have since gone dry or were part of the closed expansion ponds network, have displayed brief, intermittent gross beta excursions of the same magnitude or higher.

Based on a gradient of 0.00154 (calculated between wells 699-44-39B, 699-43-44, and 699-42-42B), an average hydraulic conductivity of 1.0 m/day, and an estimated effective porosity of 0.25, the average linear flow velocity of groundwater is estimated at 0.0062 m/day (Appendix B) in a southwest direction.

### 2.11.3.6 Nonradioactive Dangerous Waste Landfill

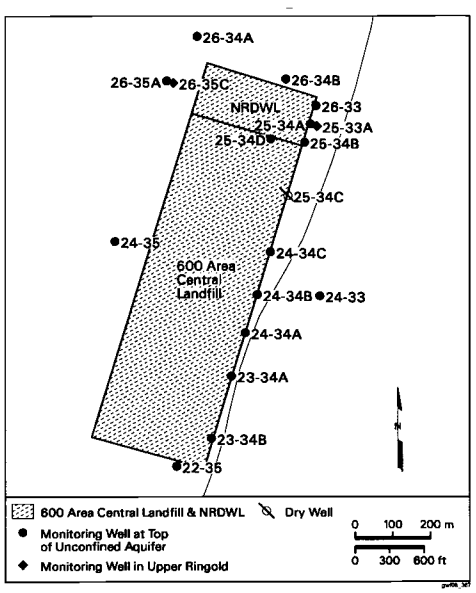
The Nonradioactive Dangerous Waste Landfill is located southeast of the 200 East Area (Figure 2.11-2) next to the Solid Waste Landfill. The objective of RCRA monitoring at the Nonradioactive Dangerous Waste Landfill is to determine if hazardous waste constituents from the landfill have contaminated groundwater (40 CFR 265.93(b) as referenced by WAC 173-303-400). Appendix B lists the wells, their locations, and groundwater constituents monitored. Groundwater flow direction is southeast as determined from the general direction of movement of major 200 East Area plumes.

***The objective of RCRA monitoring at the Nonradioactive Dangerous Waste Landfill is to determine if hazardous waste constituents from the landfill have contaminated groundwater.***

Monitoring of the Nonradioactive Dangerous Waste Landfill focuses on the RCRA interim status indicator parameters (pH, specific conductance, total organic carbon, and total organic halides), volatile organic compounds, nitrate, and the groundwater quality parameters (chloride, iron, manganese, phenols, sodium, and sulfate) (Appendix B; PNNL-12227, *Revised Hydrogeology for the Suprabasalt Aquifer System, 200-East Area and Vicinity, Hanford Site, Washington*). Wells at the Nonradioactive Dangerous Waste Landfill are sampled semiannually, usually in February and August. During FY 2008, all groundwater samples were collected as scheduled.

***Total organic carbon exceeded its critical mean at the Nonradioactive Dangerous Waste Landfill.***

Three of the indicator parameters (pH, specific conductance, and total organic halides) were below their critical means. Concentrations for total organic carbon at three downgradient wells exceeded the 1,020 µg/L critical mean in August 2008 (1,020 µg/L). One of these wells (well 699-25-33A) is a deep well screened at the top of the Ringold Formation low permeability unit at the base of the unconfined aquifer. Upgradient/downgradient statistical comparisons are not made with this well. The other two wells (699-25-34A and 699-25-34B) are screened at the water table. The quadruplicate results averaged 1,525 µg/L for well 699-25-34A and 1,803 µg/L for well 699-25-34B. The wells were resampled in October 2008. The new averaged concentration for well 699-25-34A was below the laboratory detection level of 200 µg/L, but the concentration for well 699-25-34B averaged 2,035 µg/L. Verification sampling results for well 699-25-34B confirmed the initial results, and indicate the Nonradioactive Dangerous Waste Landfill may be impacting groundwater quality. Ecology was notified of the verified exceedance, and work began on a groundwater quality assessment plan for the Nonradioactive Dangerous Waste Landfill. Activities conducted after the initial exceedances of total organic carbon at the two downgradient wells were in FY 2009, and are presented here for completeness. Further developments will be reported in the FY 2009 report.




Drinking water standards of volatile organic compounds were not exceeded at the Nonradioactive Dangerous Waste Landfill during FY 2008. However, concentration levels of five volatile organic compounds were estimated at levels between their respective method detection levels and the analytical laboratory's practical quantitation limits (required detection limits). Those volatile organic compounds were 1,1,1-trichloroethane, chloroform, methylene chloride (dichloromethane), tetrachloroethene, and trichloroethene.

During FY 2008, the only groundwater quality parameter exceeding drinking water standards was unfiltered iron (382 µg/L). The corresponding filtered sample had a concentration of 19.7 µg/L for iron. The other results for groundwater quality parameters during FY 2008 were either not detected (e.g., phenols) or were reported in concentrations below their respective drinking water standards.

### 2.11.3.7 Solid Waste Landfill (600 Area Central Landfill)

***Compliance at the Solid Waste Landfill is determined by comparing results from monitoring downgradient wells with statistically derived background threshold values from upgradient wells.***

The Solid Waste Landfill is located south of the Nonradioactive Dangerous Waste Landfill (Figure 2.11-2). The landfill is regulated by Ecology under WAC 173-304. WAC 173-304 constituents and site-specific constituents (including volatile organic compounds and filtered arsenic) are analyzed on groundwater samples collected quarterly (PNNL-13014, *Groundwater Monitoring Plan for the Solid Waste Landfill*). Compliance is determined by comparing results from monitoring downgradient wells with statistically derived background threshold values from upgradient wells. Groundwater flow direction is southeast, as inferred from the general direction of movement of major 200 East Area plumes. The well network for the Solid Waste Landfill includes two upgradient and seven downgradient wells Appendix B lists the network wells, their locations, and groundwater constituents monitored. During FY 2008, all scheduled samples were collected at the Solid Waste Landfill.

A leachate collection system underlying one set of double trenches within the landfill has detected contamination from the landfill in past years. Arsenic and

1,4-dioxane were detected in the leachate, but were not analyzed in groundwater samples. They have been added to the list of constituents analyzed in groundwater samples from the network wells. Ammonium ion, dissolved iron, dissolved manganese, dissolved zinc, arsenic, barium, chloride, copper, fluoride, nickel, selenium, sulfate, 1,4-dioxane, and 1,4-dichlorobenzene were detected in the leachate (09-AMCP-0010, "Hanford Site Solid Waste Landfill Annual Monitoring Report, July 2007 Through June 2008") between July 2007 and June 2008. All of these constituents detected in the leachate collection system (except for selenium) were analyzed in groundwater samples collected from Solid Waste Landfill network wells. Section 3.2 provides more detail about vadose zone contamination and results of analyses in the Solid Waste Landfill leachate collection system.

***All constituents detected in the leachate collection system (except for selenium) were analyzed in groundwater samples collected from Solid Waste Landfill network wells during FY 2008.***

***WAC 173-304 Parameters.*** Each WAC 173-304 parameter is discussed separately in the following paragraphs. A complete list of results for required constituents at the Solid Waste Landfill during FY 2008 and background threshold values are in Appendix B. The increased amount of detail in the discussions of individual groundwater constituents (compared to other sections of this report) is provided to meet the annual reporting requirements of the groundwater-monitoring plan (PNNL-13014).

*Ammonium* – Results for ammonium ion (background threshold value 90 μg/L) in Solid Waste Landfill wells during FY 2008 ranged from less than the method detection limit (12 μg/L) to 33.9 μg/L (from February 2008) at well 699-24-35. Ammonium ion was detected at the upgradient and downgradient wells. Detections of this groundwater constituent have been sporadic in previous years at the Solid Waste Landfill and continued in FY 2008.

*Chemical Oxygen Demand* – Chemical oxygen demand (background threshold value 10 mg/L) ranged from less than the method detection limit (10 mg/L) at upgradient wells and some downgradient wells to 23 mg/L at well 699-24-33. Historically, chemical oxygen demand values are sporadic at the Solid Waste Landfill. Elevated values of this constituent could be an indication of groundwater contamination by sewage, which was known to be discharged to Solid Waste Landfill trenches.

***Downgradient wells at the Solid Waste Landfill showed elevated concentrations of chemical oxygen demand, coliform bacteria, specific conductance, sulfate, temperature, and total organic carbon, and low pH.***

*Chloride* – Chloride ranged from 5.9 mg/L (at downgradient well 699-23-34A) to 7.6 mg/L (at downgradient well 699-24-34A). The background threshold value (7.8 mg/L) was not exceeded. Chloride slightly increased in concentration in most Solid Waste Landfill wells until about 2005, and stabilized thereafter.

*Coliform Bacteria* – The background threshold value (1 colony per 100 ml of groundwater) was exceeded at one well during FY 2008. That exceedance was 2 col./100 ml in background well 699-24-35. Like chemical oxygen demand, elevated levels of coliform bacteria have been detected sporadically at the Solid Waste Landfill in past years. Elevated levels of this constituent are expected with the known disposal of sewage at the Solid Waste Landfill.

*Filtered Iron* – None of the filtered iron results exceeded the 160 μg/L background threshold value during FY 2008. The reported values ranged from less than 9 to 109 μg/L. Elevated filtered iron results have been reported above the background threshold value occasionally at Solid Waste Landfill wells in recent years, but are not typical of the overall historical results.

*Filtered Manganese* – Filtered manganese was mostly undetected (above the method detection level of 4 μg/L) in Solid Waste Landfill wells during FY 2008.

The maximum level detected was 8.2 μg/L at downgradient well 699-24-34A. The background threshold value was 18 μg/L.

*Nitrate* – The Solid Waste Landfill is located on the western edge of the major nitrate plume emanating from the 200 East Area (Figure 2.11-7). Downgradient wells have similar levels of nitrate as the upgradient wells. During FY 2008, the highest level of nitrate at the Solid Waste Landfill was 19.2 mg/L at downgradient well 699-23-24A, which was significantly lower than the 29 mg/L background threshold value.

*Nitrite* – Although the background threshold value was 148 μg/L, the highest reported detected result of 88.4 μg/L was still below the analytical laboratory's required detection limit.

*Field pH* – Six wells at the Solid Waste Landfill during FY 2008, including upgradient well 699-24-35, had pH levels that were lower than the background threshold range (6.68 to 7.84). The downgradient wells that exceeded the background threshold range were 699-23-34A, 699-23-34B, 699-24-33, 699-24-34A, and 699-24-34B. The lowest pH value was 6.52 at well 699-23-34A. Trends of pH are relatively steady at Solid Waste Landfill wells.

*Specific Conductance* – Specific conductance values at all seven downgradient wells exceeded the 583 μS/cm background threshold value during FY 2008. At the two upgradient wells (699-24-35 and 699-26-35A), the values were lower. Six of the seven downgradient wells also had specific conductance values greater than the 700 μS/cm WAC 246-290-310 limit. The highest reported value during FY 2008 was 829 μS/cm at the downgradient well 699-22-35. Specific conductance values at the Solid Waste Landfill have remained relatively stable since 2001. Elevated specific conductance may caused by increased concentrations of sulfate and other anions in groundwater at the Solid Waste Landfill.

***The only chlorinated hydrocarbons exceeding their WAC 173-200-40 limit during FY 2008 at the Solid Waste Landfill were tetrachloroethene (limit 0.8 μg/L) and carbon tetrachloride (limit 0.3 μg/L).***

*Sulfate* – Reported results in downgradient wells ranged from 40.3 to 55.5 mg/L. Four of the seven downgradient wells had at least one result that exceeded the 47.2 mg/L background threshold value. The overall trend for sulfate at the Solid Waste Landfill is stable to slightly increasing in concentration.

*Temperature* – Two results at well 699-22-35 (24 and 25.9°C) exceeded the 20.7°C background threshold value during FY 2008. None of the other wells exceeded the limit. Both of the exceedances (one in May 2008 and one in August 2008) appear to be anomalous and not consistent with historical trends at this well. The elevated temperature measurements are under review.

*Total Organic Carbon* – Five of the downgradient wells and one of the upgradient wells had total organic carbon results that exceeded the 1,430 μg/L background threshold in the February 2008 sampling event. Results in the other three quarters were all below the background threshold value. The exceedances ranged from 2,910 μg/L at well 699-24-34B to 38,300 μg/L at well 699-24-33. Spurious elevated total organic carbon results have been reported previously at the Solid Waste Landfill. The total organic carbon exceedances are under review.

*Filtered Zinc* – Reported values for filtered zinc during FY 2008 at the Solid Waste Landfill ranged from less than 4 μg/L (the analytical method detection limit) to 25.9 μg/L at the upgradient well 699- 24-35. None of the Solid Waste Landfill wells had filtered zinc values exceeding the 43.2 μg/L background threshold value.

***Site-Specific Parameters.*** Disposed waste at the Solid Waste Landfill has impacted groundwater with minor chlorinated hydrocarbon contamination. However,

the concentrations of chlorinated hydrocarbons at the Solid Waste Landfill have decreased over the years and were barely detectable during FY 2008. The only chlorinated hydrocarbons exceeding WAC 173-200-40 limits during FY 2008 were tetrachloroethene (limit 0.8 μg/L) and carbon tetrachloride (limit 0.3 μg/L). The highest reported tetrachloroethene result was 2.6 μg/L at the downgradient well 699-24-33; and the only detected carbon tetrachloride result was 1.0 μg/L at downgradient well 699-22-35. These results were below the analytical laboratory's practical quantitation limit (required detection limit). Four chlorinated hydrocarbons (1,1,1-trichloroethane, chloroform, methylene chloride, and trichloroethene) were detected at low concentrations in Solid Waste Landfill wells during FY 2008. Like the tetrachloroethene and carbon tetrachloride results, the results for these chlorinated hydrocarbons were below the analytical laboratory's practical quantitation limits (required detection limits). The two volatile organic compounds (1,4-dioxane and 1,4-dichlorobenzene) were undetected in groundwater samples.

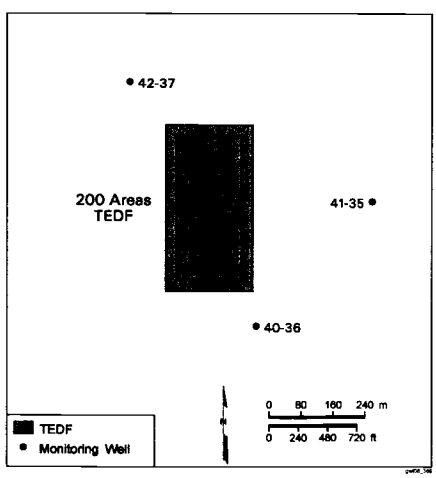
A potential cause of the widespread, low-level chlorinated hydrocarbon contamination at the Solid Waste Landfill, including the upgradient wells and the adjacent Nonradioactive Dangerous Waste Landfill wells, is the dissolution of vadose zone vapors into groundwater. However, the vapor source is uncertain. Potential sources are the chlorinated hydrocarbons dissolved in the liquid sewage or the catch tank liquid from the 1100 Area heavy equipment garage and bus shop that were disposed to the Solid Waste Landfill (PNNL-13014).

The other constituents discovered in the leachate collection system at the Solid Waste Landfill (barium, copper, fluoride, nickel, and arsenic) were all detected in groundwater but had results lower than primary drinking water standards (or secondary drinking water standards, if appropriate) or WAC 173-200-40 limits, except for arsenic. Although the drinking water standard for arsenic is 10 μg/L, the WAC 173-200-40 limit is 0.05 μg/L. Results for filtered arsenic ranged from 1.1 to 5.8 μg/L, all exceeding the WAC 173-200-40 limit. However, results from downgradient wells were not significantly different than results from upgradient wells.

Some downgradient wells continue to show higher chemical oxygen demand, coliform bacteria, specific conductance, sulfate, and lower pH. The lower pH apparently is a result of high concentrations of carbon dioxide in the vadose zone resulting from the degradation of sewage material disposed to the Solid Waste Landfill (DOE/RL-93-88, Section 5.3; PNL-7147; WHC-SD-EN-TI-199). The elevated chemical oxygen demand, coliform bacteria, and specific conductance also may be related to the disposed sewage.

### 2.11.3.8 200 Area Treated Effluent Disposal Facility

The 200 Area Treated Effluent Disposal Facility is located southeast of the B Pond RCRA facility and has received effluent since June 1995. Groundwater beneath the facility is monitored under a Washington State waste discharge permit (WAC 173-216; PNNL-13032). Wells 699-40-36, 699-41-35, and 699-42-37 monitor groundwater beneath the facility.




Prior to the 200 Area Treated Effluent Disposal Facility, there was no continuous unconfined aquifer above the Ringold Formation lower mud unit at that location. Therefore, the three groundwater monitoring wells installed at the facility were installed in the locally confined aquifer below the lower

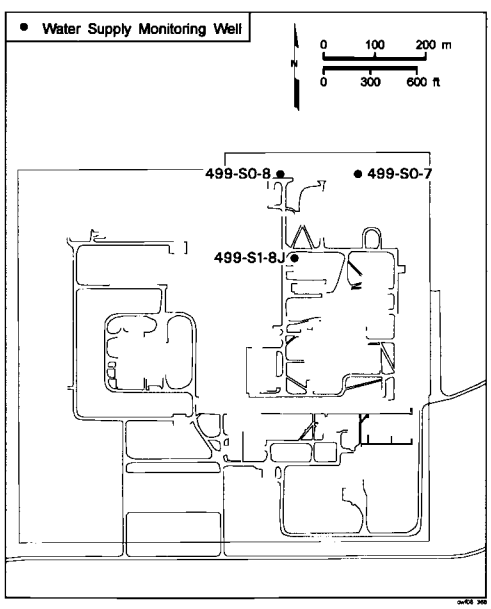
mud unit (Section 2.14) and are isolated from the effects of the effluent from the disposal facility by the relatively impermeable silts and clays of the lower mud unit (PNNL-14098; PNNL-15479). When the wells were installed, a minor amount of perched water was encountered above the lower mud unit, and recent discharges to the ground at the facility have most likely increased the amount of perched water. The quarterly analytical results from the three wells are used to demonstrate continuation of the isolation of discharges from the locally confined aquifer below the lower mud unit.

Based on hydraulic head measurements in FY 2008, and estimates of effective porosity and hydraulic conductivity, groundwater flow potential in the confined aquifer beneath the 200 Area Treated Effluent Disposal Facility is directed southwest (220° azimuth) at 0.0006 m/day. Historically, major ionic composition and extremely low tritium concentration have indicated that groundwater in the Ringold Formation confined aquifer beneath this facility is isolated from groundwater in the adjacent unconfined aquifer, and its water quality is largely unaffected by Hanford Site operations. Results of annual low-level tritium analyses confirm this interpretation. Hydraulic head continues to decline in the wells at the 200 Area Treated Effluent Disposal Facility as a result of the dissipating pressure effect of historical discharges at the nearby B Pond facility.

***Enforcement limits for groundwater constituents were not exceeded at the 200 Areas TEDF during FY 2008.***

Groundwater samples are collected quarterly from wells for a list of constituents required by the state waste-discharge permit ST-4502 (Ecology, 2000, *State Waste Discharge Permit ST 4500*). Three of the constituents (cadmium, lead, and pH) are compared with specific enforcement limits set by the permit. During FY 2008, all groundwater samples were collected as scheduled and no enforcement limits were exceeded. Most concentrations for anions, metals, and radionuclide indicators have been below Hanford Site groundwater background levels (e.g., WHC-EP-0595; DOE/RL-96-61) since monitoring began at the site.

### 2.11.3.9 400 Area Water Supply Wells




Primary groundwater monitoring activities in the 400 Area involve monitoring of the 400 Area water supply wells. Monitoring is conducted to provide information needed to describe the nature and extent of site-wide contamination (primarily tritium, nitrate, and iodine-129). This section discusses the monitoring of the 400 Area water supply wells (specifically tritium) and general aspects of groundwater chemistry in the 400 Area. The water supply wells were sampled quarterly as scheduled in FY 2008.

The Hanford Site water-table map (Figure 2.1-2) indicates that flow in the unconfined aquifer is generally to the east-southeast across the 400 Area. The water table is located near the contact of the Ringold Formation and Hanford formation, which is ~49 m below ground surface (WHC-EP-0587, *Groundwater Impact Assessment Report for the 400 Area Ponds*). Hanford formation sediment dominates groundwater flow in the 400 Area because of its relatively high permeability compared to that of the sediments in the underlying Ringold Formation.

Elevated levels of tritium associated with the groundwater plume originating from the PUREX Cribs in the 200 Area were identified in the 400 Area wells (Figures 1.0-2 and 2.11-3). Groundwater tritium levels are relevant to the water supply wells, which provide drinking water and emergency

supply water for the 400 Area. Well 499-S1-8J serves as the main water supply well, while wells 499-S0-7 and 499-S0-8 are backup supply wells. Well 499-S1-8J has lower tritium concentrations because it is screened at a greater depth than the other two water supply wells. Figure 2.11-20 compares the tritium concentrations in wells 499-S0-7, 499-S0-8, and 499-S1-8J to that of the 400 Area drinking water supply. Tritium was measured at levels below the drinking water standard (20,000 pCi/L) in all three of the water supply wells in FY 2008. Tritium levels in well 499-S1-8J (the main water supply well) ranged from 2,100 to 2,500 pCi/L.

***Tritium was measured at levels below the drinking water standard (20,000 pCi/L) in all three of the water supply wells in FY 2008.***

Tritium remained below the drinking water standard and the 4-mrem/yr dose equivalent in the drinking water supply (sampled at a tap) for all sampling events in FY 2008 (Figure 2.11-20). Nitrate remained below the 45 mg/L drinking water standard for the water supply wells. Data from these wells indicate no other constituents are present at levels above their drinking water standards.

***Groundwater monitoring in the 200-PO-1 groundwater interest area includes the following monitoring activities.***

***CERCLA Monitoring (Appendix A)***

- ***Forty-one near-field wells and eighty far-field wells are scheduled for annual to triennial sampling. The wells were sampled as planned in FY 2008.***
- ***One new well was installed in FY 2008 and will be sampled beginning in FY 2009.***
- ***Thirteen new aquifer tubes were installed and most were sampled in FY 2008.***

***Facility Monitoring (Appendix B)***

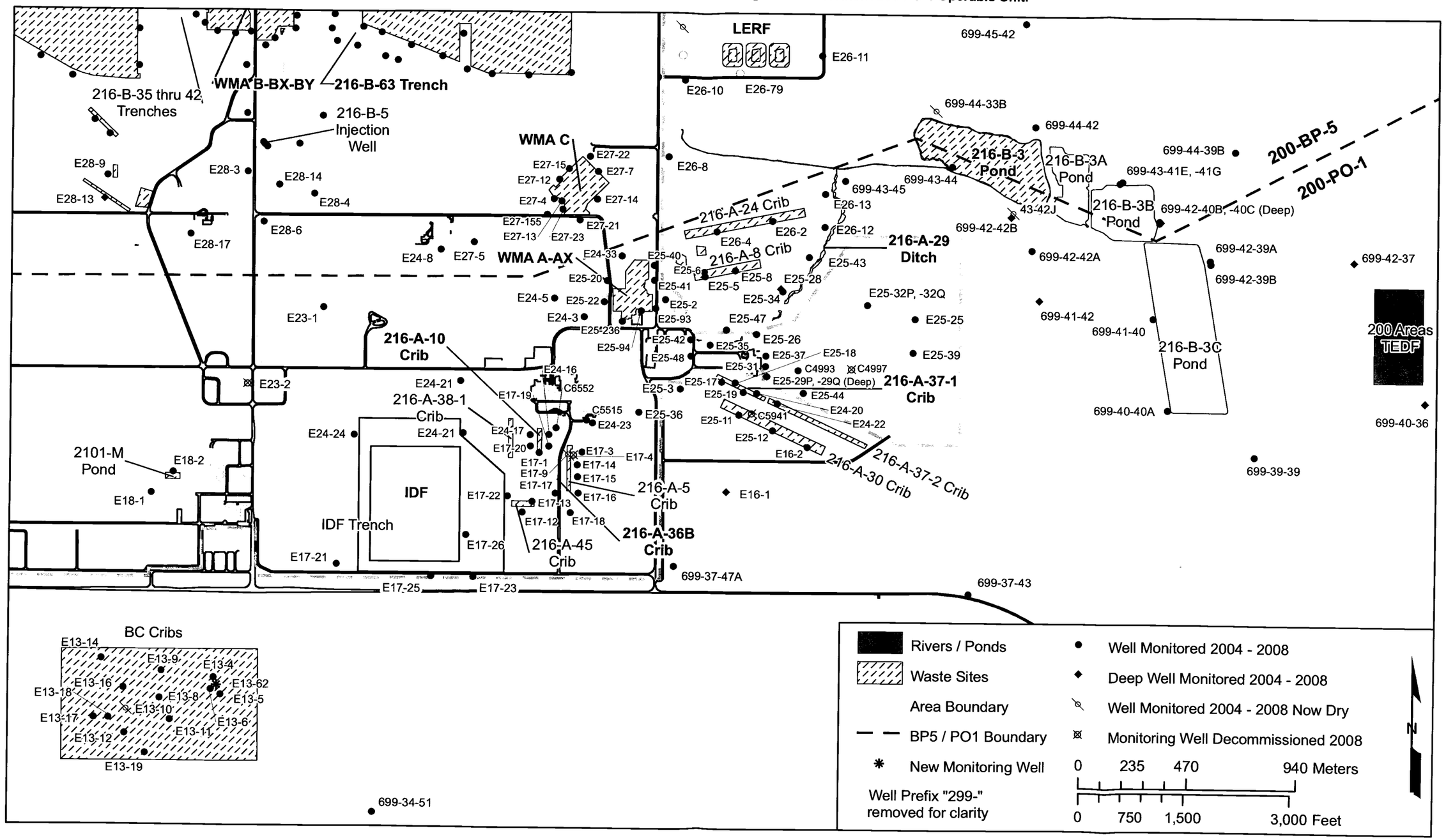
- ***Seven wells are scheduled for semiannual sampling at the Integrated Disposal Facility.***
- ***Eleven near-field wells are scheduled for quarterly to semiannual sampling at the RCRA PUREX Cribs. Far-field well sampling is coordinated with the 200-PO-1 Operable Unit.***
- ***Eight wells are scheduled for quarterly sampling at the single-shell tank Waste Management Area A-AX. One new well was installed in FY 2008 and will be sampled beginning in FY 2009.***
- ***Nine wells are scheduled for semiannual sampling at the 216-A-29 Ditch.***
- ***Four wells are scheduled for semiannual sampling at the B Pond.***
- ***Nine wells are scheduled for semiannual sampling at the Nonradioactive Dangerous Waste Landfill for RCRA monitoring.***
- ***Nine wells are scheduled for quarterly sampling at the Solid Waste Landfill under a Washington State permit (WAC 173-304).***
- ***Three wells are scheduled for quarterly sampling at the 200 Area Treated Effluent Disposal Facility under a Washington State waste discharge permit (WAC 173-216).***
- ***Three water supply wells are scheduled for quarterly to annual sampling at the 400 Area for AEA.***
- ***All wells were sampled as planned.***

**Table 2.11-1. Analytes and Analytical Methods for the 200-PO-1 Operable Unit.**

| Characterization Sampling and Analysis Plan. | Analytical Method |
|---|---|
| 1,1,2,2-Tetrachloroethane | 8260B |
| 1,2-Dichloroethane | 8260B |
| 1,4-Dioxane | 8260/8270* |
| 2,4-Dinitrophenol | 8270 |
| Antimony | 6010B |
| Arsenic | 6010B |
| Benzene | 8260B |
| Bis(2-ethylhexyl)phthalate | 8270 |
| Bromodichloromethane | 8260B |
| Cadmium | 6010B/200.8 |
| Carbon tetrachloride | 8260B |
| Chromium | 6010B/200.8 |
| Dieldrin | 8081 |
| Dimethoate | 8270/8081* |
| Dibromochloromethane | 8260B |
| Fluoride | 300 |
| Gross alpha | 9310_ALPHABETA_GPA |
| Hexane | 8260B* |
| Heptachlor | 8081 |
| Heptachlor epoxide | 8081 |
| Iodine-129 | GEA/GPC |
| Lead | 6010B/200.8 |
| Manganese | 6010B/200.8 |
| Methylene chloride | 8260B |
| Neptunium-237 | GEA/GPC |
| Nickel | 6010B/200.8 |
| Nitrate | 300 |
| Nitrite | 300 |
| Nitrobenzene | 8270 |
| Pentachlorophenol | 8270 |
| Protactinium-231 | AEA |
| Selenium-79 | LSC |
| Strontium-90 | GPC |
| Technetium-99 | LSC |
| Thallium | 6010B/200.8 |
| Tritium | LSC |
| Tetrachloroethene | 8260B |
| Trichloroethene | 8260B |
| Uranium | 6010B/200.8 |
| Uranium-234 | AEA/AS |
| Uranium-238 | AEA/AS |
| Vanadium | 6010B/200.8 |
| Vinyl chloride | 8260B |
| Zinc | 6010 B/200.8 |

* Constituents can be requested to add to the regular list of analytes analyzed with this method.
LSC = liquid scintillation counting.
AEA = alpha energy analysis.
AS = alpha spectroscopy.
GEA = gamma energy analysis.
GPC = gas proportional counting.

**Figure 2.11-1. Facilities and Groundwater Monitoring Wells in Northern 200-PO-1 Operable Unit.**




gwf08_369.mxd

**Figure 2.11-2. 200-PO-1 Operable Unit Boundaries, Far-Field Monitoring Wells, And Transects.**

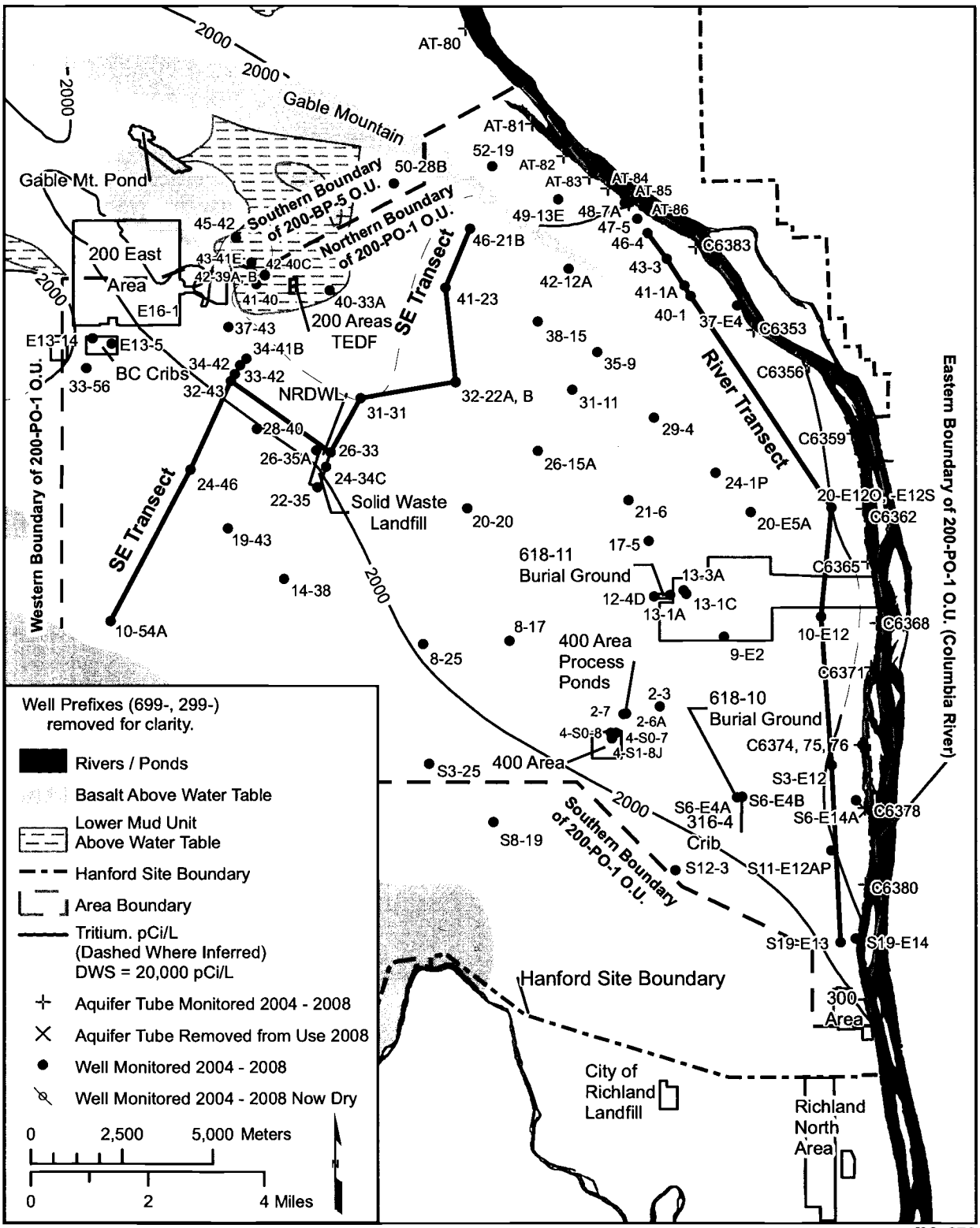


**Figure 2.11-3. Tritium Concentrations in the 200-PO-1 Operable Unit, Upper Part of Unconfined Aquifer.**

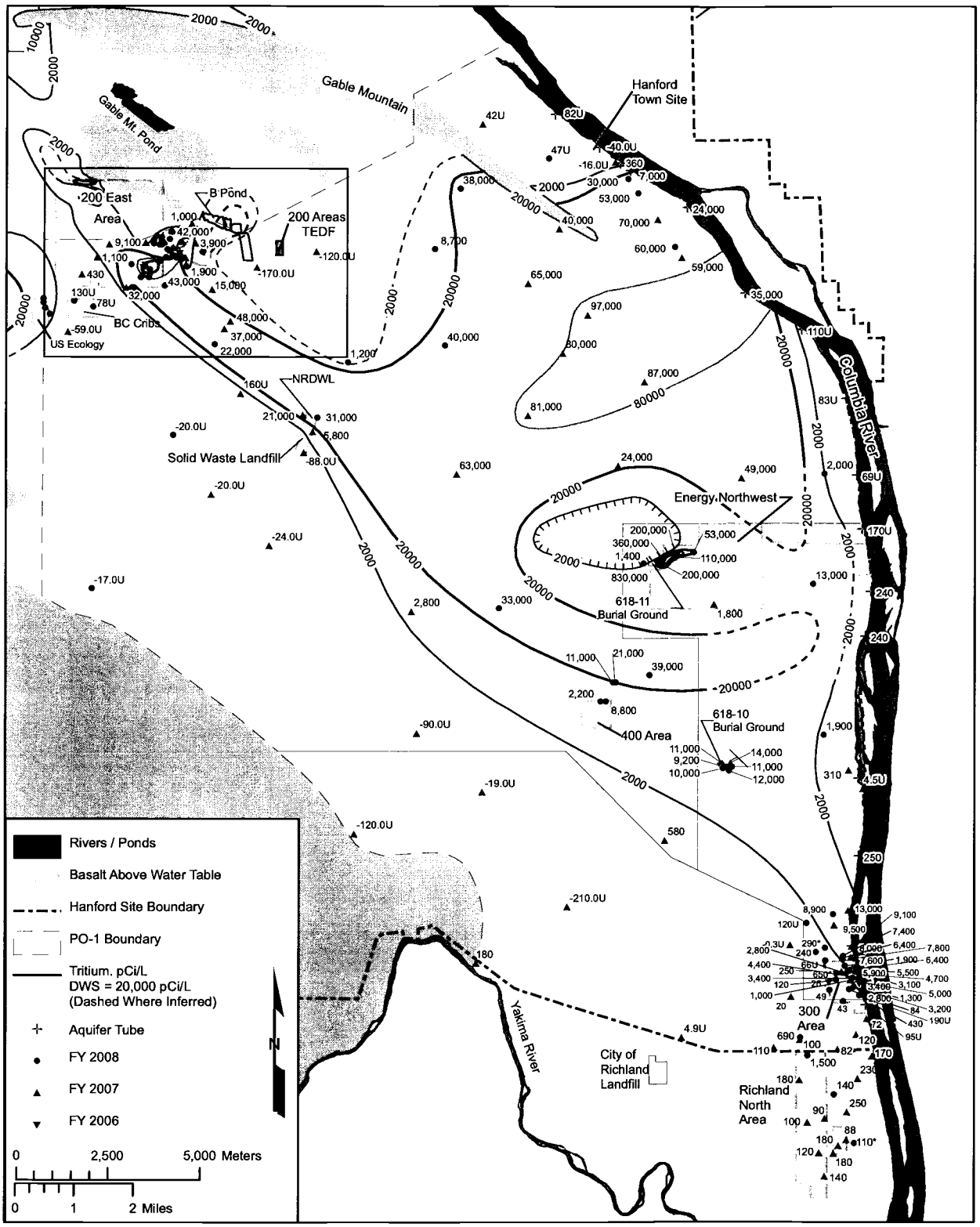


**Figure 2.11-4. Average Tritium Concentrations in the Near-Field Area, Upper Part Of Unconfined Aquifer.**

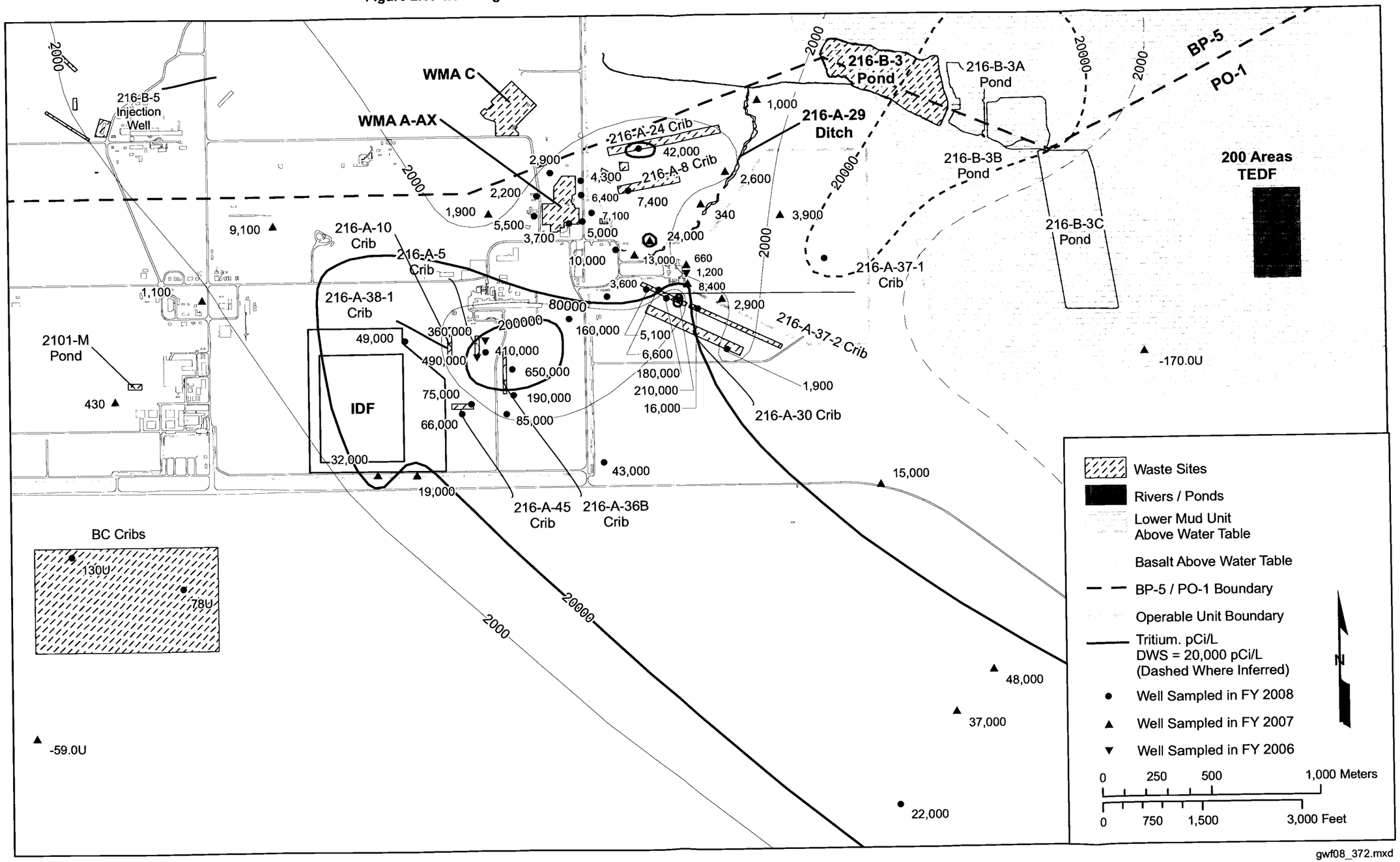


**Figure 2.11-5. Tritium Concentrations in RCRA PUREX Cribs Wells.**

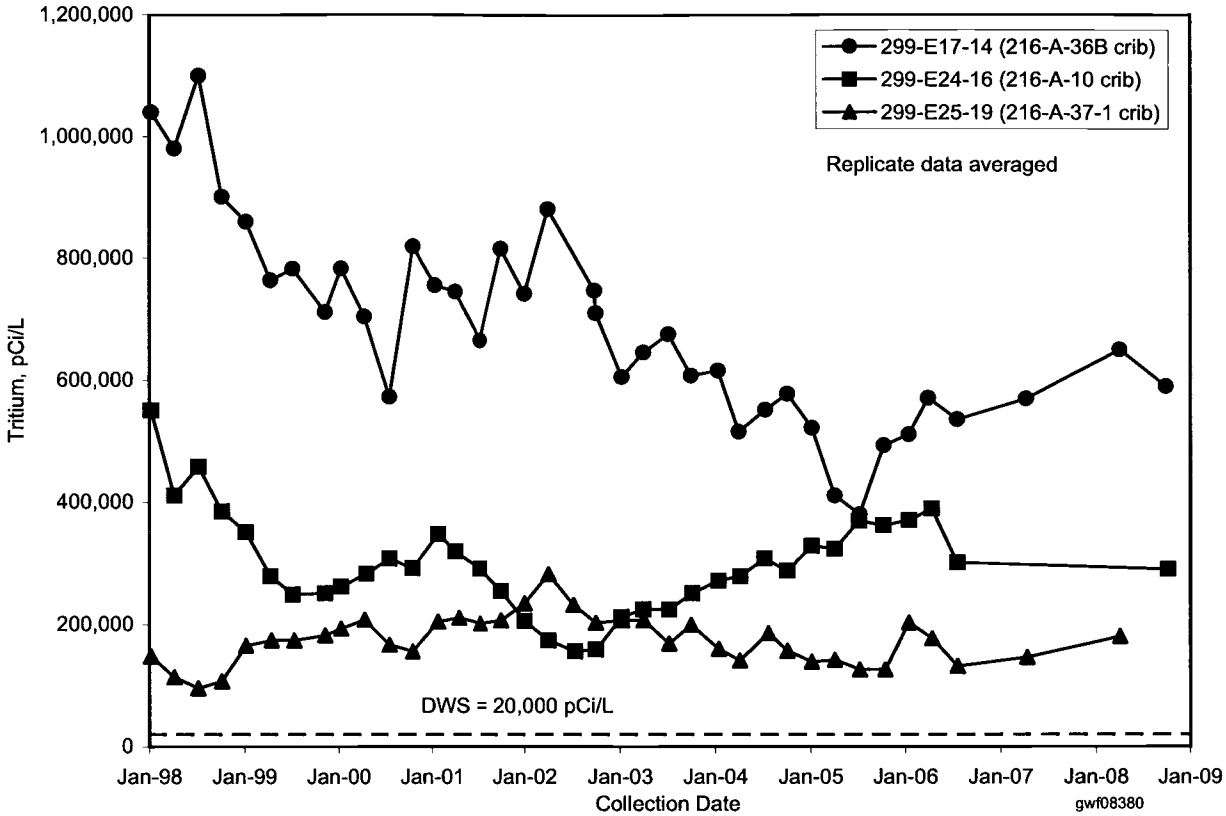


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**Figure 2.11-6. Iodine-129 Plume for the 200-PO-1 Operable Unit, Upper Part of Unconfined Aquifer.**

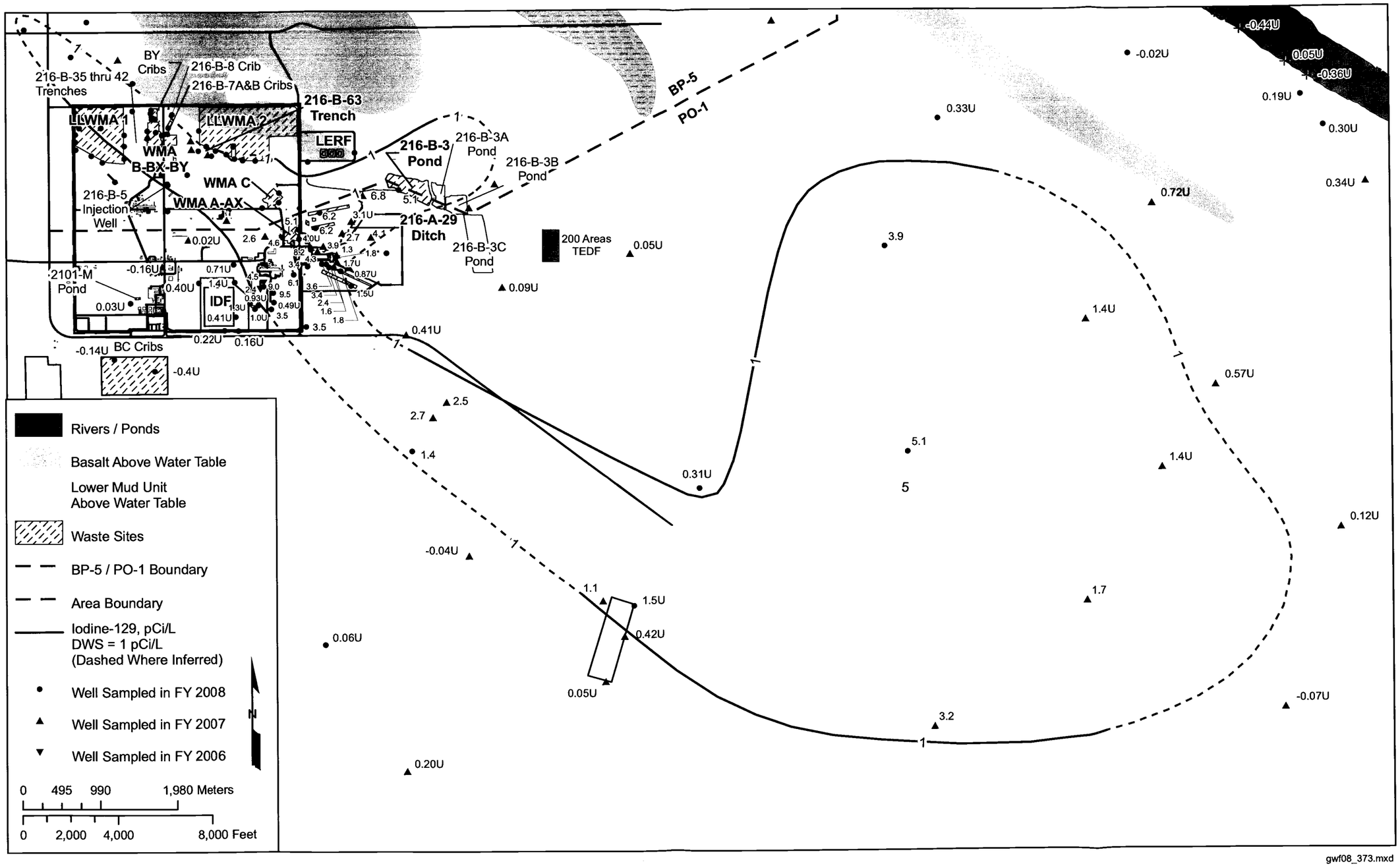


**Figure 2.11-7. Nitrate Concentrations in the 200-PO-1 Operable Unit, Upper Part of Unconfined Aquifer.**

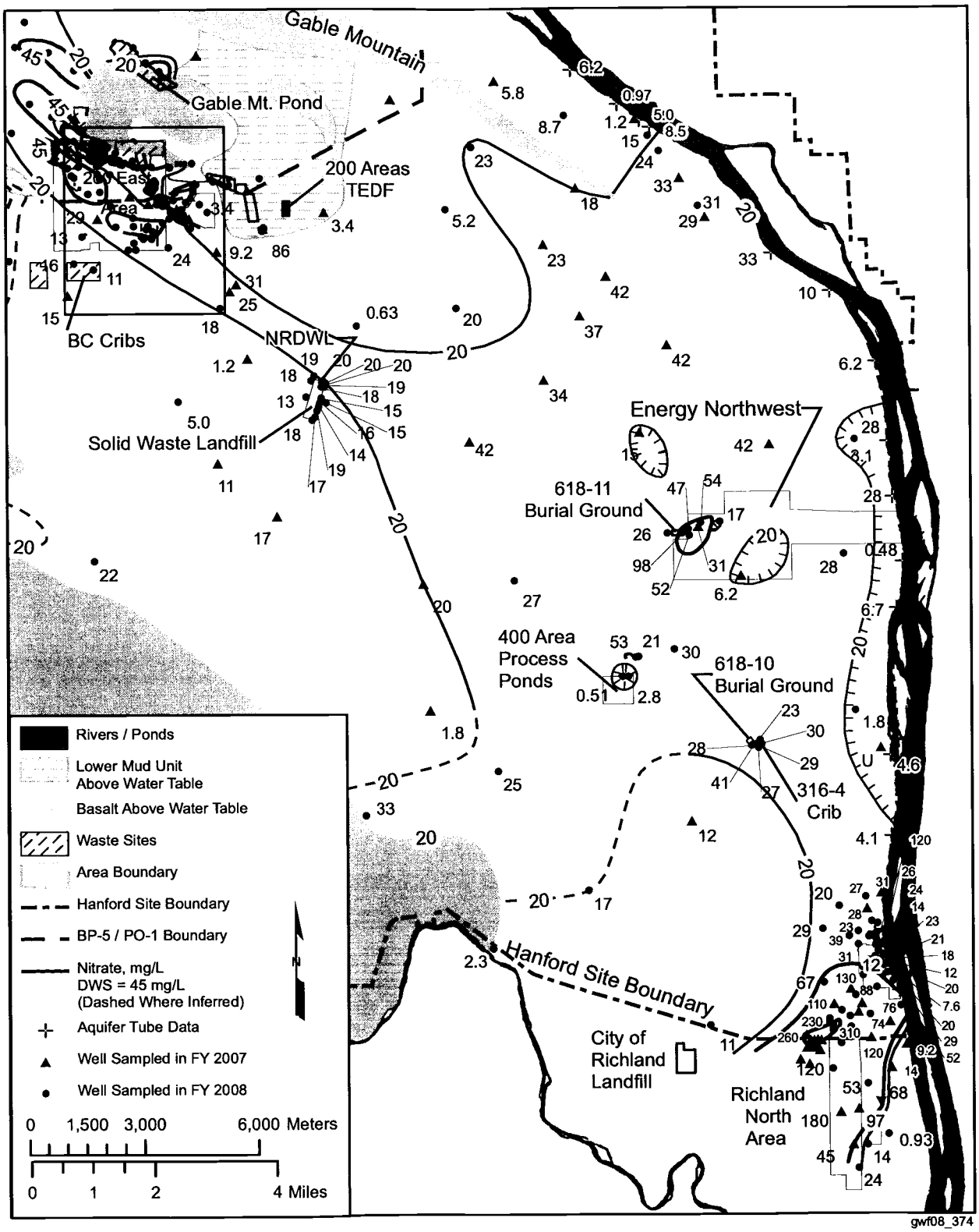


**Figure 2.11-8. Iodine-129 Concentrations in Well 299-E17-14 at the 216-A-36B Crib.**

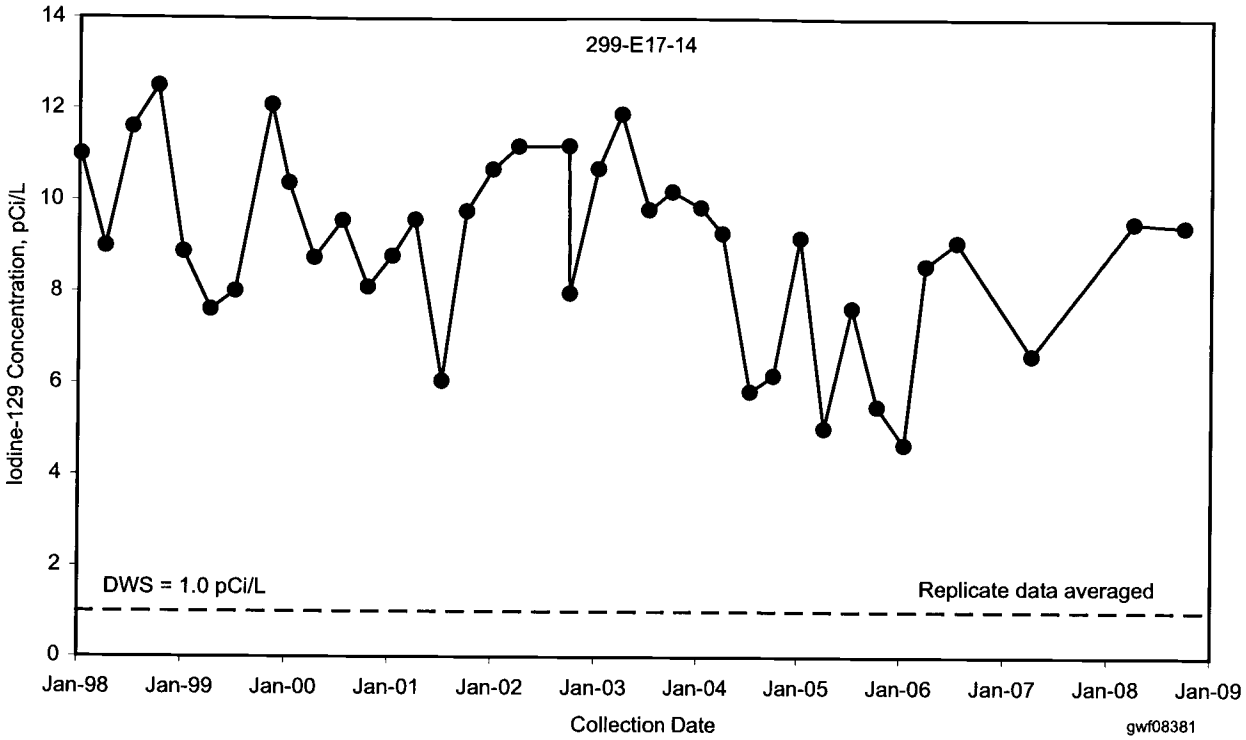
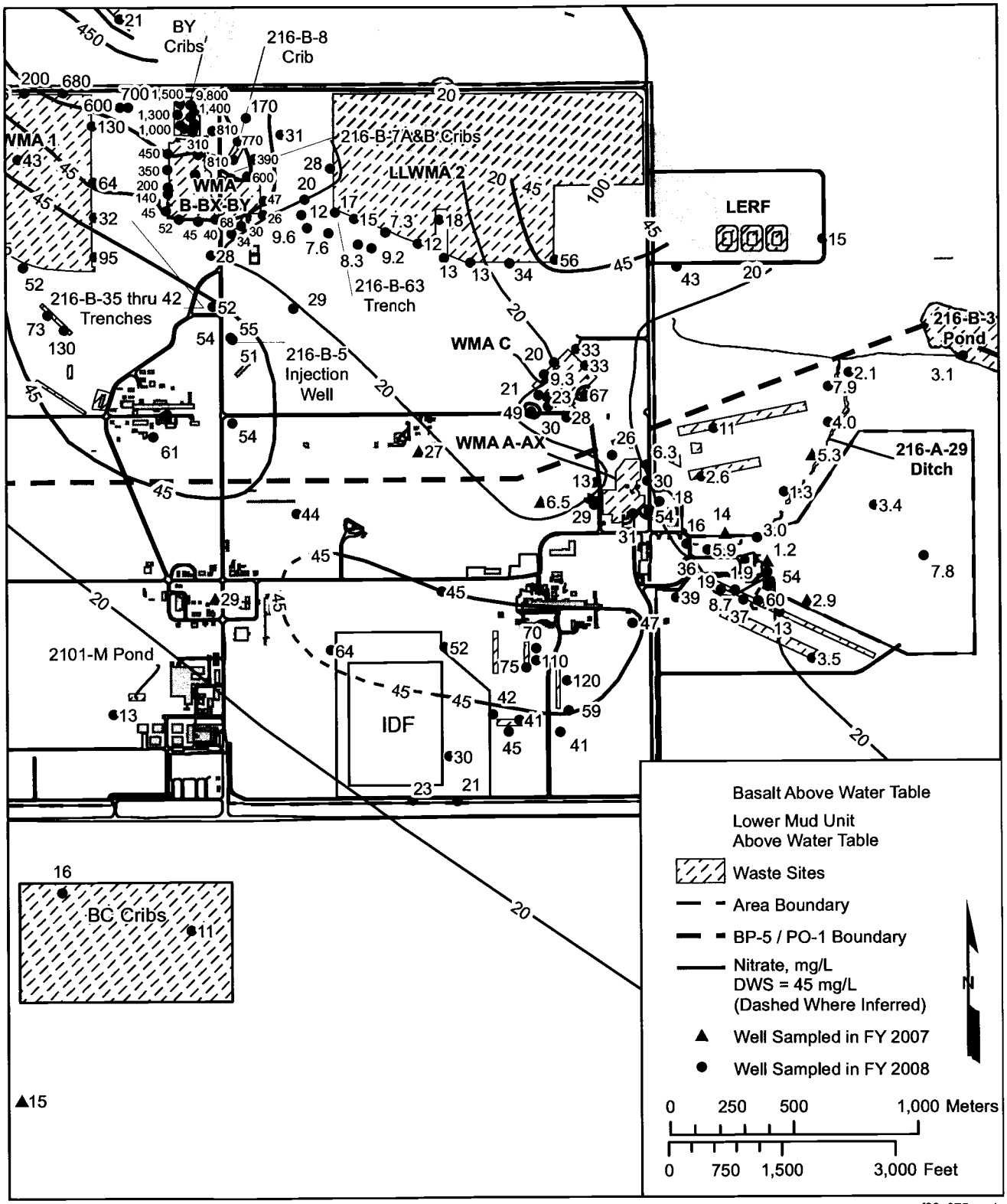


**Figure 2.11-9. Nitrate Concentrations in the Near-Field Area, Upper Part of The Unconfined Aquifer.**



- Chromium concentrations began declining in calendar year 2007. The chromium concentration averaged 29 μg/L in December 2006 and 16.5 μg/L in December 2007.
- Potassium concentrations were steady at ~23,400 μg/L in December 2007.
- Uranium concentrations, which have increased over the past 3 years, reached a new maximum concentration of 2,130 μg/L in June 2007.
- Nitrate concentrations remained steady in calendar year 2007, averaging ~ 360 mg/L.
- Specific conductance remained steady during calendar year 2007.
- Total dissolved solids, which had been increasing throughout 2006, remained steady during calendar year 2007, averaging ~2,100,000 μg/L.
- Gross alpha concentrations continued to increase, averaging ~2,840 pCi/L in June 2007.
- Gross beta concentrations, which had been increasing through calendar year 2006, remained steady in 2007, with a concentration of ~875 pCi/L in December 2007.

Groundwater monitoring data for gross alpha, gross beta, and uranium were examined to determine whether the leachate from the ERDF has affected groundwater. Uranium concentrations in groundwater remained steady. Gross alpha concentrations in groundwater showed a slight long-term decrease and gross beta concentrations showed an increase in most downgradient wells. Gross alpha and gross beta in groundwater will be closely monitored in the future but, based on the calendar year 2007 leachate concentrations, no additional analytes will be recommended for the groundwater-monitoring program.

## 3.2 Leachate and Soil-Gas Monitoring at the 600 Area Central Landfill

### *Summarized by D. G. Horton*

The Solid Waste Landfill is a disposal facility in the center of the Hanford Site (part of the Central Landfill illustrated on Figure 2.1-1). The Solid Waste Landfill covers an area of ~26.7 ha and began operating in 1973 to receive nonhazardous, nonradioactive sanitary waste generated from Hanford Site operations. The Solid Waste Landfill stopped receiving waste in 1996 and an interim cover, consisting of 0.6 to 1.2 m of soil, was placed over all trenches. Current monitoring at the Solid Waste Landfill consists of sampling groundwater, soil-gas, and leachate. Section 2.11 discusses recent groundwater-monitoring results. This section summarizes leachate and soil-gas monitoring results. The results are sent annually to Washington State Department of Ecology (Ecology) with the most recent report covering the period July 2007 to June 2008 (09-AMCP-0010).

The Solid Waste Landfill consists of single trenches and double trenches. One of the double trenches overlies a lined basin lysimeter designed to collect leachate generated by infiltration through the overlying refuse. This lysimeter covers an area of ~88 $m^2$. A discharge pipe continuously drains leachate by gravity flow from the basin to a nearby collection pump. However, leachate collected from this lysimeter

may not be representative of leachate drainage throughout the entire landfill area. Since all other trenches are unlined, the lysimeter only collects leachate from one of the double trenches and is located under one of the newer trenches built after implementation of regulations restricting land disposal practices. The lysimeter, however, provides some indication of the rate of infiltration and some of the potential contaminants released to the vadose zone beneath the site.

***Leachate is collected from the Solid Waste Landfill every 10 to 14 days and tested quarterly.***

Leachate is collected from the basin lysimeter every 10 to 14 days. Figure 3.0-1 shows the rate of leachate generated over the past 10 years. Between 1999 and 2003, the generation rate was consistently between 4 and 8 L/day. However, during the July 2003 through June 2004 and July 2004 through June 2005 reporting periods, the average generation rates increased significantly to ~19 L/day. This increase mainly was attributed to above average rainfall recorded at the Hanford Site.

For the reporting period July 2007 through June 2008, ~2,500 L of leachate was generated, for a daily average of 6.8 L. This was an ~21% decrease in leachate generation from the previous year, when the daily average was ~8.7 L/day. The decrease is attributed mainly to below normal precipitation recorded at the Hanford Site during October and December 2007. (The average yearly precipitation at the Hanford Meteorology Station is 17.3 cm for the period 1947 to 2004 [PNNL-15160, *Hanford Site Climatological Summary 2004 with Historical Data*].) The Hanford Meteorological Station recorded 0.53 cm of precipitation in October and 1.35 cm in December 2007.

Leachate is sampled and tested quarterly for indicator parameters listed in WAC 173-304-490 and annually for site-specific constituents, which cover a range of metals and organics. Concentrations measured during July 2007 to June 2008 are similar to previous concentrations and did not identify any areas of concern. Some of the indicator parameters and some organic constituents and metals in the leachate continued to exceed WAC 173-200 groundwater quality criteria and/or WAC 246-290-310 drinking water standards. Section 2.11.3.7 discusses groundwater at the Solid Waste Landfill. Table 3.0-1 shows analytical results for key constituents in Solid Waste Landfill leachate.

Soil-gas at the Solid Waste Landfill is monitored to demonstrate that the air quality performance standards are met. The soil-gas monitoring uses eight shallow monitoring stations located around the perimeter of the landfill. Each station consists of two soil-gas probes at depths of ~2.75 and 4.6 m. Soil-gas is monitored quarterly to determine concentrations of carbon dioxide, methane, and several key volatile organic compounds. During the reporting period between July 2007 and June 2008, concentrations were consistent with concentrations for soil-gas monitoring during previous years. Carbon dioxide concentrations were consistent with previous data. Carbon dioxide concentrations are lower when atmospheric pressure is rising and higher when atmospheric pressure is low. Methane concentrations were either low or not detected. The volatile organic constituents were at or below the detection limits.

**Figure B-14. Groundwater Monitoring Wells at Nonradioactive Dangerous Waste Landfill and 600 Area Central Landfill.**

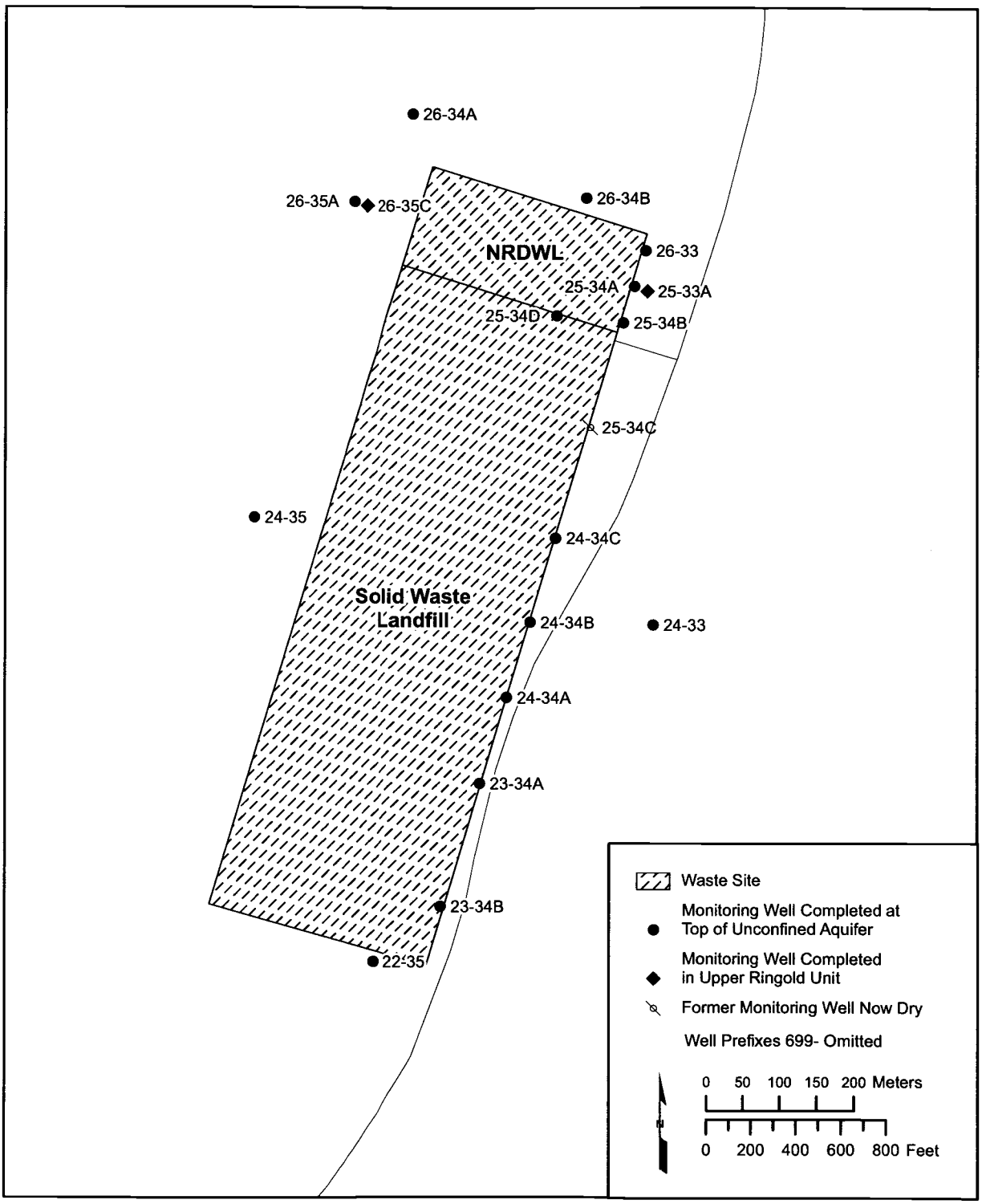


**Table B-27. Monitoring Wells and Constituents for the Nonradioactive Dangerous Waste Landfill.**

| Well Number* | Comment | WAC Compliant | Contamination Indicator Parameters | | | | Other Parameters | | | | Sampled as Scheduled in FY 2008 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | pH (field) | Spec. Cond. (field) | Total Organic Carbon | Total Organic Halides | Anions | Metals | Phenols | Volatile Organic Analyses | |
| 699-25-33A | Top of LPU; no statistics | C | S | S | S | S | S | A | A | S | Yes |
| 699-25-34A | | C | S | S | S | S | S | A | A | S | Yes |
| 699-25-34B | | C | S | S | S | S | S | A | A | S | Yes |
| 699-25-34D | | C | S | S | S | S | S | A | A | S | Yes |
| 699-26-33 | | C | S | S | S | S | S | A | A | S | Yes |
| ***699-26-34A*** | | C | S | S | S | S | S | A | A | S | Yes |
| 699-26-34B | | C | S | S | S | S | S | A | A | S | Yes |
| ***699-26-35A*** | | C | S | S | S | S | S | A | A | S | Yes |
| ***699-26-35C*** | Top of LPU; no statistics | C | S | S | S | S | S | A | A | S | Yes |

Requirements from PNNL-12227 and PNNL-12227-ICN-1.
Wells completed at the top of the unconfined aquifer unless specified otherwise.

* Bold italic = Upgradient well.

A = to be sampled annually.
C = well is constructed as a resource protection well under WAC 173-160.
FY = fiscal year.
LPU = low-permeability unit in upper Ringold Formation.
S = to be sampled semiannually.
Spec. Cond. = specific conductance.
WAC = *Washington Administrative Code*.

**Table B-28. Critical Means for Nonradioactive Dangerous Waste Landfill for FY 2009 Comparisons.**

| Constituent (unit) | n | df | Mean | Standard Deviation | CV (%) | $t_c$ | Critical Mean |
|---|---|---|---|---|---|---|---|
| pH | 8 | 7 | 7.25 | 0.0849 | 1.1717 | 6.4295 | [6.67 - 7.83] |
| Specific conductance (µS/cm) | 8 | 7 | 543.94 | 9.0955 | 1.6722 | 5.7282 | 599 |
| Total organic carbon* (µg/L) | 8 | 7 | 285.41 | 122.6511 | 42.9742 | 5.7282 | 1,031 |
| Total organic halides* (µg/L) | 9 | 8 | 3.28 | 3.4586 | 105.3827 | 5.3162 | 22.7 |

Based on semiannual sampling events from September 2006 through August 2008 for upgradient well 699-26-34A and from February 2007 through August 2008 for upgradient well 699-26-35A.

* For values reported below laboratory's specified method detection limit, one-half of the method detection limit is used in the critical mean calculation.

CV= coefficient of variation.
df = degrees of freedom (n-1).
FY = fiscal year.
n = number of background replicate averages.
$t_c$ = Bonferroni critical t-value for appropriate df and 28 comparisons.

**Table 3.0-1. Analytical Results for Key Constituents in Leachate at the Solid Waste Landfill.**

| Parameter[a] | Results by Quarter | | | | GWQC[c] | MCL[d] |
|---|---|---|---|---|---|---|
| | 3rd 2007 | 4th 2007 | 1st 2008 | 2nd 2008[b] | | |
| **Indicator Parameters** | | | | | | |
| Ammonia as N (mg/L) | 1.23 | 0.338 | 0.373 | NT | NA | NA |
| Chemical Oxygen Demand (mg/L) | 214 | 200 | 230 | NT | NA | NA |
| Specific Conductivity (µS/cm) | 2,050 | 1,840 | 2,000 | NT | NA | 700 |
| Dissolved Iron (µg/L) | 119 | 364 | 7910 | NT | 300 | 300 |
| Dissolved Manganese (µg/L) | 1,480 | 1,510 | 1,710 | NT | 50 | 50 |
| Dissolved Zinc (µg/L) | 381 | <8.0 | <4.0 | NT | 5,000 | 5,000 |
| pH | 6.83 | 6.76 | 7.23 | NT | 6.5 - 8.5 | NA |
| Total Organic Carbon (mg/L) | 72.6 | 61.9 | 3.21 | NT | NA | NA |
| **Site-Specific Parameters** | | | | | | |
| Total Dissolved Solids (mg/L) | NT | NT | 1,440 | NT | 500 | 500[e] |
| Total Organic Halides (µg/L) | NT | NT | 671 | NT | NA | NA |
| Arsenic (µg/L) | NT | 17.5 | 65.3 | NT | 0.05 | 10 |
| Barium (µg/L) | NT | 463 | 492 | NT | 1,000 | 2,000 |
| Cadmium (µg/L) | NT | <1.0 | <4.0 | NT | 10 | 5 |
| Chloride (mg/L) | 203 | 200 | 196 | NT | 250 | 25 |
| Copper (µg/L) | NT | 1.72 | <4.0 | NT | 1,000 | NA |
| Fluoride (mg/L) | <1.21 | <0.606 | 0.18 | NT | 4 | 4 |
| Nickel (µg/L) | NT | 109 | 106 | NT | NA | 100 |
| Selenium (µg/L) | NT | 11.6 | 3.43 | NT | 10 | 50 |
| Sulfate (mg/L) | <14.1 | 7.07 | 7.12 | NT | 250 | 25 |
| 1,1-Dichloroethane (µg/L) | NT | NT | <1.0 | NT | 1 | NA |
| 1,1,1-Trichloroethane (µg/L) | NT | NT | <1.0 | NT | 200 | 200 |
| 1,4-Dioxane (µg/L) | NT | NT | 26 | NT | 7 | NA |
| 1,4-Dichlorobenzene (µg/L) | NT | NT | 12 | NT | 4 | NA |
| Carbon Tetrachloride (µg/L) | NT | NT | <1.0 | NT | 0.3 | 5 |
| Chloroform (µg/L) | NT | NT | <1.0 | NT | 7 | NA |
| Methylene Chloride (µg/L) | NT | NT | <1.0 | NT | 5 | NA |
| Tetrachloroethene (µg/L) | NT | NT | <1.0 | NT | NA | NA |
| Trichloroethene (µg/L) | NT | NT | <1.0 | NT | NA | NA |

[a] Units as provided in analytical results report.
[b] Leachate was not tested for indicator parameters during the second quarter of calendar year 2008 because of an scheduling oversight.
[c] Groundwater Quality Criteria from WAC 173-200, "Water Quality Standards for Ground Waters of the State of Washington."
[d] Maximum Contaminant Levels from WAC 246-290, "Public Water Supplies."
[e] Required only when specific conductivity exceeds 700 µS/cm.

NT = not tested.
NA = not applicable.

**Table B-42. Analytical Results for Required Constituents at the Solid Waste Landfill.**

| Constituent [a] | Background Threshold Value [b] | Date | 699-22-35 | 699-23-34A | 699-23-34B | 699-24-33 | 699-24-34A | 699-24-34B | 699-24-34C | 699-24-35 | 699-26-35A |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Ammonium ion (µg/L) | 90 | Nov-Dec 2007 | <12 | <12 | <12 | <12 | <12 | <12 | <12 | 22.5 | <12 |
| | | Feb-Mar 2008 | <12 | 17.4 | <12 | <12 | 12.5 | 25.6 | <12 | 33.9 | 28.8 |
| | | May-Jun 2008 | <12 | <12 | <12 | 17.1 | <12 | <12 | 22.3 | 13.7 | <12 |
| | | Aug-Sep 2008 | <12 | 24.3 | <12 | <12 | <12 | <12 | 17.5 | 15.8 | <12 |
| Chemical Oxygen Demand (mg/L) | 10 | Nov-Dec 2007 | <10 | <10 | <10 | **23** | <10 | <10 | <10 | <10 | <10 |
| | | Feb-Mar 2008 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 |
| | | May-Jun 2008 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 |
| | | Aug-Sep 2008 | **16** | **18** | <10 | <10 | <10 | <10 | <10 | <10 | <10 |
| Chloride (mg/L) | 7.8 | Nov-Dec 2007 | 6.8 | 5.96 | 7.14 | 6.91 | 7.01 | 6.86 | 6.73 | 6.37 | 6.42 |
| | | Feb-Mar 2008 | 6.95 | 7.18 | 7 | 7.35 | 7.66 | 7.08 | 7.25 | 6.45 | 7.62 |
| | | May-Jun 2008 | 6.75 | 6.62 | 6.53 | 7.28 | 7.34 | 7.04 | 7.05 | 6.31 | 7.28 |
| | | Aug-Sep 2008 | 6.75 | 6.6 | 6.22 | 6.96 | 7.56 | 6.84 | 6.88 | 6.16 | 7.17 |
| Coliform Bacteria (col/100 mL) | 1 | Nov-Dec 2007 | <0 | <0 | <0 | <0 | <0 | <0 | <0 | **2** | <0 |
| | | Feb-Mar 2008 | <1 | <1 | <1 | <1 | <1 | <1 | **1** | <1 | <1 |
| | | May-Jun 2008 | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 |
| | | Aug-Sep 2008 | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 |
| Iron, filtered (ug/L) | 160 | Nov-Dec 2007 | <9 | 31.1 | <9 | <9 | <9 | <9 | <9 | <9 | <9 |
| | | Feb-Mar 2008 | 20.5 | 36.1 | 30.8 | 29 | 41.8 | 37.2 | 34.4 | 19.9 | <9 |
| | | May-Jun 2008 | 15.5 | <25 | 20.6 | <9 | 25.9 | 23.7 | 39.6 | <25 | <9 |
| | | Aug-Sep 2008 | <25 | <25 | <25 | <25 | <25 | 109 | 41.7 | <25 | 45 |
| Manganese, filtered (µg/L) | 18 | Nov-Dec 2007 | <4 | <4 | <4 | <4 | <4 | <4 | <4 | <4 | <4 |
| | | Feb-Mar 2008 | <4 | <4 | <4 | <4 | <4 | <4 | <4 | <4 | <4 |
| | | May-Jun 2008 | <4 | <4 | <4 | <4 | 8.2 | <4 | <4 | <4 | <4 |
| | | Aug-Sep 2008 | <4 | <4 | <4 | <4 | <4 | 6.3 | <4 | <4 | <4 |
| Nitrate (mg/L) | 29 | Nov-Dec 2007 | 17.8 | 17.8 | 17.7 | 15 | 13.5 | 15 | 14.4 | 12.9 | 17.1 |
| | | Feb-Mar 2008 | 17.3 | 19.3 | 17.8 | 15.4 | 14.2 | 15.8 | 14.6 | 12.9 | 18.3 |
| | | May-Jun 2008 | 17.8 | 19.1 | 17.4 | 15.2 | 14.2 | 15.8 | 14.8 | 13.9 | 18.5 |
| | | Aug-Sep 2008 | 18.2 | 19.2 | 16.8 | 14.9 | 14.3 | 15.8 | 16.1 | 12.7 | 17.6 |
| Nitrite (µg/L) | 148 | Nov-Dec 2007 | 64.7 | <32.8 | <32.8 | 50.9 | 62.4 | 61.1 | 60.4 | 55.2 | 57.8 |
| | | Feb-Mar 2008 | <65.7 | <65.7 | <65.7 | <65.7 | <65.7 | <65.7 | <65.7 | <65.7 | <65.7 |
| | | May-Jun 2008 | <65 | 88.4 | <65 | <65 | <65 | <65 | <65 | <65 | <65 |
| | | Aug-Sep 2008 | <84.1 | <84.1 | <84.1 | <84.1 | <84.1 | <84.1 | <84.1 | <84.1 | <84.1 |
| Field pH | 6.68 - 7.84 | Nov-Dec 2007 | 6.87 | **6.59** | 6.69 | 6.84 | 6.72 | 6.72 | 6.89 | 6.73 | 7.17 |
| | | Feb-Mar 2008 | 6.89 | **6.63** | 6.69 | 6.86 | 6.69 | 6.69 | 6.94 | 6.75 | 7.17 |
| | | May-Jun 2008 | 6.9 | **6.55** | **6.62** | 6.84 | **6.65** | **6.66** | 6.93 | **6.62** | 7.21 |
| | | Aug-Sep 2008 | 6.84 | **6.52** | **6.56** | **6.66** | **6.61** | 6.7 | 6.9 | **6.65** | 7.17 |
| Specific Conductance (µS/cm) | 583 | Nov-Dec 2007 | **827** | **744** | **761** | **746** | **665** | **703** | **706** | **587** | 538 |
| | | Feb-Mar 2008 | **828** | **755** | **766** | **753** | **664** | **686** | **732** | 581 | 543 |
| | | May-Jun 2008 | **824** | **755** | **783** | **756** | **672** | **733** | **735** | 429 | 538 |
| | | Aug-Sep 2008 | **827** | **770** | **775** | **765** | **676** | **707** | **750** | **589** | 547 |
| Sulfate (mg/L) | 47.2 | Nov-Dec 2007 | 43.2 | 46.5 | 40.3 | 42.5 | 45.6 | 43.4 | 43.4 | 42.9 | 46.5 |
| | | Feb-Mar 2008 | 43.4 | **51.6** | **48.5** | 42.4 | **47.8** | **54.3** | 43.5 | 46.5 | 40.9 |
| | | May-Jun 2008 | 44 | **47.6** | 46.4 | 44.6 | 46.6 | **55.5** | 42.9 | 46.6 | 41.1 |
| | | Aug-Sep 2008 | 46.6 | **48.3** | 43.7 | 43.9 | **47.9** | **50.3** | 41.8 | 44.8 | 39.3 |

**Table B-42. (cont.)**

| Constituent [a] | Background Threshold Value [b] | Date | 699-22-35 | 699-23-34A | 699-23-34B | 699-24-33 | 699-24-34A | 699-24-34B | 699-24-34C | 699-24-35 | 699-26-35A |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Temperature (°C) | 20.7 | Nov-Dec 2007 | 17.9 | 18 | 18.2 | 19.4 | 16.4 | 17.3 | 18.3 | 17.9 | 19.3 |
| | | Feb-Mar 2008 | 16.9 | 17.8 | 12.5 | 19.3 | 18.1 | 18.4 | 18.2 | 17.5 | 19 |
| | | May-Jun 2008 | **[25.9]** | 19.2 | 18.3 | 19.8 | 18.8 | 18.9 | 19.1 | 18.4 | 19.8 |
| | | Aug-Sep 2008 | **[24]** | 19.7 | 19.4 | 20 | **22.8** | 19.7 | 19.5 | 19.7 | 20 |
| Total organic carbon (µg/L) | 1,430 | Nov-Dec 2007 | 952 | 1,120 | 462 | 869 | 789 | 831 | 771 | 573 | 983 |
| | | Feb-Mar 2008 | 1,210 | 1,050 | **[22,600]** | **[38,300]** | **[21,000]** | **[2,910]** | **[11,000]** | **[12,800]** | 386 |
| | | May-Jun 2008 | 1,050 | 730 | 1,240 | 948 | 999 | 760 | 968 | 663 | 511 |
| | | Aug-Sep 2008 | <200 | <200 | <200 | <200 | <200 | <200 | 240 | 370 | 350 |
| Zinc, filtered (µg/L) | 43.2 | Nov-Dec 2007 | <4 | <4 | <4 | <4 | <4 | <4 | <4 | <4 | <4 |
| | | Feb-Mar 2008 | <4 | <4 | <4 | 9.3 | <4 | 6.5 | 9.8 | 25.9 | 8 |
| | | May-Jun 2008 | <4 | <9 | <4 | 8.8 | <4 | <4 | 12.4 | 9.2 | 6.8 |
| | | Aug-Sep 2008 | <9 | <9 | <9 | <9 | <9 | <9 | <9 | <9 | <9 |

Results in bold exceed background threshold value.
Results in brackets are inconsistent with historical trends and are under review.

[a] WAC 173-304.
[b] Numbers obtained from DOE/RL-2008-01, Table B.43.