
P-AREA ACID/CAUSTIC BASIN GROUNDWATER MONITORING REPORT (U)

SECOND QUARTER 1994

Publication Date: September 1994

Authorized Derivative Classifier:

UNCLASSIFIED
Does Not Contain Unclassified
Controlled Nuclear Information

Westinghouse Savannah River Company
Savannah River Site
Aiken, SC 29808

Prepared for the U.S. Department of Energy under Control Contract No. DE-AC09-89SR18035

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Joseph P. Kozlowski, Engineer 9-26-94

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Key Words

**aluminum
iron
manganese
PAC wells
specific conductance**

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Abstract

During second quarter 1994, groundwater from the six PAC monitoring wells at the P-Area Acid/Caustic Basin was analyzed for herbicides/pesticides, radium-226, radium-228, turbidity, and comprehensive constituents. Monitoring results that exceeded the final Primary Drinking Water Standards (PDWS) or the Savannah River Site (SRS) flagging criteria or turbidity standard during the quarter are discussed in this report.

During second quarter 1994, no constituents exceeded the final PDWS. Aluminum exceeded its SRS Flag 2 criterion in five PAC wells. Iron and manganese exceeded Flag 2 criteria in three wells, while specific conductance was elevated in one well.

Groundwater flow direction and rate in the water table beneath the P-Area Acid/Caustic Basin were similar to past quarters.

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Executive Summary

The six monitoring wells at the P-Area Acid/Caustic Basin are sampled quarterly as part of the Savannah River Site (SRS) Groundwater Monitoring Program and to comply with the terms of a consent decree signed May 26, 1988, by the U.S. District Court (District of South Carolina, Aiken Division).

During second quarter 1994, groundwater from the PAC wells received analyses for herbicides/pesticides, radium-226, radium-228, turbidity, and comprehensive constituents. Monitoring results that exceeded the final Primary Drinking Water Standards (PDWS) or the SRS flagging criteria or turbidity standard are discussed in this report.

During second quarter 1994, no constituents exceeded the final PDWS in wells at the P-Area Acid/Caustic Basin. Aluminum exceeded its SRS Flag 2 criterion in five PAC wells. Iron and manganese exceeded Flag 2 criteria in wells PAC 2, 5, and 6. Specific conductance was elevated in well PAC 5.

Groundwater flow direction and rate in the water table beneath the P-Area Acid/Caustic Basin were similar to past quarters.

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Introduction

The P-Area Acid/Caustic Basin is located east of P Area and Road F at the Savannah River Site (SRS) (Figures 1 and 2, Appendix C) on a slope that leads to a tributary of Par Pond. The following description outlines important events in the history of the P-Area Acid/Caustic Basin.

- The basin, constructed in the early 1950s, is an unlined earthen pit that received dilute sulfuric acid and sodium hydroxide solutions and other wastes from several areas within SRS. The basin provided an area for the mixing and neutralization of the dilute solutions before their discharge to nearby streams (Heffner and Exploration Resources, 1991).
- The P-Area Acid/Caustic Basin remained in service until new neutralization facilities became operational in 1982 (Heffner and Exploration Resources, 1991).
- Groundwater monitoring wells PAC 1, 2, 3, and 4 were installed at the P-Area Acid/Caustic Basin between November 1983 and July 1984 (EPD/EMS, 1994) (Figure 2, Appendix C).
- Under the terms of a consent decree signed May 26, 1988, by the U.S. District Court (Civil Action 1:85-2583-6, District of South Carolina, Aiken Division), the basin became subject to requirements of Subtitle C of the Resource Conservation and Recovery Act (RCRA), the South Carolina Hazardous Waste Management Regulations (SCHWMMR), and associated regulations on June 1, 1988.
- The basin monitoring wells were reevaluated during the summer of 1988 to ensure compliance with SCHWMMR. As part of this compliance effort, wells PAC 5 and 6 were installed at the P-Area Acid/Caustic Basin during fall 1988 (EPD/EMS, 1994).
- The revised Groundwater Quality Assessment Plan (WSRC, 1991), submitted to the South Carolina Department of Health and Environmental Control (SCDHEC) on April 30, 1991, indicated that the monitoring well network at the P-Area Acid/Caustic Basin is sufficient to detect effects of the basin on the groundwater.
- During July through September 1993, with SCDHEC's permission to proceed at risk, SRS stabilized the H- and P-Area Acid/Caustic Basins as proposed in the Interim Status Closure Plan for the F-, H-, K-, and P-Area Acid/Caustic Basins (Revision 3, February 5, 1992). The basins were dewatered and filled with compacted clay-rich soil, and a vegetative cover of winter- and drought-hardy grass was established.

Each quarter, the Environmental Protection Department/Environmental Monitoring Section (EPD/EMS) samples the monitoring wells at the P-Area Acid/Caustic Basin as part of the SRS Groundwater Monitoring Program. The Environmental Restoration Department provides a quarterly report describing the monitoring results to SCDHEC in compliance with SCHWMMR.

Discussion

Groundwater Monitoring Data

The EPD/EMS groundwater sampling procedure (EPD/EMS, 1992) requires evacuation of a minimum of two well volumes and stabilization of pH, specific conductance, and turbidity prior to sample collection. Stability is established when a minimum of three successive measurements, taken within a given time period, are within a specified tolerance range. If a well pumps dry before two well volumes are purged or before stabilization is achieved, it must be revisited within 24 hours for the data to be considered the result of a single sampling event. On the second visit within 24 hours, samples are taken without purging or measuring stability; thus, these samples may not be representative of the groundwater quality.

During second quarter 1994, samples from the six monitoring wells at the P-Area Acid/Caustic Basin were analyzed for herbicides/pesticides, indicator parameters, metals, nitrate, radionuclide indicators, and other constituents. This report describes results that equaled or exceeded the Safe Drinking Water Act final Primary Drinking Water Standards (PDWS) or drinking water screening levels, as established by the U.S. Environmental Protection Agency (EPA) (Appendix A); the South Carolina final PDWS for lead (Appendix A); SRS flagging criteria that are based on final and proposed PDWS, Secondary Drinking Water Standards, and method detection limits (Appendix B); or the SRS turbidity standard. Constituent levels that equaled or exceeded the final PDWS, screening levels, or other Flag 2 criteria are described as *exceeding* or *above standards* or as *elevated*.

The final PDWS for individual analytes presented in Appendix A may not always match the SRS flagging criteria presented in Appendix B. The final PDWS generally are used in this compliance report as guidelines to meet regulatory requirements; the flagging criteria are used by EPD/EMS to identify relative levels of constituents in the groundwater and as guides for scheduling groundwater monitoring.

Analytical Results Exceeding Standards

No analytes exceeded the final PDWS (Appendix A) during second quarter 1994; see Table 1 (Appendix D).

Constituents that exceeded other Flag 2 criteria (Appendix B) during second quarter 1994 are summarized in Table 2 (Appendix D). Aluminum exceeded the Flag 2 criterion in all PAC wells except PAC 2, with a maximum concentration of 771 $\mu\text{g/L}$ in well PAC 5. Iron and manganese exceeded Flag 2 criteria in wells PAC 2, 5, and 6. Iron had a maximum concentration of 14,400 $\mu\text{g/L}$ in well PAC 6, and manganese had a maximum concentration of 384 $\mu\text{g/L}$ in well PAC 5. Specific conductance was elevated in well PAC 5, at 640 $\mu\text{S/cm}$.

Table 3 (Appendix D) presents all of the results for individual wells and indicates the analytical laboratories that conducted the analyses, the dilution factors used in the analyses, and the analyses that received modifiers (which help identify laboratory accuracy and precision) or that exceeded the EPA-approved holding times during second quarter 1994. Constituent results in Table 3 that appear to equal the final PDWS but are not marked in the *D* column (exceeded final

PDWS or screening level) are below the final PDWS in the database. Database results, the results that are compared to the final PDWS, are entered with more significant digits than the results given in this report. Apparent discrepancies are the result of the rounding of reported results.

Table 3 also lists the number of well volumes purged from each well during second quarter 1994 and provides a statement that describes incomplete or unsuccessful sampling events. Wells PAC 5 and 6 failed to produce two well volumes before pumping dry; thus, these wells may not have produced representative groundwater samples.

Appendix D provides definitions of the abbreviations and the modifiers used in the results tables as well as descriptions of holding times, data rounding, and data qualification practices.

Appendix E provides a general assessment of the quality and useability of the data provided by EPD/EMS.

Turbidity Results Exceeding Standards

Turbidity results, in nephelometric turbidity units (NTU), of less than 5 NTU meet the EPA's general standard for acceptability of groundwater samples (EPA, 1986). That standard, however, is considered unrealistic for monitoring wells at SRS. Gass (1989) has documented turbidity measurements ranging up to 5,000 NTU from properly designed wells screened in poorly productive formations. During the 1989 RCRA Compliance Evaluation Inspection, officials from EPA Region IV indicated that the SRS turbidity standard of 50 NTU is conservative. These officials also agreed that water-table wells in this area often correspond to nonaquifer formations, rendering development of these wells more difficult due to the low yield and high proportion of mobile fines typical of these formations (Bergren and Bennett, 1989).

During second quarter 1994, turbidity results for samples from wells PAC 1, 2, 3, 4, and 5 were less than 10 (Table 3, Appendix D). Well PAC 6 had the highest turbidity value, at 39 NTU. None of the samples exceeded the SRS turbidity standard of 50 NTU.

Water Elevations, Flow Directions, and Flow Rates

Water-table elevations and the groundwater flow direction beneath the P-Area Acid/Caustic Basin are shown in Figure 3 (Appendix C). Water-table elevations indicate that the groundwater flow direction is north-northwest (using universal transverse Mercator coordinates).

The groundwater flow rate in the water table (Aquifer Zone IIB₂) beneath the P-Area Acid/Caustic Basin is estimated using the following equation:

$$\text{Flow (ft/day)} = \frac{\text{Hydraulic Conductivity (ft/day)}}{\text{Porosity (unitless)}} \times \frac{dh \text{ (ft)}}{dl \text{ (ft)}}$$

A hydraulic conductivity constant of 10 ft/day (Geraghty & Miller, Inc., 1990) is a conservative estimate (i.e., the actual hydraulic conductivity should be somewhat less than 10 ft/day).

The effective porosity is estimated at 20% (Killian et al., 1987); dh is the difference in head, and dl is the length of the flow path to the nearest 10 ft. Flow rate estimates vary depending on the vertical gradient between wells, the size of the area under consideration, and the number of data points. The flow path is measured along the map; as much as possible, the path is drawn the

same each quarter. Because of these variables, the estimation of flow rate must be considered accurate to an order of magnitude only.

Flow rate estimates are calculated as follows: flow rate per day is calculated to two significant figures using the above equation. This value is then multiplied by 365 and rounded to two significant figures for the flow rate per year.

Using the above equation with $dh = 12$ ft and $dl = 70$ ft, the flow rate estimate for groundwater in the water table beneath the P-Area Acid/Caustic Basin (Figure 3, Appendix C) is as follows:

$$\frac{10}{0.20} \times \frac{12}{70} = 8.6 \text{ ft/day}$$

$$8.6 \text{ ft/day} \times 365 \text{ days} \approx 3,100 \text{ ft/yr}$$

Results for Upgradient vs. Downgradient Wells

Wells PAC 1 and 4 are the upgradient wells at the P-Area Acid/Caustic Basin. Wells PAC 2, 3, 5, and 6 are downgradient. During second quarter 1994, no constituents exceeded the final PDWS or the SRS turbidity standard in the upgradient or downgradient wells. Aluminum exceeded its SRS Flag 2 criterion in both upgradient wells. Aluminum was elevated in downgradient wells PAC 3, 5, and 6; iron and manganese were elevated in downgradient wells PAC 2, 5, and 6. Specific conductance was above its Flag 2 criterion in downgradient well PAC 5.

Conclusions

During second quarter 1994, no analytes exceeded the final PDWS in any wells at the P-Area Acid/Caustic Basin. Aluminum exceeded its SRS Flag 2 criterion in both upgradient wells and in downgradient wells PAC 3, 5, and 6. Iron and manganese each exceeded the Flag 2 criterion in downgradient wells PAC 2, 5, and 6. Specific conductance was elevated in downgradient well PAC 5. Generally, constituents found in downgradient wells but not in upgradient wells at a waste management unit are considered products of the waste management unit.

Water-table elevations at the P-Area Acid/Caustic Basin indicate that groundwater flow direction was north-northwest (UTM coordinates) at a rate of approximately 3,100 ft/yr. Groundwater flow direction in this area can be accurately defined because the groundwater gradient is large and follows the surface topography. The revised Groundwater Quality Assessment Plan (WSRC, 1991) for the P-Area Acid/Caustic Basin indicates that the monitoring well network at the basin is sufficient to detect effects of past operations at the basin on groundwater quality.

References Cited

Bergren, C. L., and C. B. Bennett, 1989. **Assessment of SRS Groundwater Monitoring Wells Impacted by Turbidity**, WSRC-RP-89-891. Westinghouse Savannah River Company, Savannah River Site, Aiken, SC.

EPA (U.S. Environmental Protection Agency), 1986. **RCRA Ground Water Monitoring Technical Enforcement Guidance Document**, OSWER-9950.1. Washington, DC.

EPD/EMS (Environmental Protection Department/Environmental Monitoring Section), 1992. **Hydrogeologic Data Collection Procedures and Specifications: Sampling Groundwater Monitoring Wells**, Manual 3Q5, Chapter 14, Revision 0. Westinghouse Savannah River Company, Savannah River Site, Aiken, SC.

EPD/EMS (Environmental Protection Department/Environmental Monitoring Section), 1994. **Environmental Protection Department's Well Inventory (through the fourth quarter of 1993)**, ESH-EMS-930262, March 1994. Westinghouse Savannah River Company, Savannah River Site, Aiken, SC.

Gass, T. E., 1989. *Monitoring Wells in Non-Aquifer Formations*. **Water Well Journal**, 43(2):27-29.

Geraghty & Miller, Inc., 1990. **Evaluation of Integrated Waste Facility Closure Capping on Ground-Water Flow and Solute Transport in General Separations Area, Savannah River Site: Flow Model and Particle-Tracking Analysis, Final Report**. Prepared by Geraghty & Miller Modeling Group for Westinghouse Savannah River Company, Waste Management Technology, Savannah River Site, Aiken, SC.

Heffner, J. D., and Exploration Resources, Inc., 1991. **Technical Summary of Groundwater Quality Protection Program at the Savannah River Site (1952-1986), Volume I—Site Geohydrology and Waste Sites**, DPSP-88-1002. Westinghouse Savannah River Company, Savannah River Site, Aiken, SC.

Killian, T. H., N. L. Kolb, P. Corbo, and I. W. Marine, 1987. **F-Area Seepage Basins**, DPST-85-704. E. I. du Pont de Nemours & Company, Savannah River Laboratory, Aiken, SC.

WSRC (Westinghouse Savannah River Company), 1991. **F-, H-, K-, and P-Area Acid Caustic Basins Groundwater Quality Assessment Plan**, WSRC-TR-91-178, Revision 1.0. Westinghouse Savannah River Company, Savannah River Site, Aiken, SC.

Errata

In tables with four quarters of data, some values for earlier quarters may differ from values for those same quarters presented in earlier reports because some reanalyses may have been performed by the laboratories after the reports were printed.

Second Quarter 1993 through Fourth Quarter 1993:

- No errata have been reported.

First Quarter 1994:

- Page 4, Groundwater Monitoring Data: The copper standard is the final Primary Drinking Water Standard established by EPA.

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Appendix A

Final Primary Drinking Water Standards

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Final Primary Drinking Water Standards

| Analyte | Unit | Level | Status | Source |
|--------------------------------------|----------|-----------|--------|-----------|
| Alachlor | µg/L | 2 | Final | EPA, 1993 |
| Aldicarb ^a | µg/L | 3 | Final | EPA, 1993 |
| Aldicarb sulfone ^a | µg/L | 2 | Final | EPA, 1993 |
| Aldicarb sulfoxide ^a | µg/L | 4 | Final | EPA, 1993 |
| Antimony | µg/L | 6 | Final | EPA, 1993 |
| Antimony, dissolved | µg/L | 6 | Final | EPA, 1993 |
| Antimony, total recoverable | µg/L | 6 | Final | EPA, 1993 |
| Arsenic | µg/L | 50 | Final | EPA, 1993 |
| Arsenic, dissolved | µg/L | 50 | Final | EPA, 1993 |
| Arsenic, total recoverable | µg/L | 50 | Final | EPA, 1993 |
| Asbestos | Fibers/L | 7,000,000 | Final | EPA, 1993 |
| Atrazine | µg/L | 3 | Final | EPA, 1993 |
| Barium | µg/L | 2,000 | Final | EPA, 1993 |
| Barium, dissolved | µg/L | 2,000 | Final | EPA, 1993 |
| Barium, total recoverable | µg/L | 2,000 | Final | EPA, 1993 |
| Benzene | µg/L | 5 | Final | EPA, 1993 |
| Benzo[a]pyrene | µg/L | 0.2 | Final | EPA, 1993 |
| Beryllium | µg/L | 4 | Final | EPA, 1993 |
| Beryllium, dissolved | µg/L | 4 | Final | EPA, 1993 |
| Beryllium, total recoverable | µg/L | 4 | Final | EPA, 1993 |
| Bis(2-ethylhexyl) phthalate | µg/L | 6 | Final | EPA, 1993 |
| Bromodichloromethane | µg/L | 100 | Final | EPA, 1993 |
| Bromoform | µg/L | 100 | Final | EPA, 1993 |
| 2-sec-Butyl-4,6-dinitrophenol | µg/L | 7 | Final | EPA, 1993 |
| Cadmium | µg/L | 5 | Final | EPA, 1993 |
| Cadmium, dissolved | µg/L | 5 | Final | EPA, 1993 |
| Cadmium, total recoverable | µg/L | 5 | Final | EPA, 1993 |
| Carbofuran | µg/L | 40 | Final | EPA, 1993 |
| Carbon tetrachloride | µg/L | 5 | Final | EPA, 1993 |
| Chlordane | µg/L | 2 | Final | EPA, 1993 |
| Chlorobenzene | µg/L | 100 | Final | EPA, 1993 |
| Chloroethene (Vinyl chloride) | µg/L | 2 | Final | EPA, 1993 |
| Chloroform | µg/L | 100 | Final | EPA, 1993 |
| Chromium | µg/L | 100 | Final | EPA, 1993 |
| Chromium, dissolved | µg/L | 100 | Final | EPA, 1993 |
| Chromium, total recoverable | µg/L | 100 | Final | EPA, 1993 |
| Copper | µg/L | 1,300 | Final | EPA, 1993 |
| Copper, dissolved | µg/L | 1,300 | Final | EPA, 1993 |
| Copper, total recoverable | µg/L | 1,300 | Final | EPA, 1993 |
| Cyanide | µg/L | 200 | Final | EPA, 1993 |
| Dalapon ^a | µg/L | 200 | Final | EPA, 1993 |
| Dibromochloromethane | µg/L | 100 | Final | EPA, 1993 |
| 1,2-Dibromo-3-chloropropane | µg/L | 0.2 | Final | EPA, 1993 |
| 1,2-Dibromoethane | µg/L | 0.05 | Final | EPA, 1993 |
| 1,2-Dichlorobenzene | µg/L | 600 | Final | EPA, 1993 |
| 1,4-Dichlorobenzene | µg/L | 75 | Final | EPA, 1993 |
| 1,2-Dichloroethane | µg/L | 5 | Final | EPA, 1993 |
| 1,1-Dichloroethylene | µg/L | 7 | Final | EPA, 1993 |
| 1,2-Dichloroethylene | µg/L | 50 | Final | EPA, 1993 |
| cis-1,2-Dichloroethylene | µg/L | 70 | Final | EPA, 1993 |
| trans-1,2-Dichloroethylene | µg/L | 100 | Final | EPA, 1993 |
| Dichloromethane (Methylene chloride) | µg/L | 5 | Final | EPA, 1993 |
| 2,4-Dichlorophenoxyacetic acid | µg/L | 70 | Final | EPA, 1993 |

| Analyte | Unit | Level | Status | Source |
|---------------------------------------|-------|---------|---------------|--------------|
| 1,2-Dichloropropane | µg/L | 5 | Final | EPA, 1993 |
| Di(2-ethylhexyl) adipate ^a | µg/L | 400 | Final | EPA, 1993 |
| Diquat dibromide ^a | µg/L | 20 | Final | EPA, 1993 |
| Endothal ^a | µg/L | 100 | Final | EPA, 1993 |
| Endrin | µg/L | 2 | Final | EPA, 1993 |
| Ethylbenzene | µg/L | 700 | Final | EPA, 1993 |
| Fluoride | µg/L | 4,000 | Final | EPA, 1993 |
| Glyphosate ^a | µg/L | 700 | Final | EPA, 1993 |
| Gross alpha ^b | pCi/L | 1.5E+01 | Final | EPA, 1993 |
| Heptachlor | µg/L | 0.4 | Final | EPA, 1993 |
| Heptachlor epoxide | µg/L | 0.2 | Final | EPA, 1993 |
| Hexachlorobenzene | µg/L | 1 | Final | EPA, 1993 |
| Hexachlorocyclopentadiene | µg/L | 50 | Final | EPA, 1993 |
| Lead | µg/L | 50 | Final | SCDHEC, 1981 |
| Lead, dissolved | µg/L | 50 | Final | SCDHEC, 1981 |
| Lead, total recoverable | µg/L | 50 | Final | SCDHEC, 1981 |
| Lindane | µg/L | 0.2 | Final | EPA, 1993 |
| Mercury | µg/L | 2 | Final | EPA, 1993 |
| Mercury, dissolved | µg/L | 2 | Final | EPA, 1993 |
| Mercury, total recoverable | µg/L | 2 | Final | EPA, 1993 |
| Methoxychlor | µg/L | 40 | Final | EPA, 1993 |
| Nickel | µg/L | 100 | Final | EPA, 1993 |
| Nickel, dissolved | µg/L | 100 | Final | EPA, 1993 |
| Nickel, total recoverable | µg/L | 100 | Final | EPA, 1993 |
| Nitrate as nitrogen | µg/L | 10,000 | Final | EPA, 1993 |
| Nitrate-nitrite as nitrogen | µg/L | 10,000 | Final | EPA, 1993 |
| Nitrite as nitrogen | µg/L | 1,000 | Final | EPA, 1993 |
| Nonvolatile beta | pCi/L | 5E+01 | Interim Final | EPA, 1977 |
| Oxamyl ^a | µg/L | 200 | Final | EPA, 1993 |
| PCB 1016 | µg/L | 0.5 | Final | EPA, 1993 |
| PCB 1221 | µg/L | 0.5 | Final | EPA, 1993 |
| PCB 1232 | µg/L | 0.5 | Final | EPA, 1993 |
| PCB 1242 | µg/L | 0.5 | Final | EPA, 1993 |
| PCB 1248 | µg/L | 0.5 | Final | EPA, 1993 |
| PCB 1254 | µg/L | 0.5 | Final | EPA, 1993 |
| PCB 1260 | µg/L | 0.5 | Final | EPA, 1993 |
| PCB 1262 | µg/L | 0.5 | Final | EPA, 1993 |
| Pentachlorophenol | µg/L | 1 | Final | EPA, 1993 |
| Picloram ^a | µg/L | 500 | Final | EPA, 1993 |
| Selenium | µg/L | 50 | Final | EPA, 1993 |
| Selenium, dissolved | µg/L | 50 | Final | EPA, 1993 |
| Selenium, total recoverable | µg/L | 50 | Final | EPA, 1993 |
| Simazine ^a | µg/L | 4 | Final | EPA, 1993 |
| Strontium-89/90 ^c | pCi/L | 8E+00 | Final | EPA, 1993 |
| Strontium-90 | pCi/L | 8E+00 | Final | EPA, 1993 |
| Styrene | µg/L | 100 | Final | EPA, 1993 |
| 2,3,7,8-TCDD | µg/L | 0.00003 | Final | EPA, 1993 |
| Tetrachloroethylene | µg/L | 5 | Final | EPA, 1993 |
| Thallium | µg/L | 2 | Final | EPA, 1993 |
| Thallium, dissolved | µg/L | 2 | Final | EPA, 1993 |
| Thallium, total recoverable | µg/L | 2 | Final | EPA, 1993 |
| Toluene | µg/L | 1,000 | Final | EPA, 1993 |
| Toxaphene | µg/L | 3 | Final | EPA, 1993 |
| 2,4,5-TP (Silvex) | µg/L | 50 | Final | EPA, 1993 |
| 1,2,4-Trichlorobenzene | µg/L | 70 | Final | EPA, 1993 |

| Analyte | Unit | Level | Status | Source |
|-----------------------|--------|--------|--------|-----------|
| 1,1,1-Trichloroethane | µg/L | 200 | Final | EPA, 1993 |
| 1,1,2-Trichloroethane | µg/L | 5 | Final | EPA, 1993 |
| Trichloroethylene | µg/L | 5 | Final | EPA, 1993 |
| Tritium | pCi/mL | 2E+01 | Final | EPA, 1993 |
| Xylenes | µg/L | 10,000 | Final | EPA, 1993 |

Note: Final PDWS were assigned to alachlor, aldicarb, aldicarb sulfone, aldicarb sulfoxide, atrazine, carbofuran, dalapon, di(2-ethylhexyl) adipate, diquat dibromide, endosulf, glyphosate, oxamyl, picloram, and simazine in the SRS Groundwater Monitoring Program for the first time beginning first quarter 1994.

- ^a At present, EMS does not perform this analysis because the constituent is not in the current contract.
^b The standard given is for gross alpha including radium-226 but excluding radon and uranium.
^c For double radionuclide analyses where each separate radionuclide has its own standard, the more stringent standard is used.

References

EPA (U.S. Environmental Protection Agency), 1977. **National Interim Primary Drinking Water Regulations**, EPA-570/9-76-003. Washington, DC.

EPA (U.S. Environmental Protection Agency), 1993. **National Primary Drinking Water Regulations, Code of Federal Regulations**, Section 40, Part 141, pp. 592-732. Washington, DC.

SCDHEC (South Carolina Department of Health and Environmental Control), 1981. **State Primary Drinking Water Regulations**, R.61-58.5. Columbia, SC.

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Appendix B

Flagging Criteria

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Flagging Criteria

The Savannah River Site Environmental Protection Department/Environmental Monitoring Section (EPD/EMS) flagging criteria are as follows:

- Flag 2 criteria for constituents equal the Safe Drinking Water Act (SDWA) final Primary Drinking Water Standard (PDWS), the SDWA proposed PDWS, or the SDWA Secondary Drinking Water Standard (SDWS). If a constituent does not have a drinking water standard, the Flag 2 criterion equals 10 times the method detection limit (MDL) calculated as the 90th percentile detection limit obtained recently by one of the primary analytical laboratories.
- Flag 1 criteria for constituents equal one-half of the final PDWS, one-half the proposed PDWS, or one-half the SDWS. If a constituent does not have a drinking water standard, the Flag 1 criterion equals 5 times the MDL calculated as the 90th percentile detection limit obtained recently by one of the primary analytical laboratories.
- Flag 0 criteria are assigned to constituent levels below Flag 1 criteria, constituent levels below the sample detection limits, or constituents having no flagging criteria.

The following parameters are exceptions to the flagging rules:

- EPD/EMS sets flagging criteria for specific conductance and pH. No flags are set for alkalinity, calcium, carbonate, magnesium, potassium, silica, sodium, total dissolved solids, total phosphates (as P), and total phosphorus. Analyses for these parameters are conducted as part of the biennial comprehensive analyses or by special request.
- Aesthetic parameters such as color, corrosivity, Eh, odor, surfactants, and turbidity are not assigned flagging criteria but are analyzed by special request.
- Common laboratory contaminants and cleaners such as dichloromethane (methylene chloride), ketones, phthalates, and toluene are not assigned flagging criteria unless they have primary drinking water standards. These constituents are analyzed by special request.

| Analyte | Unit | Flag 1 | Flag 2 | Source ^a |
|------------------------------------|-------|----------|----------|---------------------------|
| Acenaphthene | µg/L | 50 | 100 | EPA Method 8270 |
| Acenaphthylene | µg/L | 50 | 100 | EPA Method 8270 |
| Acetone | µg/L | 500 | 1,000 | EPA Method 8240 |
| Acetonitrile (Methyl cyanide) | µg/L | 500 | 1,000 | EPA Method 8240 |
| Acetophenone | µg/L | 50 | 100 | EPA Method 8270 |
| 2-Acetylaminofluorene | µg/L | 50 | 100 | EPA Method 8270 |
| Acrolein | µg/L | 100 | 200 | EPA Method 8240 |
| Acrylonitrile | µg/L | 100 | 200 | EPA Method 8240 |
| Actinium-228 | pCi/L | 1.64E+03 | 3.27E+03 | Proposed PDWS (EPA, 1991) |
| Alachlor | µg/L | 1 | 2 | Final PDWS (EPA, 1993a) |
| Aldicarb ^b | µg/L | 1.5 | 3 | Final PDWS (EPA, 1993a) |
| Aldicarb sulfone ^b | µg/L | 1 | 2 | Final PDWS (EPA, 1993a) |
| Aldicarb sulfoxide ^b | µg/L | 2 | 4 | Final PDWS (EPA, 1993a) |
| Aldrin | µg/L | 0.25 | 0.5 | EPA Method 8080 |
| Alkalinity (as CaCO ₃) | | No flag | No flag | Set by EPD/EMS |
| Allyl chloride | µg/L | 250 | 500 | EPA Method 8240 |
| Aluminum | µg/L | 25 | 50 | SDWS (EPA, 1993b) |
| Aluminum, dissolved | µg/L | 25 | 50 | SDWS (EPA, 1993b) |
| Aluminum, total recoverable | µg/L | 25 | 50 | SDWS (EPA, 1993b) |

| Analyte | Unit | Flag 1 | Flag 2 | Source |
|-------------------------------|----------|-----------|-----------|--------------------------------|
| Americium-241 | pCi/L | 3.17E+00 | 6.34E+00 | Proposed PDWS (EPA, 1991) |
| Americium-243 | pCi/L | 3.19E+00 | 6.37E+00 | Proposed PDWS (EPA, 1991) |
| 4-Aminobiphenyl | µg/L | 50 | 100 | EPA Method 8270 |
| Ammonia | µg/L | 500 | 1,000 | APHA Method 417B |
| Ammonia nitrogen | µg/L | 500 | 1,000 | EPA Method 350.1 |
| Aniline | µg/L | 50 | 100 | EPA Method 8270 |
| Anthracene | µg/L | 50 | 100 | EPA Method 8270 |
| Antimony | µg/L | 3 | 6 | Final PDWS (EPA, 1993a) |
| Antimony, dissolved | µg/L | 3 | 6 | Final PDWS (EPA, 1993a) |
| Antimony, total recoverable | µg/L | 3 | 6 | Final PDWS (EPA, 1993a) |
| Antimony-125 | pCi/L | 1.5E+02 | 3E+02 | Interim Final PDWS (EPA, 1977) |
| Aramite | µg/L | 50 | 100 | EPA Method 8270 |
| Arsenic | µg/L | 25 | 50 | Final PDWS (EPA, 1993a) |
| Arsenic, dissolved | µg/L | 25 | 50 | Final PDWS (EPA, 1993a) |
| Arsenic, total recoverable | µg/L | 25 | 50 | Final PDWS (EPA, 1993a) |
| Asbestos | Fibers/L | 3,500,000 | 7,000,000 | Final PDWS (EPA, 1993a) |
| Atrazine | µg/L | 1.5 | 3 | Final PDWS (EPA, 1993a) |
| Azobenzene | µg/L | 50 | 100 | EPA Method 625 |
| Barium | µg/L | 1,000 | 2,000 | Final PDWS (EPA, 1993a) |
| Barium, dissolved | µg/L | 1,000 | 2,000 | Final PDWS (EPA, 1993a) |
| Barium, total recoverable | µg/L | 1,000 | 2,000 | Final PDWS (EPA, 1993a) |
| Barium-140 ^c | pCi/L | 4.5E+01 | 9E+01 | Interim Final PDWS (EPA, 1977) |
| Benzene | µg/L | 2.5 | 5 | Final PDWS (EPA, 1993a) |
| alpha-Benzene hexachloride | µg/L | 0.25 | 0.5 | EPA Method 8080 |
| beta-Benzene hexachloride | µg/L | 0.25 | 0.5 | EPA Method 8080 |
| delta-Benzene hexachloride | µg/L | 0.25 | 0.5 | EPA Method 8080 |
| Benzidine | µg/L | 250 | 500 | EPA Method 8270 |
| Benzo[a]anthracene | µg/L | 0.05 | 0.1 | Proposed PDWS (EPA, 1990) |
| Benzo[b]fluoranthene | µg/L | 0.1 | 0.2 | Proposed PDWS (EPA, 1990) |
| Benzo[k]fluoranthene | µg/L | 0.1 | 0.2 | Proposed PDWS (EPA, 1990) |
| Benzoic acid | µg/L | 250 | 500 | EPA Method 8270 |
| Benzo[g,h,i]perylene | µg/L | 50 | 100 | EPA Method 8270 |
| Benzo[a]pyrene | µg/L | 0.1 | 0.2 | Final PDWS (EPA, 1993a) |
| 1,4-Benzoquinone | µg/L | 50 | 100 | EPA Method 8270 |
| Benzyl alcohol | µg/L | 50 | 100 | EPA Method 8270 |
| Beryllium | µg/L | 2 | 4 | Final PDWS (EPA, 1993a) |
| Beryllium, dissolved | µg/L | 2 | 4 | Final PDWS (EPA, 1993a) |
| Beryllium, total recoverable | µg/L | 2 | 4 | Final PDWS (EPA, 1993a) |
| Beryllium-7 | pCi/L | 3E+03 | 6E+03 | Interim Final PDWS (EPA, 1977) |
| Bis(2-chloroethoxy) methane | µg/L | 50 | 100 | EPA Method 8270 |
| Bis(2-chloroethyl) ether | µg/L | 50 | 100 | EPA Method 8270 |
| Bis(2-chloroisopropyl) ether | µg/L | 50 | 100 | EPA Method 8270 |
| Bis(chloromethyl) ether | µg/L | 50 | 100 | EPA Method 8270 |
| Bis(2-ethylhexyl) phthalate | µg/L | 3 | 6 | Final PDWS (EPA, 1993a) |
| Bismuth-214 | pCi/L | 9.4E+03 | 1.89E+04 | Proposed PDWS (EPA, 1991) |
| Boron | µg/L | 150 | 300 | EPA Method 6010 |
| Boron, dissolved | µg/L | 150 | 300 | EPA Method 6010 |
| Boron, total recoverable | µg/L | 150 | 300 | EPA Method 6010 |
| Bromide | µg/L | 5,000 | 10,000 | EPA Method 300.0 |
| Bromodichloromethane | µg/L | 50 | 100 | Final PDWS (EPA, 1993a) |
| Bromoform | µg/L | 50 | 100 | Final PDWS (EPA, 1993a) |
| Bromomethane (Methyl bromide) | µg/L | 5 | 10 | EPA Method 8240 |
| 4-Bromophenyl phenyl ether | µg/L | 50 | 100 | EPA Method 8270 |
| 2-sec-Butyl-4,6-dinitrophenol | µg/L | 3.5 | 7 | Final PDWS (EPA, 1993a) |
| Butylbenzyl phthalate | | No flag | No flag | Set by EPD/EMS |

| Analyte | Unit | Flag 1 | Flag 2 | Source |
|---------------------------------|-------|----------|----------|--------------------------------|
| Cadmium | µg/L | 2.5 | 5 | Final PDWS (EPA, 1993a) |
| Cadmium, dissolved | µg/L | 2.5 | 5 | Final PDWS (EPA, 1993a) |
| Cadmium, total recoverable | µg/L | 2.5 | 5 | Final PDWS (EPA, 1993a) |
| Calcium | | No flag | No flag | Set by EPD/EMS |
| Calcium, dissolved | | No flag | No flag | Set by EPD/EMS |
| Calcium, total recoverable | | No flag | No flag | Set by EPD/EMS |
| Carbon disulfide | µg/L | 5 | 10 | EPA Method 8240 |
| Carbofuran | µg/L | 20 | 40 | Final PDWS (EPA, 1993a) |
| Carbon tetrachloride | µg/L | 2.5 | 5 | Final PDWS (EPA, 1993a) |
| Carbon-14 | pCi/L | 1E+03 | 2E+03 | Interim Final PDWS (EPA, 1977) |
| Carbonate | | No flag | No flag | Set by EPD/EMS |
| Cerium-141 ^c | pCi/L | 1.5E+02 | 3E+02 | Interim Final PDWS (EPA, 1977) |
| Cerium-144 | pCi/L | 1.31E+02 | 2.61E+02 | Proposed PDWS (EPA, 1991) |
| Cesium-134 ^d | pCi/L | 4.07E+01 | 8.13E+01 | Proposed PDWS (EPA, 1991) |
| Cesium-137 | pCi/L | 1E+02 | 2E+02 | Interim Final PDWS (EPA, 1977) |
| Chlordane | µg/L | 1 | 2 | Final PDWS (EPA, 1993a) |
| Chloride | µg/L | 125,000 | 250,000 | SDWS (EPA, 1993b) |
| 4-Chloroaniline | µg/L | 50 | 100 | EPA Method 8270 |
| Chlorobenzene | µg/L | 50 | 100 | Final PDWS (EPA, 1993a) |
| Chlorobenzilate | µg/L | 50 | 100 | EPA Method 8270 |
| Chloroethane | µg/L | 5 | 10 | EPA Method 8240 |
| Chloroethene (Vinyl chloride) | µg/L | 1 | 2 | Final PDWS (EPA, 1993a) |
| Chloroethyl vinyl ether | µg/L | 5 | 10 | EPA Method 8240 |
| 2-Chloroethyl vinyl ether | µg/L | 5 | 10 | EPA Method 8240 |
| Chloroform | µg/L | 50 | 100 | Final PDWS (EPA, 1993a) |
| 4-Chloro-m-cresol | µg/L | 50 | 100 | EPA Method 8270 |
| Chloromethane (Methyl chloride) | µg/L | 5 | 10 | EPA Method 8240 |
| 2-Chloronaphthalene | µg/L | 50 | 100 | EPA Method 8240 |
| 2-Chlorophenol | µg/L | 50 | 100 | EPA Method 8270 |
| 4-Chlorophenyl phenyl ether | µg/L | 50 | 100 | EPA Method 8270 |
| Chloroprene | µg/L | 1,000 | 2,000 | EPA Method 8240 |
| Chromium | µg/L | 50 | 100 | Final PDWS (EPA, 1993a) |
| Chromium, dissolved | µg/L | 50 | 100 | Final PDWS (EPA, 1993a) |
| Chromium, total recoverable | µg/L | 50 | 100 | Final PDWS (EPA, 1993a) |
| Chromium-51 ^c | pCi/L | 3E+03 | 6E+03 | Interim Final PDWS (EPA, 1977) |
| Chrysene | µg/L | 0.1 | 0.2 | Proposed PDWS (EPA, 1990) |
| Cobalt | µg/L | 20 | 40 | EPA Method 6010 |
| Cobalt, dissolved | µg/L | 20 | 40 | EPA Method 6010 |
| Cobalt, total recoverable | µg/L | 20 | 40 | EPA Method 6010 |
| Cobalt-57 | pCi/L | 5E+02 | 1E+03 | Interim Final PDWS (EPA, 1977) |
| Cobalt-58 ^d | pCi/L | 4.5E+03 | 9E+03 | Interim Final PDWS (EPA, 1977) |
| Cobalt-60 | pCi/L | 5E+01 | 1E+02 | Interim Final PDWS (EPA, 1977) |
| Color | | No flag | No flag | Set by EPD/EMS |
| Copper | µg/L | 500 | 1,000 | Final PDWS (SCDHEC, 1981) |
| Copper, dissolved | µg/L | 500 | 1,000 | Final PDWS (SCDHEC, 1981) |
| Copper, total recoverable | µg/L | 500 | 1,000 | Final PDWS (SCDHEC, 1981) |
| Corrosivity | | No flag | No flag | Set by EPD/EMS |
| m-Cresol (3-Methylphenol) | µg/L | 50 | 100 | EPA Method 8270 |
| o-Cresol (2-Methylphenol) | µg/L | 50 | 100 | EPA Method 8270 |
| p-Cresol (4-Methylphenol) | µg/L | 50 | 100 | EPA Method 8270 |
| Curium-242 | pCi/L | 6.65E+01 | 1.33E+02 | Proposed PDWS (EPA, 1991) |
| Curium-243 | pCi/L | 4.15E+00 | 8.3E+00 | Proposed PDWS (EPA, 1991) |
| Curium-243/244 ^e | pCi/L | 4.15E+00 | 8.3E+00 | Proposed PDWS (EPA, 1991) |
| Curium-244 | pCi/L | 4.92E+00 | 9.84E+00 | Proposed PDWS (EPA, 1991) |
| Curium-245/246 ^e | pCi/L | 3.12E+00 | 6.23E+00 | Proposed PDWS (EPA, 1991) |

| Analyte | Unit | Flag 1 | Flag 2 | Source |
|--------------------------------|-------|----------|----------|---------------------------|
| Curium-246 | pCi/L | 3.14E+00 | 6.27E+00 | Proposed PDWS (EPA, 1991) |
| Cyanide | µg/L | 100 | 200 | Final PDWS (EPA, 1993a) |
| Dalapon ^b | µg/L | 100 | 200 | Final PDWS (EPA, 1993a) |
| p,p'-DDD | µg/L | 0.5 | 1 | EPA Method 8080 |
| p,p'-DDE | µg/L | 0.5 | 1 | EPA Method 8080 |
| p,p'-DDT | µg/L | 0.5 | 1 | EPA Method 8080 |
| Di-n-butyl phthalate | | No flag | No flag | Set by EPD/EMS |
| Di-n-octyl phthalate | | No flag | No flag | Set by EPD/EMS |
| Diallate | µg/L | 50 | 100 | EPA Method 8270 |
| Dibenz[a,h]anthracene | µg/L | 0.15 | 0.3 | Proposed PDWS (EPA, 1990) |
| Dibenzofuran | µg/L | 50 | 100 | EPA Method 8270 |
| Dibromochloromethane | µg/L | 50 | 100 | Final PDWS (EPA, 1993a) |
| 1,2-Dibromo-3-chloropropane | µg/L | 0.1 | 0.2 | Final PDWS (EPA, 1993a) |
| 1,2-Dibromoethane | µg/L | 0.025 | 0.05 | Final PDWS (EPA, 1993a) |
| Dibromomethane | µg/L | 5 | 10 | EPA Method 8240 |
| (Methylene bromide) | | | | |
| 1,2-Dichlorobenzene | µg/L | 300 | 600 | Final PDWS (EPA, 1993a) |
| 1,3-Dichlorobenzene | µg/L | 50 | 100 | EPA Method 8270 |
| 1,4-Dichlorobenzene | µg/L | 37.5 | 75 | Final PDWS (EPA, 1993a) |
| 3,3'-Dichlorobenzidine | µg/L | 50 | 100 | EPA Method 8270 |
| trans-1,4-Dichloro-2-butene | µg/L | 150 | 300 | EPA Method 8240 |
| Dichlorodifluoromethane | µg/L | 5 | 10 | EPA Method 8240 |
| 1,1-Dichloroethane | µg/L | 5 | 10 | EPA Method 8240 |
| 1,2-Dichloroethane | µg/L | 2.5 | 5 | Final PDWS (EPA, 1993a) |
| 1,1-Dichloroethylene | µg/L | 3.5 | 7 | Final PDWS (EPA, 1993a) |
| 1,2-Dichloroethylene | µg/L | 25 | 50 | Final PDWS (EPA, 1993a) |
| cis-1,2-Dichloroethylene | µg/L | 35 | 70 | Final PDWS (EPA, 1993a) |
| trans-1,2-Dichloroethylene | µg/L | 50 | 100 | Final PDWS (EPA, 1993a) |
| Dichloromethane | µg/L | 2.5 | 5 | Final PDWS (EPA, 1993a) |
| (Methylene chloride) | | | | |
| 2,4-Dichlorophenol | µg/L | 50 | 100 | EPA Method 8270 |
| 2,6-Dichlorophenol | µg/L | 50 | 100 | EPA Method 8270 |
| 2,4-Dichlorophenoxyacetic acid | µg/L | 35 | 70 | Final PDWS (EPA, 1993a) |
| 1,2-Dichloropropane | µg/L | 2.5 | 5 | Final PDWS (EPA, 1993a) |
| cis-1,3-Dichloropropene | µg/L | 5 | 10 | EPA Method 8240 |
| trans-1,3-Dichloropropene | µg/L | 5 | 10 | EPA Method 8240 |
| Di(2-ethylhexyl) adipate | µg/L | 200 | 400 | Final PDWS (EPA, 1993a) |
| Dieldrin | µg/L | 2.5 | 5 | EPA Method 8080 |
| Diethyl phthalate | | No flag | No flag | Set by EPD/EMS |
| Dimethoate | µg/L | 50 | 100 | EPA Method 8270 |
| p-Dimethylaminoazobenzene | µg/L | 50 | 100 | EPA Method 8270 |
| p-(Dimethylamino)ethylbenzene | µg/L | 50 | 100 | EPA Method 8270 |
| 7,12-Dimethylbenz[a]anthracene | µg/L | 50 | 100 | EPA Method 8270 |
| 3,3'-Dimethylbenzidine | µg/L | 50 | 100 | EPA Method 8270 |
| a,a-Dimethylphenethylamine | µg/L | 50 | 100 | EPA Method 8270 |
| 2,4-Dimethyl phenol | µg/L | 50 | 100 | EPA Method 8270 |
| Dimethyl phthalate | | No flag | No flag | Set by EPD/EMS |
| 1,3-Dinitrobenzene | µg/L | 50 | 100 | EPA Method 8270 |
| 2,4-Dinitrophenol | µg/L | 250 | 500 | EPA Method 8270 |
| 2,4-Dinitrotoluene | µg/L | 50 | 100 | EPA Method 8270 |
| 2,6-Dinitrotoluene | µg/L | 50 | 100 | EPA Method 8270 |
| Diquat dibromide ^b | µg/L | 10 | 20 | Final PDWS (EPA, 1993a) |
| 1,4-Dioxane | µg/L | 50 | 100 | EPA Method 8270 |
| Diphenylamine | µg/L | 50 | 100 | EPA Method 8270 |
| 1,2-Diphenylhydrazine | µg/L | 50 | 100 | EPA Method 8270 |

| Analyte | Unit | Flag 1 | Flag 2 | Source |
|-------------------------------------|-------|---------|---------|--------------------------------|
| Dissolved organic carbon | µg/L | 5,000 | 10,000 | EPA Method 9060 |
| Disulfoton | µg/L | 50 | 100 | EPA Method 8270 |
| Eh | | No flag | No flag | Set by EPD/EMS |
| Endosulfan I | µg/L | 0.5 | 1 | EPA Method 8080 |
| Endosulfan II | µg/L | 0.5 | 1 | EPA Method 8080 |
| Endosulfan sulfate | µg/L | 0.5 | 1 | EPA Method 8080 |
| Endothall ^b | µg/L | 50 | 100 | Final PDWS (EPA, 1993a) |
| Endrin | µg/L | 1 | 2 | Final PDWS (EPA, 1993a) |
| Endrin aldehyde | µg/L | 0.5 | 1 | EPA Method 8080 |
| Endrin ketone | | No flag | No flag | Set by EPD/EMS |
| Ethylbenzene | µg/L | 350 | 700 | Final PDWS (EPA, 1993a) |
| Ethyl methacrylate | µg/L | 50 | 100 | EPA Method 8270 |
| Ethyl methanesulfonate | µg/L | 50 | 100 | EPA Method 8270 |
| Europium-152 | pCi/L | 3E+01 | 6E+01 | Interim Final PDWS (EPA, 1977) |
| Europium-154 | pCi/L | 1E+02 | 2E+02 | Interim Final PDWS (EPA, 1977) |
| Europium-155 | pCi/L | 3E+02 | 6E+02 | Interim Final PDWS (EPA, 1977) |
| Famphur | µg/L | 50 | 100 | EPA Method 8270 |
| Fluoranthene | µg/L | 50 | 100 | EPA Method 8270 |
| Fluorene | µg/L | 50 | 100 | EPA Method 8270 |
| Fluoride | µg/L | 2,000 | 4,000 | Final PDWS (EPA, 1993a) |
| Glyphosate ^b | µg/L | 350 | 700 | Final PDWS (EPA, 1993a) |
| Gross alpha | pCi/L | 7.5E+00 | 1.5E+01 | Final PDWS (EPA, 1993a) |
| Heptachlor | µg/L | 0.2 | 0.4 | Final PDWS (EPA, 1993a) |
| Heptachlor epoxide | µg/L | 0.1 | 0.2 | Final PDWS (EPA, 1993a) |
| Heptachlorodibenzo-p-dioxin isomers | µg/L | 0.00325 | 0.0065 | EPA Method 8280 |
| 1,2,3,4,6,7,8-HPCDD | µg/L | 0.00325 | 0.0065 | EPA Method 8280 |
| Heptachlorodibenzo-p-furan isomers | µg/L | 0.00225 | 0.0045 | EPA Method 8280 |
| 1,2,3,4,6,7,8-HPCDF | µg/L | 0.00225 | 0.0045 | EPA Method 8280 |
| Hexachlorobenzene | µg/L | 0.5 | 1 | Final PDWS (EPA, 1993a) |
| Hexachlorobutadiene | µg/L | 50 | 100 | EPA Method 8270 |
| Hexachlorocyclopentadiene | µg/L | 25 | 50 | Final PDWS (EPA, 1993a) |
| Hexachlorodibenzo-p-dioxin isomers | µg/L | 0.00225 | 0.0045 | EPA Method 8280 |
| 1,2,3,4,7,8-HXCDD | µg/L | 0.00225 | 0.0045 | EPA Method 8280 |
| Hexachlorodibenzo-p-furan isomers | µg/L | 0.002 | 0.004 | EPA Method 8280 |
| 1,2,3,4,7,8-HXCDF | µg/L | 0.002 | 0.004 | EPA Method 8280 |
| Hexachloroethane | µg/L | 50 | 100 | EPA Method 8270 |
| Hexachlorophene | µg/L | 250 | 500 | EPA Method 8270 |
| Hexachloropropene | µg/L | 50 | 100 | EPA Method 8270 |
| 2-Hexanone | µg/L | 50 | 100 | EPA Method 8240 |
| Indeno[1,2,3-c,d]pyrene | µg/L | 50 | 100 | EPA Method 8270 |
| Iodine | µg/L | 250 | 500 | APHA Method 415A |
| Iodine-129 | pCi/L | 5E-01 | 1E+00 | Interim Final PDWS (EPA, 1977) |
| Iodine-131 ^c | pCi/L | 1.5E+00 | 3E+00 | Interim Final PDWS (EPA, 1977) |
| Iodomethane (Methyl iodide) | µg/L | 75 | 150 | EPA Method 8240 |
| Iron | µg/L | 150 | 300 | SDWS (EPA, 1993b) |
| Iron, dissolved | µg/L | 150 | 300 | SDWS (EPA, 1993b) |
| Iron, total recoverable | µg/L | 150 | 300 | SDWS (EPA, 1993b) |
| Iron-55 ^c | pCi/L | 1E+03 | 2E+03 | Interim Final PDWS (EPA, 1977) |
| Iron-59 ^c | pCi/L | 1E+02 | 2E+02 | Interim Final PDWS (EPA, 1977) |
| Isobutyl alcohol | µg/L | 500 | 1,000 | EPA Method 8240 |
| Isodrin | µg/L | 50 | 100 | EPA Method 8270 |

| Analyte | Unit | Flag 1 | Flag 2 | Source |
|-------------------------------|-------|----------|----------|--------------------------------|
| Isophorone | µg/L | 50 | 100 | EPA Method 8270 |
| Isosafrole | µg/L | 50 | 100 | EPA Method 8270 |
| Kepone | µg/L | 50 | 100 | EPA Method 8270 |
| Lanthanum-140 ^c | pCi/L | 3E+01 | 6E+01 | Interim Final PDWS (EPA, 1977) |
| Lead | µg/L | 25 | 50 | Final PDWS (SCDHEC, 1981) |
| Lead, dissolved | µg/L | 25 | 50 | Final PDWS (SCDHEC, 1981) |
| Lead, total recoverable | µg/L | 25 | 50 | Final PDWS (SCDHEC, 1981) |
| Lead-212 | pCi/L | 6.2E+01 | 1.23E+02 | Proposed PDWS (EPA, 1991) |
| Lindane | µg/L | 0.1 | 0.2 | Final PDWS (EPA, 1993a) |
| Lithium | µg/L | 25 | 50 | EPA Method 6010 |
| Lithium, dissolved | µg/L | 25 | 50 | EPA Method 6010 |
| Lithium, total recoverable | µg/L | 25 | 50 | EPA Method 6010 |
| Magnesium | | No flag | No flag | Set by EPD/EMS |
| Magnesium, dissolved | | No flag | No flag | Set by EPD/EMS |
| Magnesium, total recoverable | | No flag | No flag | Set by EPD/EMS |
| Manganese | µg/L | 25 | 50 | SDWS (EPA, 1993b) |
| Manganese, dissolved | µg/L | 25 | 50 | SDWS (EPA, 1993b) |
| Manganese, total recoverable | µg/L | 25 | 50 | SDWS (EPA, 1993b) |
| Manganese-54 | pCi/L | 1.5E+02 | 3E+02 | Interim Final PDWS (EPA, 1977) |
| Mercury | µg/L | 1 | 2 | Final PDWS (EPA, 1993a) |
| Mercury, dissolved | µg/L | 1 | 2 | Final PDWS (EPA, 1993a) |
| Mercury, total recoverable | µg/L | 1 | 2 | Final PDWS (EPA, 1993a) |
| Methacrylonitrile | µg/L | 250 | 500 | EPA Method 8240 |
| Methapyrilene | µg/L | 50 | 100 | EPA Method 8270 |
| Methoxychlor | µg/L | 20 | 40 | Final PDWS (EPA, 1993a) |
| 3-Methylcholanthrene | µg/L | 50 | 100 | EPA Method 8270 |
| 2-Methyl-4,6-dinitrophenol | µg/L | 250 | 500 | EPA Method 8270 |
| Methyl ethyl ketone | | No flag | No flag | Set by EPD/EMS |
| Methyl isobutyl ketone | | No flag | No flag | Set by EPD/EMS |
| Methyl methacrylate | µg/L | 50 | 100 | EPA Method 8270 |
| Methyl methanesulfonate | µg/L | 50 | 100 | EPA Method 8270 |
| 2-Methylnaphthalene | µg/L | 50 | 100 | EPA Method 8270 |
| Molybdenum | µg/L | 250 | 500 | EPA Method 6010 |
| Molybdenum, dissolved | µg/L | 250 | 500 | EPA Method 6010 |
| Molybdenum, total recoverable | µg/L | 250 | 500 | EPA Method 6010 |
| Naphthalene | µg/L | 50 | 100 | EPA Method 8270 |
| 1,4-Naphthoquinone | µg/L | 50 | 100 | EPA Method 8270 |
| 1-Naphthylamine | µg/L | 50 | 100 | EPA Method 8270 |
| 2-Naphthylamine | µg/L | 50 | 100 | EPA Method 8270 |
| Neptunium-237 | pCi/L | 3.53E+00 | 7.06E+00 | Proposed PDWS (EPA, 1991) |
| Nickel | µg/L | 50 | 100 | Final PDWS (EPA, 1993a) |
| Nickel, dissolved | µg/L | 50 | 100 | Final PDWS (EPA, 1993a) |
| Nickel, total recoverable | µg/L | 50 | 100 | Final PDWS (EPA, 1993a) |
| Nickel-59 ^c | pCi/L | 1.5E+02 | 3E+02 | Interim Final PDWS (EPA, 1977) |
| Nickel-63 ^c | pCi/L | 2.5E+01 | 5E+01 | Interim Final PDWS (EPA, 1977) |
| Niobium-95 ^c | pCi/L | 1.5E+02 | 3.E+02 | Interim Final PDWS (EPA, 1977) |
| Nitrate as nitrogen | µg/L | 5,000 | 10,000 | Final PDWS (EPA, 1993a) |
| Nitrate-nitrite as nitrogen | µg/L | 5,000 | 10,000 | Final PDWS (EPA, 1993a) |
| Nitrite as nitrogen | µg/L | 500 | 1,000 | Final PDWS (EPA, 1993a) |
| m-Nitroaniline | µg/L | 50 | 100 | EPA Method 8270 |
| o-Nitroaniline | µg/L | 50 | 100 | EPA Method 8270 |
| p-Nitroaniline | µg/L | 50 | 100 | EPA Method 8270 |
| Nitrobenzene | µg/L | 50 | 100 | EPA Method 8270 |
| Nitrogen by Kjeldahl method | µg/L | 500 | 1,000 | EPA Method 351.2 |
| 2-Nitrophenol | µg/L | 50 | 100 | EPA Method 8270 |

| Analyte | Unit | Flag 1 | Flag 2 | Source |
|-------------------------------------|-------|----------|----------|--------------------------------|
| 4-Nitrophenol | µg/L | 50 | 100 | EPA Method 8270 |
| 4-Nitroquinoline-1-oxide | µg/L | 50 | 100 | EPA Method 8270 |
| N-Nitrosodi-n-butylamine | µg/L | 50 | 100 | EPA Method 8270 |
| N-Nitrosodiethylamine | µg/L | 50 | 100 | EPA Method 8270 |
| N-Nitrosodimethylamine | µg/L | 50 | 100 | EPA Method 8270 |
| N-Nitrosodiphenylamine | µg/L | 50 | 100 | EPA Method 8270 |
| N-Nitrosodipropylamine | µg/L | 50 | 100 | EPA Method 8270 |
| N-Nitrosomethylethylamine | µg/L | 50 | 100 | EPA Method 8270 |
| N-Nitrosomorpholine | µg/L | 50 | 100 | EPA Method 8270 |
| N-Nitrosopiperidine | µg/L | 50 | 100 | EPA Method 8270 |
| N-Nitrosopyrrolidine | µg/L | 50 | 100 | EPA Method 8270 |
| 5-Nitro-o-toluidine | µg/L | 50 | 100 | EPA Method 8270 |
| Nonvolatile beta | pCi/L | 2.5E+01 | 5E+01 | Interim Final PDWS (EPA, 1977) |
| Octachlorodibenzo-p-dioxin isomers | µg/L | 0.005 | 0.01 | EPA Method 8280 |
| Octachlorodibenzo-p-furan isomers | µg/L | 0.005 | 0.01 | EPA Method 8280 |
| Odor | | No flag | No flag | Set by EPD/EMS |
| Oil & Grease | µg/L | 5,000 | 10,000 | EPA Method 413.1 |
| Oxamyl ^b | µg/L | 100 | 200 | Final PDWS (EPA, 1993a) |
| Parathion | µg/L | 0.25 | 0.5 | EPA Method 8080 |
| Parathion methyl | µg/L | 0.25 | 0.5 | EPA Method 8080 |
| PCB 1016 | µg/L | 0.25 | 0.5 | Final PDWS (EPA, 1993a) |
| PCB 1221 | µg/L | 0.25 | 0.5 | Final PDWS (EPA, 1993a) |
| PCB 1232 | µg/L | 0.25 | 0.5 | Final PDWS (EPA, 1993a) |
| PCB 1242 | µg/L | 0.25 | 0.5 | Final PDWS (EPA, 1993a) |
| PCB 1248 | µg/L | 0.25 | 0.5 | Final PDWS (EPA, 1993a) |
| PCB 1254 | µg/L | 0.25 | 0.5 | Final PDWS (EPA, 1993a) |
| PCB 1260 | µg/L | 0.25 | 0.5 | Final PDWS (EPA, 1993a) |
| PCB 1262 | µg/L | 0.25 | 0.5 | Final PDWS (EPA, 1993a) |
| Pentachlorobenzene | µg/L | 50 | 100 | EPA Method 8270 |
| Pentachlorodibenzo-p-dioxin isomers | µg/L | 0.00275 | 0.0055 | EPA Method 8280 |
| 1,2,3,7,8-PCDD | µg/L | 0.00275 | 0.0055 | EPA Method 8280 |
| Pentachlorodibenzo-p-furan isomers | µg/L | 0.00275 | 0.0055 | EPA Method 8280 |
| 1,2,3,7,8-PCDF | µg/L | 0.00275 | 0.0055 | EPA Method 8280 |
| Pentachloroethane | µg/L | 50 | 100 | EPA Method 8270 |
| Pentachloronitrobenzene | µg/L | 50 | 100 | EPA Method 8270 |
| Pentachlorophenol | µg/L | 0.5 | 1 | Final PDWS (EPA, 1993a) |
| pH | pH | 8 | 10 | Set by EPD/EMS |
| pH | pH | 4 | 3 | Set by EPD/EMS |
| Phenacetin | µg/L | 50 | 100 | EPA Method 8270 |
| Phenanthrene | µg/L | 50 | 100 | EPA Method 8270 |
| Phenol | µg/L | 50 | 100 | EPA Method 8270 |
| Phenols | µg/L | 25 | 50 | EPA Method 420.1 |
| p-Phenylenediamine | µg/L | 50 | 100 | EPA Method 8270 |
| Phorate | µg/L | 0.5 | 1 | EPA Method 8080 |
| Picloram ^b | µg/L | 250 | 500 | Final PDWS (EPA, 1993a) |
| 2-Picoline | µg/L | 50 | 100 | EPA Method 8270 |
| Plutonium-238 | pCi/L | 3.51E+00 | 7.02E+00 | Proposed PDWS (EPA, 1991) |
| Plutonium-239 | pCi/L | 3.11E+01 | 6.21E+01 | Proposed PDWS (EPA, 1991) |
| Plutonium-239/240 ^e | pCi/L | 3.11E+01 | 6.21E+01 | Proposed PDWS (EPA, 1991) |
| Plutonium-240 | pCi/L | 3.11E+01 | 6.22E+01 | Proposed PDWS (EPA, 1991) |
| Plutonium-241 ^c | pCi/L | 3.13E+01 | 6.26E+01 | Proposed PDWS (EPA, 1991) |

| Analyte | Unit | Flag 1 | Flag 2 | Source |
|--------------------------------------|-------|----------|----------|--------------------------------|
| Plutonium-242 ^c | pCi/L | 3.27E+01 | 6.54E+01 | Proposed PDWS (EPA, 1991) |
| Potassium | | No flag | No flag | Set by EPD/EMS |
| Potassium, dissolved | | No flag | No flag | Set by EPD/EMS |
| Potassium, total recoverable | | No flag | No flag | Set by EPD/EMS |
| Potassium-40 | pCi/L | 1.5E+02 | 3E+02 | Proposed PDWS (EPA, 1986) |
| Promethium-144 | pCi/L | 5E+01 | 1E+02 | EPA Method 901.1 |
| Promethium-146 | pCi/L | 5E+01 | 1E+02 | EPA Method 901.1 |
| Promethium-147 | pCi/L | 5.24E+03 | 5.24E+03 | Proposed PDWS (EPA, 1991) |
| Pronamid | µg/L | 50 | 100 | EPA Method 8270 |
| Propionitrile | µg/L | 1,000 | 2,000 | EPA Method 8240 |
| Pyrene | µg/L | 50 | 100 | EPA Method 8270 |
| Pyridine | µg/L | 50 | 100 | EPA Method 8270 |
| Radium (alpha-emitting) ^f | pCi/L | 1E+01 | 2E+01 | Proposed PDWS (EPA, 1991) |
| Radium-226 | pCi/L | 1E+01 | 2E+01 | Proposed PDWS (EPA, 1991) |
| Radium-228 | pCi/L | 1E+01 | 2E+01 | Proposed PDWS (EPA, 1991) |
| Radon-222 | pCi/L | 1.5E+02 | 3E+02 | Proposed PDWS (EPA, 1991) |
| Ruthenium-103 ^c | pCi/L | 1E+02 | 2E+02 | Interim Final PDWS (EPA, 1977) |
| Ruthenium-106 | pCi/L | 1.5E+01 | 3E+01 | Interim Final PDWS (EPA, 1977) |
| Safrole | µg/L | 50 | 100 | EPA Method 8270 |
| Selenium | µg/L | 25 | 50 | Final PDWS (EPA, 1993a) |
| Selenium, dissolved | µg/L | 25 | 50 | Final PDWS (EPA, 1993a) |
| Selenium, total recoverable | µg/L | 25 | 50 | Final PDWS (EPA, 1993a) |
| Silica | | No flag | No flag | Set by EPD/EMS |
| Silica, dissolved | | No flag | No flag | Set by EPD/EMS |
| Silica, total recoverable | | No flag | No flag | Set by EPD/EMS |
| Silver | µg/L | 50 | 100 | SDWS (EPA, 1993b) |
| Silver, dissolved | µg/L | 50 | 100 | SDWS (EPA, 1993b) |
| Silver, total recoverable | µg/L | 50 | 100 | SDWS (EPA, 1993b) |
| Simazine ^b | µg/L | 2 | 4 | Final PDWS (EPA, 1993a) |
| Sodium | | No flag | No flag | Set by EPD/EMS |
| Sodium, dissolved | | No flag | No flag | Set by EPD/EMS |
| Sodium, total recoverable | | No flag | No flag | Set by EPD/EMS |
| Sodium-22 | pCi/L | 2.33E+02 | 4.66E+02 | Proposed PDWS (EPA, 1991) |
| Specific conductance | µS/cm | 250 | 500 | Set by EPD/EMS |
| Strontium-89 | pCi/L | 1E+01 | 2E+01 | Interim Final PDWS (EPA, 1977) |
| Strontium-89/90 ^e | pCi/L | 4E+00 | 8E+00 | Final PDWS (EPA, 1993a) |
| Strontium-90 | pCi/L | 4E+00 | 8E+00 | Final PDWS (EPA, 1993a) |
| Styrene | µg/L | 50 | 100 | Final PDWS (EPA, 1993a) |
| Sulfate | µg/L | 200,000 | 400,000 | Proposed PDWS (EPA, 1990) |
| Sulfide | µg/L | 5,000 | 10,000 | EPA Method 9030 |
| Sulfotep | µg/L | 50 | 100 | EPA Method 8270 |
| Surfactants | | No flag | No flag | Set by EPD/EMS |
| 2,3,7,8-TCDD | µg/L | 0.000015 | 0.00003 | Final PDWS (EPA, 1993a) |
| 2,3,7,8-TCDF | µg/L | 0.002 | 0.004 | EPA Method 8280 |
| Technetium-99 | pCi/L | 4.5E+02 | 9E+02 | Interim Final PDWS (EPA, 1977) |
| 1,2,4,5-Tetrachlorobenzene | µg/L | 50 | 100 | EPA Method 8270 |
| Tetrachlorodibenzo-p-dioxin isomers | µg/L | 0.00225 | 0.0045 | EPA Method 8280 |
| Tetrachlorodibenzo-p-furan isomers | µg/L | 0.002 | 0.004 | EPA Method 8280 |
| 1,1,1,2-Tetrachloroethane | µg/L | 5 | 10 | EPA Method 8240 |
| 1,1,2,2-Tetrachloroethane | µg/L | 5 | 10 | EPA Method 8240 |
| Tetrachloroethylene | µg/L | 2.5 | 5 | Final PDWS (EPA, 1993a) |
| 2,3,4,6-Tetrachlorophenol | µg/L | 50 | 100 | EPA Method 8270 |
| Thallium | µg/L | 1 | 2 | Final PDWS (EPA, 1993a) |

| Analyte | Unit | Flag 1 | Flag 2 | Source |
|-----------------------------------|--------|----------|----------|--------------------------------|
| Thallium, dissolved | µg/L | 1 | 2 | Final PDWS (EPA, 1993a) |
| Thallium, total recoverable | µg/L | 1 | 2 | Final PDWS (EPA, 1993a) |
| Thionazin | µg/L | 50 | 100 | EPA Method 8270 |
| Thorium-228 | pCi/L | 6.25E+01 | 1.25E+02 | Proposed PDWS (EPA, 1991) |
| Thorium-230 | pCi/L | 3.96E+01 | 7.92E+01 | Proposed PDWS (EPA, 1991) |
| Thorium-232 | pCi/L | 4.4E+01 | 8.8E+01 | Proposed PDWS (EPA, 1991) |
| Thorium-234 | pCi/L | 2E+02 | 4.01E+02 | Proposed PDWS (EPA, 1991) |
| Tin | µg/L | 10 | 20 | EPA Method 282.2 |
| Tin, dissolved | µg/L | 10 | 20 | EPA Method 282.2 |
| Tin, total recoverable | µg/L | 10 | 20 | EPA Method 282.2 |
| Tin-113 ^c | pCi/L | 1.5E+02 | 3E+02 | Interim Final PDWS (EPA, 1977) |
| Toluene | µg/L | 500 | 1,000 | Final PDWS (EPA, 1993a) |
| o-Toluidine | µg/L | 50 | 100 | EPA Method 8270 |
| Total carbon | µg/L | 5,000 | 10,000 | EPA Method 9060 |
| Total coliform | | 0 | 0 | Final PDWS (EPA, 1993a) |
| Total dissolved solids | | No flag | No flag | Set by EPD/EMS |
| Total hydrocarbons | µg/L | 5,000 | 10,000 | EPA Method 418.1 |
| Total inorganic carbon | µg/L | 5,000 | 10,000 | EPA Method 9060 |
| Total organic carbon | µg/L | 5,000 | 10,000 | EPA Method 9060 |
| Total organic halogens | µg/L | 25 | 50 | EPA Method 9020 |
| Total organic nitrogen | µg/L | 500 | 1,000 | APHA Method 420 |
| Total petroleum hydrocarbons | µg/L | 5,000 | 10,000 | EPA Method 418.1 |
| Total phosphates (as P) | | No flag | No flag | Set by EPD/EMS |
| Total phosphorus | | No flag | No flag | Set by EPD/EMS |
| Toxaphene | µg/L | 1.5 | 3 | Final PDWS (EPA, 1993a) |
| 2,4,5-TP (Silvex) | µg/L | 25 | 50 | Final PDWS (EPA, 1993a) |
| Tributyl phosphate | µg/L | 50 | 100 | EPA Method 8270 |
| 1,2,4-Trichlorobenzene | µg/L | 35 | 70 | Final PDWS (EPA, 1993a) |
| 1,1,1-Trichloroethane | µg/L | 100 | 200 | Final PDWS (EPA, 1993a) |
| 1,1,2-Trichloroethane | µg/L | 2.5 | 5 | Final PDWS (EPA, 1993a) |
| Trichloroethylene | µg/L | 2.5 | 5 | Final PDWS (EPA, 1993a) |
| Trichlorofluoromethane | µg/L | 5 | 10 | EPA Method 8240 |
| 2,4,5-Trichlorophenol | µg/L | 50 | 100 | EPA Method 8270 |
| 2,4,6-Trichlorophenol | µg/L | 50 | 100 | EPA Method 8270 |
| 2,4,5-Trichlorophenoxyacetic acid | µg/L | 2.5 | 5 | EPA Method 8150 |
| 1,2,3-Trichloropropane | µg/L | 5 | 10 | EPA Method 8240 |
| O,O,O-Triethyl phosphorothioate | µg/L | 50 | 100 | EPA Method 8270 |
| 1,3,5-Trinitrobenzene | µg/L | 50 | 100 | EPA Method 8270 |
| Tritium | pCi/mL | 1E+01 | 2E+01 | Final PDWS (EPA, 1993a) |
| Turbidity ^g | | No flag | No flag | Set by EPD/EMS |
| Uranium | µg/L | 10 | 20 | Proposed PDWS (EPA, 1991) |
| Uranium, dissolved | µg/L | 10 | 20 | Proposed PDWS (EPA, 1991) |
| Uranium, total recoverable | µg/L | 10 | 20 | Proposed PDWS (EPA, 1991) |
| Uranium alpha activity | pCi/L | 1.5E+01 | 3E+01 | Proposed PDWS (EPA, 1991) |
| Uranium-233/234 ^e | pCi/L | 6.9E+00 | 1.38E+01 | Proposed PDWS (EPA, 1991) |
| Uranium-234 | pCi/L | 6.95E+00 | 1.39E+01 | Proposed PDWS (EPA, 1991) |
| Uranium-235 | pCi/L | 7.25E+00 | 1.45E+01 | Proposed PDWS (EPA, 1991) |
| Uranium-238 | pCi/L | 7.3E+00 | 1.46E+01 | Proposed PDWS (EPA, 1991) |
| Vanadium | µg/L | 40 | 80 | EPA Method 6010 |
| Vanadium, dissolved | µg/L | 40 | 80 | EPA Method 6010 |
| Vanadium, total recoverable | µg/L | 40 | 80 | EPA Method 6010 |
| Vinyl acetate | µg/L | 5 | 10 | EPA Method 8240 |

| Analyte | Unit | Flag 1 | Flag 2 | Source |
|-----------------------------------|-------|---------|--------|--------------------------------|
| Xylenes | µg/L | 5,000 | 10,000 | Final PDWS (EPA, 1993a) |
| Yttrium-88 | pCi/L | 5E+01 | 1E+02 | EPA Method 901.1 |
| Zinc | µg/L | 2,500 | 5,000 | SDWS (EPA, 1993b) |
| Zinc, dissolved | µg/L | 2,500 | 5,000 | SDWS (EPA, 1993b) |
| Zinc, total recoverable | µg/L | 2,500 | 5,000 | SDWS (EPA, 1993b) |
| Zinc-65 | pCi/L | 1.5E+02 | 3E+02 | Interim Final PDWS (EPA, 1977) |
| Zirconium-95 ^c | pCi/L | 1E+02 | 2E+02 | Interim Final PDWS (EPA, 1977) |
| Zirconium/Niobium-95 ^c | pCi/L | 1E+02 | 2E+02 | Interim Final PDWS (EPA, 1977) |

- ^a References for methods are in Appendix E; references for dated sources are at the end of this appendix.
- ^b EMS is currently unable to perform this analysis.
- ^c EMS discontinued monitoring this radionuclide because it is inappropriate for the SRS Groundwater Monitoring Program.
- ^d EPD/EMS set this flagging criterion using the 1991 proposed PDWS because the final PDWS in 1977 may have been in error.
- ^e For double radionuclide analyses where each separate radionuclide has its own standard, the more stringent standard is used.
- ^f The applied standard is for radium-226.
- ^g The primary maximum contaminant level range for turbidity is 1–5 NTU, which is inappropriate for the SRS Groundwater Monitoring Program.

References

- EPA (U.S. Environmental Protection Agency), 1977. **National Interim Primary Drinking Water Regulations**, EPA-570/9-76-003. Washington, DC.
- EPA (U.S. Environmental Protection Agency), 1986. *Water Pollution Control; National Primary Drinking Water Regulations, Radionuclides (Proposed)*. **Federal Register**, September 30, 1986, pp. 34835–34862. Washington, DC.
- EPA (U.S. Environmental Protection Agency), 1990. *National Primary and Secondary Drinking Water Regulations; Synthetic Organic Chemicals and Inorganic Chemicals (Proposed Rule)*. **Federal Register**, July 25, 1990, pp. 30369–30448. Washington, DC.
- EPA (U.S. Environmental Protection Agency), 1991. *National Primary Drinking Water Regulations; Radionuclides; Proposed Rule*. **Federal Register**, July 18, 1991, pp. 33052–33127. Washington, DC.
- EPA (U.S. Environmental Protection Agency), 1993a. *National Primary Drinking Water Regulations. Code of Federal Regulations*, Section 40, Part 141, pp. 592–732. Washington, DC.
- EPA (U.S. Environmental Protection Agency), 1993b. *National Secondary Drinking Water Regulations. Code of Federal Regulations*, Section 40, Part 143, pp. 774–777. Washington, DC.
- SCDHEC (South Carolina Department of Health and Environmental Control), 1981. **State Primary Drinking Water Regulations**, R.61–58.5. Columbia, SC.

Appendix C

Figures

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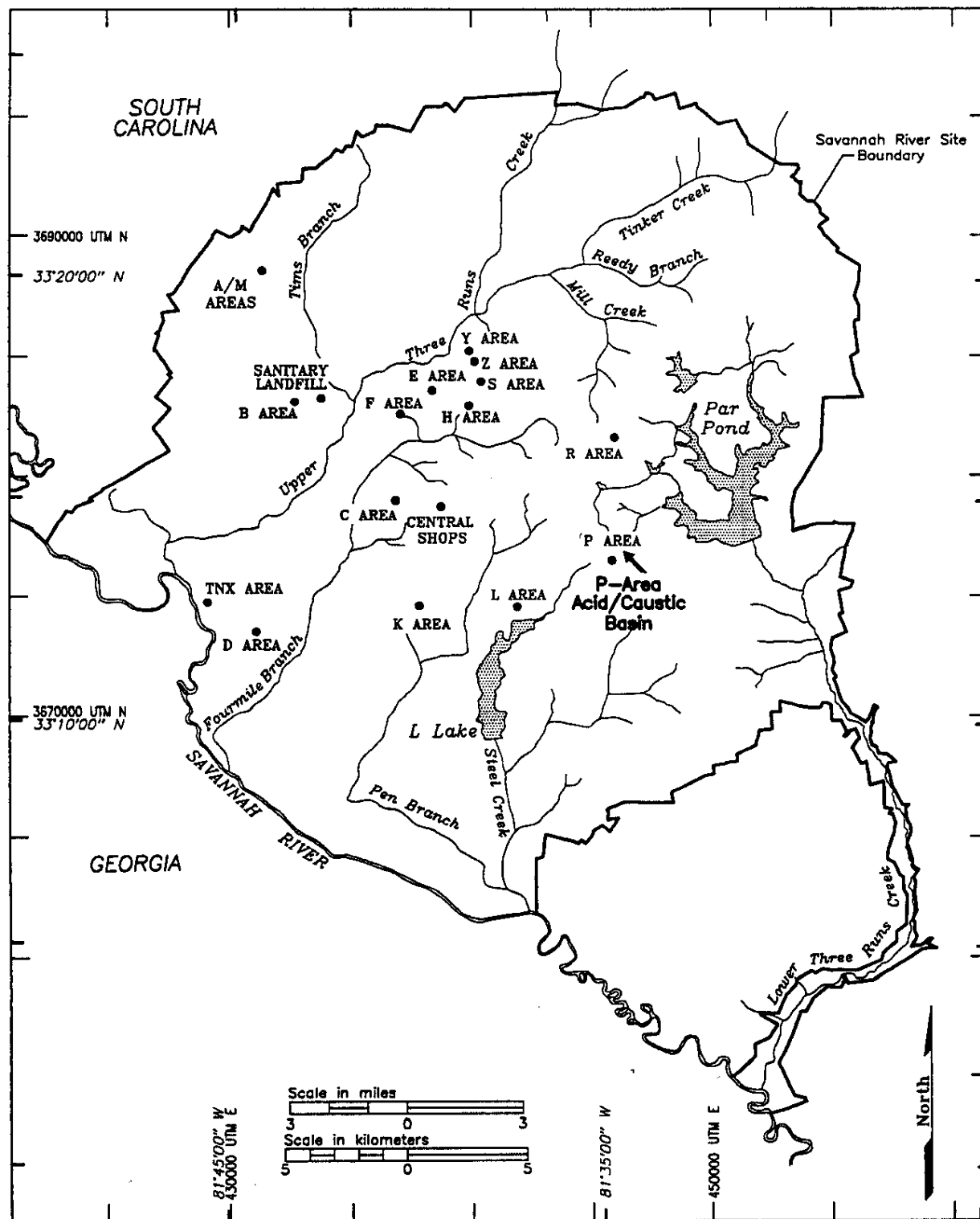


Figure 1. Location of the P-Area Acid/Caustic Basin at the Savannah River Site

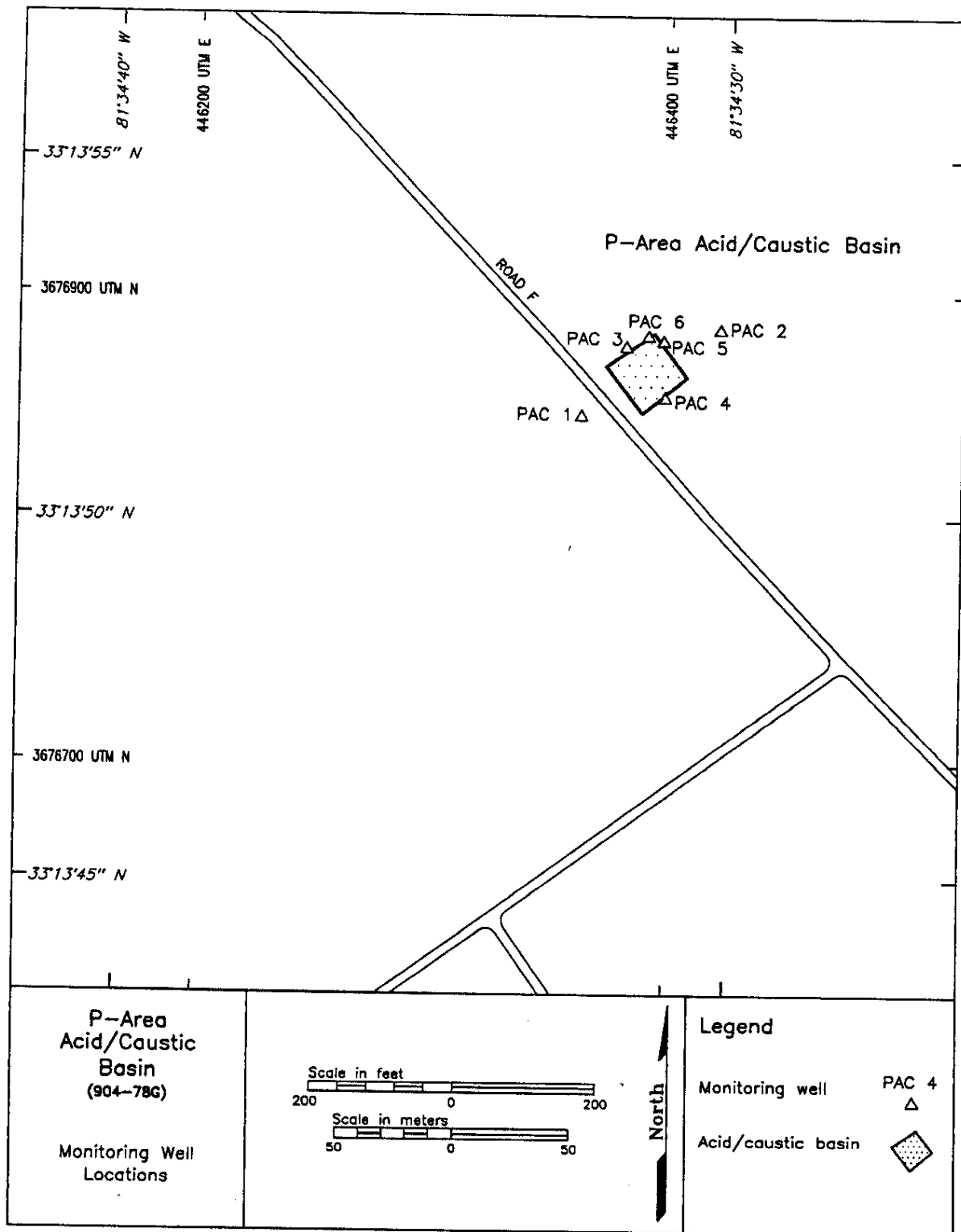


Figure 2. Location of Groundwater Monitoring Wells at the P-Area Acid/Caustic Basin

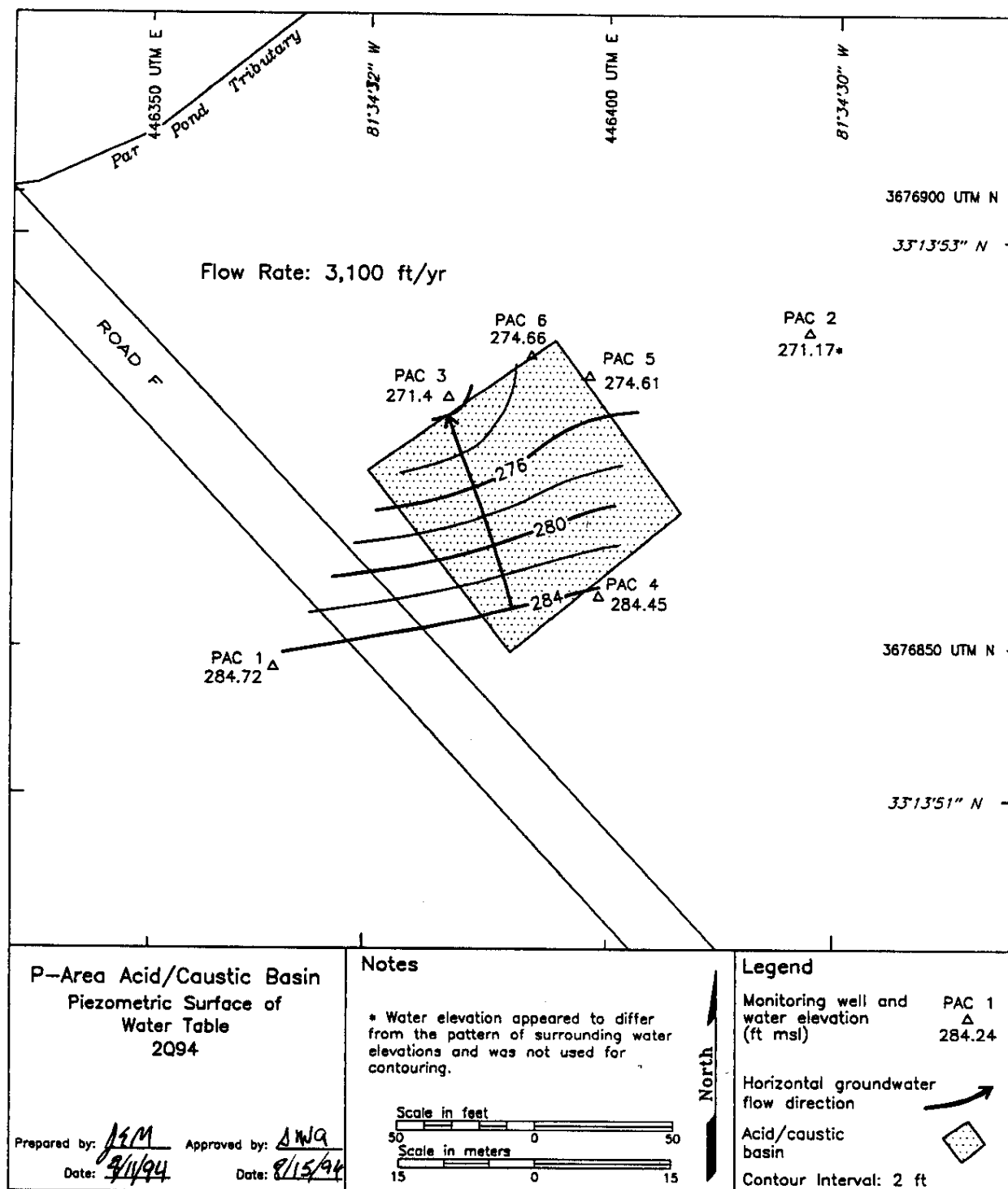


Figure 3. Piezometric Surface Map of the Water Table at the P-Area Acid/Caustic Basin

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Appendix D

Groundwater Monitoring Results Tables

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Key to Reading the Tables

The following abbreviations may appear in the data tables:

Constituents

| | |
|---------------------|---|
| 1,2,3,4,6,7,8-HPCDD | 1,2,3,4,6,7,8-heptachlorodibenzo-p-dioxin |
| 1,2,3,4,6,7,8-HPCDF | 1,2,3,4,6,7,8-heptachlorodibenzo-p-furan |
| 1,2,3,4,7,8-HXCDD | 1,2,3,4,7,8-hexachlorodibenzo-p-dioxin |
| 1,2,3,4,7,8-HXCDF | 1,2,3,4,7,8-hexachlorodibenzo-p-furan |
| Lindane | gamma-benzene hexachloride |
| PCB | polychlorinated biphenyl |
| 1,2,3,7,8-PCDD | 1,2,3,7,8-pentachlorodibenzo-p-dioxin |
| 1,2,3,7,8-PCDF | 1,2,3,7,8-pentachlorodibenzo-p-furan |
| Sp. conductance | specific conductance |
| TCDD | tetrachlorodibenzo-p-dioxin |
| TCDF | tetrachlorodibenzo-p-furan |

Laboratories

| | |
|-----------|---|
| CN | Clemson Technical Center, Inc. |
| EM | Environmental Protection Department/Environmental Monitoring Section (EPD/EMS) Laboratory |
| GE and GP | General Engineering Laboratories |
| SC | Savannah River Technology Center |
| SP | Spencer Testing Services, Inc. |
| TM | TMA/Eberline |
| WA and WS | Roy F. Weston, Inc. |

Sampling Codes

| | |
|---|---|
| B | blank sample was collected |
| C | well was pumping continuously |
| D | well was dry |
| E | equipment blank was collected |
| I | well went dry during sampling; insufficient water to collect all samples |
| L | well went dry before sampling began; only depth to water can be determined |
| P | inaccessibility or mechanical failure prevented sample collection and field analysis of the water |
| S | no water in standpipe; for water level events only |
| X | well went dry during purging; samples collected after well recovered |

Sampling Methods

| | |
|---|---|
| B | sample collected using an open-bucket bailer |
| P | sample collected using a bladder pump |
| S | sample collected using a single-speed centrifugal downhole pump |
| V | sample collected using a variable-speed pump |

Units

| | |
|------------------|---|
| E | exponential notation (e.g., $1.1E-09 = 1.1 \times 10^{-9} = 0.0000000011$) |
| mg/L | milligrams per liter |
| msl | mean sea level |
| MSL | million structures per liter |
| NTU | turbidity unit |
| pCi/L | picocuries per liter |
| pCi/mL | picocuries per milliliter |
| pH | pH unit |
| $\mu\text{g/L}$ | micrograms per liter |
| $\mu\text{S/cm}$ | microsiemens per centimeter |

Other

| | |
|------|--|
| CS | carbon steel |
| D | exceeded final Primary Drinking Water Standard (PDWS) or screening level column in data tables |
| DF | dilution factor column in data tables |
| GS | groundwater protection standard column in data tables |
| H | holding time column in data tables |
| Mod | modifier column in data tables |
| PDWS | primary drinking water standard |
| PVC | polyvinyl chloride |
| TOC | top of casing |

Holding Times

Standard analytical methods include a limit, called holding time, on the maximum elapsed time between sample collection and extraction or analysis by the laboratory. In the data tables, a large bullet (•) in the *H* (holding time) column indicates that holding time was exceeded. Analyses performed beyond holding times may not yield valid results.

The South Carolina Department of Health and Environmental Control allows only 15 minutes to elapse between sampling and analysis for pH. Thus, only field pH measurements can meet the holding time criterion; laboratory pH analyses always will exceed it.

The laboratory procedure used for the determination of specific conductance allows one day to elapse between sampling and analysis. Thus, laboratory specific conductance measurements may exceed the holding time criterion.

Data Rounding

Constituent results in analytical results tables that appear to equal the final PDWS but are not marked in the *D* (exceeded the final PDWS or screening level) column are below the final PDWS in the database. Values stored in the database contain more significant digits than the reported results. Apparent discrepancies in the tables are due to the rounding of reported results.

Data Qualification

The contract laboratories continually assess their own accuracy and precision according to U.S. Environmental Protection Agency (EPA) guidelines. They submit sample- or batch-specific quality assurance/quality control information either at the same time as analytical results or in a quarterly summary. Properly defined and used result modifiers (also referred to as qualifiers) can be a key component in assessing data useability. Result modifiers designed by the Environmental Protection Department/Environmental Monitoring Section and provided to the primary laboratories are defined below. These modifiers appear in the data tables under the column *Mod*. The lettered modifiers are based on EPA's STORET codes.

Result modifier

| | |
|---------|--|
| (Blank) | Data are not qualified. Numbers should be interpreted exactly as reported. |
| J | Value is estimated because quantitation in the sample or in associated quality control samples did not meet specifications. |
| I | The value in the result field is the instrument reading, not the sample quantification limit. Always used with the result qualifier <i>U</i> . |
| L | Value is off-scale high. The actual value is not known but is known to be greater than the value shown. |
| M | Presence of the analyte is verified but not quantified. |
| R | Result was rejected because performance requirements in the sample analysis or associated quality control analyses were not met. |
| T | Analyte was not detected; if present, it was below the criteria for detection. |
| U | Material analyzed for but not detected. Analytical result reported is less than the sample quantitation limit. |
| V | Analyte was detected in an associated method blank. |
| Y | Result was obtained from an unpreserved or improperly preserved sample. Data may not be accurate. |
| 1 | Result may be an underestimation of the true value due to analytical bias. |
| 2 | Result may be an overestimation of the true value due to analytical bias. |
| 3 | The associated result may be of poor precision (high variability) due to analytical bias. |
| 4 | Result is associated with QA results indicating matrix interference. |
| 6 | The associated result is from a reanalysis performed out of holding time due to problems with an earlier analysis. |

Table 1. Maximum Results for Constituents Exceeding Final Primary Drinking Water Standards

| <u>Well</u> | <u>Constituent</u> | <u>Unit</u> | <u>3Q93</u> | <u>4Q93</u> | <u>1Q94</u> | <u>2Q94</u> | <u>Mod</u> |
|----------------|--------------------|-------------|-------------|-------------|-------------|-------------|------------|
| N ^a | None | | N | N | N | N | |

Note: The modifier column applies to second quarter 1994 data only.

^a N = not applicable.

Table 2. Maximum Results for Constituents Exceeding Other Flag 2 Criteria or the SRS Turbidity Standard

| <u>Well</u> | <u>Constituent</u> | <u>Unit</u> | <u>2Q94</u> | <u>Mod</u> |
|-------------|----------------------|-------------|-------------|------------|
| PAC 1 | Aluminum | µg/L | 76 | |
| PAC 2 | Iron | µg/L | 5,300 | |
| | Manganese | µg/L | 73 | |
| PAC 3 | Aluminum | µg/L | 101 | |
| PAC 4 | Aluminum | µg/L | 75 | |
| PAC 5 | Aluminum | µg/L | 771 | |
| | Iron | µg/L | 1,240 | |
| | Manganese | µg/L | 384 | |
| | Specific conductance | µS/cm | 640 | |
| PAC 6 | Aluminum | µg/L | 523 | |
| | Iron | µg/L | 14,400 | |
| | Manganese | µg/L | 175 | |

Notes: These results do not include field data.

The groundwater samples are unfiltered. Thus, the results for metals are for total recoverable metals.

Flags are established by EPD/EMS and are based on final PDWS, Secondary Drinking Water Standards, or method detection limits (see Appendix B).

Table 3. Groundwater Monitoring Results for Individual Wells

WELL PAC 1

| <u>SRS Coord.</u> | <u>Lat/Longitude</u> | <u>Screen Zone Elevation</u> | <u>Top of Casing</u> | <u>Casing</u> | <u>Pump</u> | <u>Formation</u> |
|----------------------|------------------------------|------------------------------|----------------------|---------------|-------------|------------------|
| N43543.3 E66753.4 | 33.230963 °N 81.575658 °W | 283.9-253.9 ft msl | 295.9 ft msl | 4" PVC | S | Water Table |

FIELD MEASUREMENTS

Sample date: 05/10/94
Depth to water: 11.18 ft (3.41 m) below TOC
Water elevation: 284.72 ft (86.78 m) msl
Sp. conductance: 39 µS/cm
Turbidity: 4.8 NTU
Water evacuated before sampling: 244 gal

Time: 8:58
pH: 5.2
Alkalinity: 1 mg/L
Water temperature: 16.8 °C
Volumes purged: 12.1 well volumes

LABORATORY ANALYSES

| <u>H</u> | <u>D</u> | <u>Analyte</u> | <u>Result</u> | <u>DF</u> | <u>Mod</u> | <u>Unit</u> | <u>Flag</u> | <u>Lab</u> |
|----------|----------|--------------------------------|---------------|-----------|------------|-------------|-------------|------------|
| • | | pH | 5.4 | 1 | J | pH | 0 | WA |
| | | Specific conductance | 32 | 1 | | µS/cm | 0 | WA |
| • | | Turbidity | 3.1 | 1 | J | NTU | 0 | WA |
| • | | Turbidity | 3.1 | 1 | J | NTU | 0 | WA |
| | | Aluminum, total recoverable | 76 | 1 | | µg/L | 2 | WA |
| | | Arsenic, total recoverable | <2.0 | 1 | | µg/L | 0 | WA |
| | | Barium, total recoverable | 18 | 1 | | µg/L | 0 | WA |
| | | Cadmium, total recoverable | <2.0 | 1 | | µg/L | 0 | WA |
| | | Calcium, total recoverable | 394 | 1 | | µg/L | 0 | WA |
| | | Chloride | 2,820 | 1 | | µg/L | 0 | WA |
| | | Chromium, total recoverable | <4.0 | 1 | | µg/L | 0 | WA |
| | | 2,4-Dichlorophenoxyacetic acid | <1.1 | 1.09 | | µg/L | 0 | WA |
| | | Endrin | <0.10 | 1.04 | | µg/L | 0 | WA |
| | | Fluoride | <100 | 1 | | µg/L | 0 | WA |
| | | Iron, total recoverable | 75 | 1 | | µg/L | 0 | WA |
| | | Lead, total recoverable | 3.9 | 1 | | µg/L | 0 | WA |
| | | Lindane | <0.052 | 1.04 | | µg/L | 0 | WA |
| | | Magnesium, total recoverable | 212 | 1 | | µg/L | 0 | WA |
| | | Manganese, total recoverable | 3.5 | 1 | | µg/L | 0 | WA |
| | | Mercury, total recoverable | <0.20 | 1 | | µg/L | 0 | WA |
| | | Methoxychlor | <0.52 | 1.04 | | µg/L | 0 | WA |
| | | Methoxychlor | <0.52 | 1.04 | | µg/L | 0 | WA |
| | | Nitrate as nitrogen | 602 | 1 | | µg/L | 0 | WA |
| | | Phenols | <5.0 | 1 | | µg/L | 0 | WA |
| | | Potassium, total recoverable | 517 | 1 | | µg/L | 0 | WA |
| | | Selenium, total recoverable | <2.0 | 1 | | µg/L | 0 | WA |
| | | Silica, total recoverable | 5,170 | 2.1 | | µg/L | 0 | WA |
| | | Silver, total recoverable | <2.0 | 1 | | µg/L | 0 | WA |
| | | Sodium, total recoverable | 6,250 | 1 | | µg/L | 0 | WA |
| | | Sulfate | 1,660 | 1 | | µg/L | 0 | WA |
| | | Total dissolved solids | 54,000 | 1 | | µg/L | 0 | WA |
| | | Total organic carbon | <1,000 | 1 | | µg/L | 0 | WA |
| | | Total organic halogens | 8.5 | 1 | | µg/L | 0 | WA |
| | | Total phosphates (as P) | <50 | 1 | | µg/L | 0 | WA |
| | | Toxaphene | <1.0 | 1.04 | | µg/L | 0 | WA |
| | | Toxaphene | <1.0 | 1.04 | | µg/L | 0 | WA |
| | | 2,4,5-TP (Silvex) | <0.55 | 1.09 | | µg/L | 0 | WA |
| | | Gross alpha | 8.0E-01 | 1 | | pCi/L | 0 | TM |

• = exceeded holding time. ■ = exceeded screening level or final primary drinking water standard.

WELL PAC 1 collected on 05/10/94, laboratory analyses (cont.)

| H | D | Analyte | Result | DF | Mod | Unit | Flag | Lab |
|---|---|------------------|---------|----|-----|--------|------|-----|
| | | Nonvolatile beta | 9.0E-01 | 1 | UI | pCi/L | 0 | TM |
| | | Radium-226 | 3.6E-01 | 1 | | pCi/L | 0 | TM |
| | | Radium-228 | 4.0E-01 | 1 | UI | pCi/L | 0 | TM |
| | | Tritium | 4.8E+00 | 1 | | pCi/mL | 0 | TM |

WELL PAC 2

| SRS Coord. | Lat/Longitude | Screen Zone Elevation | Top of Casing | Casing | Pump | Formation |
|----------------------|------------------------------|-----------------------|---------------|--------|------|-------------|
| N43527.7 E66980.9 | 33.231299 °N 81.575029 °W | 277.9-247.9 ft msl | 284.8 ft msl | 4" PVC | S | Water Table |

FIELD MEASUREMENTS

Sample date: 05/09/94
Depth to water: 13.63 ft (4.15 m) below TOC
Water elevation: 271.17 ft (82.65 m) msl
Sp. conductance: 80 µS/cm
Turbidity: 2.1 NTU
Water evacuated before sampling: 322 gal

Time: 14:12
pH: 6.4
Alkalinity: 16 mg/L
Water temperature: 18.4 °C

Volumes purged: 21.1 well volumes

LABORATORY ANALYSES

| H | D | Analyte | Result | DF | Mod | Unit | Flag | Lab |
|---|---|--------------------------------|--------|------|-----|-------|------|-----|
| • | | pH | 5.5 | 1 | J | pH | 0 | WA |
| | | Specific conductance | 57 | 1 | | µS/cm | 0 | WA |
| | | Turbidity | 5.2 | 1 | | NTU | 0 | WA |
| | | Aluminum, total recoverable | <20 | 1 | | µg/L | 0 | WA |
| | | Arsenic, total recoverable | <2.0 | 1 | | µg/L | 0 | WA |
| | | Barium, total recoverable | 26 | 1 | | µg/L | 0 | WA |
| | | Cadmium, total recoverable | <2.0 | 1 | | µg/L | 0 | WA |
| | | Calcium, total recoverable | 4,320 | 1 | | µg/L | 0 | WA |
| | | Chloride | 4,430 | 1 | | µg/L | 0 | WA |
| | | Chromium, total recoverable | <4.0 | 1 | | µg/L | 0 | WA |
| | | 2,4-Dichlorophenoxyacetic acid | <1.1 | 1.11 | | µg/L | 0 | WA |
| | | Endrin | <0.10 | 1.04 | | µg/L | 0 | WA |
| | | Fluoride | <100 | 1 | | µg/L | 0 | WA |
| | | Fluoride | <100 | 1 | | µg/L | 0 | WA |
| | | Iron, total recoverable | 5,300 | 1 | | µg/L | 2 | WA |
| | | Lead, total recoverable | <3.0 | 1 | | µg/L | 0 | WA |
| | | Lindane | <0.052 | 1.04 | | µg/L | 0 | WA |
| | | Magnesium, total recoverable | 790 | 1 | | µg/L | 0 | WA |
| | | Manganese, total recoverable | 73 | 1 | | µg/L | 2 | WA |
| | | Mercury, total recoverable | <0.20 | 1 | | µg/L | 0 | WA |
| | | Methoxychlor | <0.52 | 1.04 | | µg/L | 0 | WA |
| | | Nitrate as nitrogen | <20 | 1 | | µg/L | 0 | WA |
| | | Phenols | <5.0 | 1 | | µg/L | 0 | WA |
| | | Potassium, total recoverable | 1,220 | 1 | | µg/L | 0 | WA |
| | | Selenium, total recoverable | <2.0 | 1 | | µg/L | 0 | WA |
| | | Silica, total recoverable | 8,040 | 2.1 | | µg/L | 0 | WA |
| | | Silver, total recoverable | <2.0 | 1 | | µg/L | 0 | WA |
| | | Sodium, total recoverable | 4,780 | 1 | | µg/L | 0 | WA |
| | | Sulfate | 7,340 | 1 | | µg/L | 0 | WA |
| | | Total dissolved solids | 63,000 | 1 | | µg/L | 0 | WA |
| | | Total organic carbon | <1,000 | 1 | | µg/L | 0 | WA |

• = exceeded holding time. ■ = exceeded screening level or final primary drinking water standard.

WELL PAC 2 collected on 05/09/94, laboratory analyses (cont.)

| H | D | Analyte | Result | DF | Mod | Unit | Flag | Lab |
|---|---|-------------------------|----------|------|-----|--------|------|-----|
| | | Total organic halogens | <5.0 | 1 | | µg/L | 0 | WA |
| | | Total organic halogens | <5.0 | 1 | | µg/L | 0 | WA |
| | | Total phosphates (as P) | <50 | 1 | | µg/L | 0 | WA |
| | | Toxaphene | <1.0 | 1.04 | | µg/L | 0 | WA |
| | | 2,4,5-TP (Silvex) | <0.56 | 1.11 | | µg/L | 0 | WA |
| | | Gross alpha | 8.0E-01 | 1 | | pCi/L | 0 | TM |
| | | Nonvolatile beta | <4.0E-01 | 1 | | pCi/L | 0 | TM |
| | | Radium-226 | 8.6E-01 | 1 | | pCi/L | 0 | TM |
| | | Radium-228 | 7.0E-01 | 1 | | pCi/L | 0 | TM |
| | | Tritium | 4.2E-01 | 1 | | pCi/mL | 0 | TM |

WELL PAC 3

| SRS Coord. | Lat/Longitude | Screen Zone Elevation | Top of Casing | Casing | Pump | Formation |
|------------|---------------|-----------------------|---------------|--------|------|-------------|
| N43585.6 | 33.231232 °N | 282.9-252.9 ft msl | 289.9 ft msl | 4" PVC | S | Water Table |
| E66861.4 | 81.575456 °W | | | | | |

FIELD MEASUREMENTS

Sample date: 05/10/94
Depth to water: 18.50 ft (5.64 m) below TOC
Water elevation: 271.40 ft (82.72 m) msl
Sp. conductance: 227 µS/cm
Turbidity: 3.2 NTU
Water evacuated before sampling: 296 gal

Time: 11:13
pH: 5.6
Alkalinity: 13 mg/L
Water temperature: 19.2 °C
Volumes purged: 24.4 well volumes

LABORATORY ANALYSES

| H | D | Analyte | Result | DF | Mod | Unit | Flag | Lab |
|---|---|--------------------------------|--------|------|-----|-------|------|-----|
| • | | pH | 5.7 | 1 | J | pH | 0 | WA |
| | | Specific conductance | 201 | 1 | | µS/cm | 0 | WA |
| • | | Turbidity | 0.82 | 1 | J | NTU | 0 | WA |
| | | Aluminum, total recoverable | 101 | 1 | | µg/L | 2 | WA |
| | | Arsenic, total recoverable | <2.0 | 1 | | µg/L | 0 | WA |
| | | Barium, total recoverable | 59 | 1 | | µg/L | 0 | WA |
| | | Cadmium, total recoverable | <2.0 | 1 | | µg/L | 0 | WA |
| | | Calcium, total recoverable | 7,440 | 1 | | µg/L | 0 | WA |
| | | Chloride | 12,600 | 2 | | µg/L | 0 | WA |
| | | Chromium, total recoverable | <4.0 | 1 | | µg/L | 0 | WA |
| | | 2,4-Dichlorophenoxyacetic acid | <1.1 | 1.09 | | µg/L | 0 | WA |
| | | 2,4-Dichlorophenoxyacetic acid | <1.1 | 1.11 | | µg/L | 0 | WA |
| | | Endrin | <0.10 | 1.04 | | µg/L | 0 | WA |
| | | Endrin | <0.11 | 1.06 | | µg/L | 0 | WA |
| | | Fluoride | 177 | 1 | | µg/L | 0 | WA |
| | | Iron, total recoverable | 210 | 1 | | µg/L | 1 | WA |
| | | Lead, total recoverable | 3.1 | 1 | | µg/L | 0 | WA |
| | | Lindane | <0.052 | 1.04 | | µg/L | 0 | WA |
| | | Lindane | <0.053 | 1.06 | | µg/L | 0 | WA |
| | | Magnesium, total recoverable | 3,480 | 1 | | µg/L | 0 | WA |
| | | Manganese, total recoverable | 10 | 1 | | µg/L | 0 | WA |
| | | Mercury, total recoverable | <0.20 | 1 | | µg/L | 0 | WA |
| | | Methoxychlor | <0.52 | 1.04 | | µg/L | 0 | WA |
| | | Methoxychlor | <0.53 | 1.06 | | µg/L | 0 | WA |

• = exceeded holding time. ■ = exceeded screening level or final primary drinking water standard.

WELL PAC 3 collected on 05/10/94, laboratory analyses (cont.)

| <u>H</u> | <u>D</u> | <u>Analyte</u> | <u>Result</u> | <u>DF</u> | <u>Mod</u> | <u>Unit</u> | <u>Flag</u> | <u>Lab</u> |
|----------|----------|------------------------------|---------------|-----------|------------|-------------|-------------|------------|
| | | Nitrate as nitrogen | 1,130 | 2 | | µg/L | 0 | WA |
| | | Phenols | <5.0 | 1 | | µg/L | 0 | WA |
| | | Potassium, total recoverable | 1,560 | 1 | | µg/L | 0 | WA |
| | | Selenium, total recoverable | <2.0 | 1 | | µg/L | 0 | WA |
| | | Silica, total recoverable | 13,100 | 2.1 | | µg/L | 0 | WA |
| | | Silver, total recoverable | <2.0 | 1 | | µg/L | 0 | WA |
| | | Sodium, total recoverable | 27,000 | 1 | | µg/L | 0 | WA |
| | | Sulfate | 56,200 | 10 | | µg/L | 0 | WA |
| | | Total dissolved solids | 168,000 | 1 | | µg/L | 0 | WA |
| | | Total organic carbon | <1,000 | 1 | | µg/L | 0 | WA |
| | | Total organic halogens | 12 | 1.33 | | µg/L | 0 | WA |
| | | Total phosphates (as P) | <50 | 1 | | µg/L | 0 | WA |
| | | Toxaphene | <1.0 | 1.04 | | µg/L | 0 | WA |
| | | Toxaphene | <1.1 | 1.06 | | µg/L | 0 | WA |
| | | 2,4,5-TP (Silvex) | <0.55 | 1.09 | | µg/L | 0 | WA |
| | | 2,4,5-TP (Silvex) | <0.56 | 1.11 | | µg/L | 0 | WA |
| | | Gross alpha | 9.0E-01 | 1 | | pCi/L | 0 | TM |
| | | Nonvolatile beta | 4.5E+00 | 1 | | pCi/L | 0 | TM |
| | | Radium-226 | 4.1E-01 | 1 | | pCi/L | 0 | TM |
| | | Radium-228 | 2.1E+00 | 1 | | pCi/L | 0 | TM |
| | | Tritium | 6.5E+00 | 1 | | pCi/mL | 0 | TM |

WELL PAC 4

| <u>SRS Coord.</u> | <u>Lat/Longitude</u> | <u>Screen Zone Elevation</u> | <u>Top of Casing</u> | <u>Casing</u> | <u>Pump</u> | <u>Formation</u> |
|-------------------|----------------------|------------------------------|----------------------|---------------|-------------|------------------|
| N43495.4 | 33.231036 °N | 280.6-250.6 ft msl | 291.6 ft msl | 4" PVC | S | Water Table |
| E66863.2 | 81.575276 °W | | | | | |

FIELD MEASUREMENTS

Sample date: 05/09/94

Depth to water: 7.15 ft (2.18 m) below TOC

Water elevation: 284.45 ft (86.70 m) msl

Sp. conductance: 99 µS/cm

Turbidity: 4.0 NTU

Water evacuated before sampling: 192 gal

Time: 12:21

pH: 5.4

Alkalinity: 3 mg/L

Water temperature: 18.8 °C

Volumes purged: 8.6 well volumes

LABORATORY ANALYSES

| <u>H</u> | <u>D</u> | <u>Analyte</u> | <u>Result</u> | <u>DF</u> | <u>Mod</u> | <u>Unit</u> | <u>Flag</u> | <u>Lab</u> |
|----------|----------|--------------------------------|---------------|-----------|------------|-------------|-------------|------------|
| • | | pH | 6.4 | 1 | J | pH | 0 | WA |
| | | Specific conductance | 88 | 1 | | µS/cm | 0 | WA |
| | | Turbidity | 2.8 | 1 | | NTU | 0 | WA |
| | | Turbidity | 2.8 | 1 | | NTU | 0 | WA |
| | | Aluminum, total recoverable | 75 | 1 | | µg/L | 2 | WA |
| | | Arsenic, total recoverable | <2.0 | 1 | | µg/L | 0 | WA |
| | | Barium, total recoverable | 18 | 1 | | µg/L | 0 | WA |
| | | Cadmium, total recoverable | <2.0 | 1 | | µg/L | 0 | WA |
| | | Calcium, total recoverable | 278 | 1 | | µg/L | 0 | WA |
| | | Chloride | 2,990 | 1 | | µg/L | 0 | WA |
| | | Chloride | 3,030 | 1 | | µg/L | 0 | WA |
| | | Chromium, total recoverable | <4.0 | 1 | | µg/L | 0 | WA |
| | | 2,4-Dichlorophenoxyacetic acid | <1.1 | 1.1 | | µg/L | 0 | WA |

• = exceeded holding time. ■ = exceeded screening level or final primary drinking water standard.

WELL PAC 4 collected on 05/09/94, laboratory analyses (cont.)

| <u>H</u> | <u>D</u> | <u>Analyte</u> | <u>Result</u> | <u>DF</u> | <u>Mod</u> | <u>Unit</u> | <u>Flag</u> | <u>Lab</u> |
|----------|----------|------------------------------|---------------|-----------|------------|-------------|-------------|------------|
| | | Endrin | <0.11 | 1.08 | | µg/L | 0 | WA |
| | | Fluoride | <100 | 1 | | µg/L | 0 | WA |
| | | Iron, total recoverable | 132 | 1 | | µg/L | 0 | WA |
| | | Lead, total recoverable | <3.0 | 1 | | µg/L | 0 | WA |
| | | Lindane | <0.054 | 1.08 | | µg/L | 0 | WA |
| | | Magnesium, total recoverable | 273 | 1 | | µg/L | 0 | WA |
| | | Manganese, total recoverable | 3.4 | 1 | | µg/L | 0 | WA |
| | | Mercury, total recoverable | <0.20 | 1 | | µg/L | 0 | WA |
| | | Methoxychlor | <0.54 | 1.08 | | µg/L | 0 | WA |
| | | Nitrate as nitrogen | 882 | 1 | | µg/L | 0 | WA |
| | | Phenols | <5.0 | 1 | | µg/L | 0 | WA |
| | | Phenols | <5.0 | 1 | | µg/L | 0 | WA |
| | | Potassium, total recoverable | 523 | 1 | | µg/L | 0 | WA |
| | | Selenium, total recoverable | <2.0 | 1 | | µg/L | 0 | WA |
| | | Silica, total recoverable | 5,780 | 2.1 | | µg/L | 0 | WA |
| | | Silver, total recoverable | 7.3 | 1 | | µg/L | 0 | WA |
| | | Sodium, total recoverable | 17,000 | 1 | | µg/L | 0 | WA |
| | | Sulfate | 24,600 | 5 | | µg/L | 0 | WA |
| | | Sulfate | 24,700 | 5 | | µg/L | 0 | WA |
| | | Total dissolved solids | 68,000 | 1 | | µg/L | 0 | WA |
| | | Total organic carbon | <1,000 | 1 | | µg/L | 0 | WA |
| | | Total organic halogens | 18 | 1.33 | | µg/L | 0 | WA |
| | | Total organic halogens | 22 | 1.33 | | µg/L | 0 | WA |
| | | Total phosphates (as P) | <50 | 1 | | µg/L | 0 | WA |
| | | Toxaphene | <1.1 | 1.08 | | µg/L | 0 | WA |
| | | 2,4,5-TP (Silvex) | <0.55 | 1.1 | | µg/L | 0 | WA |
| | | Gross alpha | <3.2E-01 | 1 | | pCi/L | 0 | TM |
| | | Nonvolatile beta | <4.1E-01 | 1 | | pCi/L | 0 | TM |
| | | Radium-226 | 1.9E+00 | 1 | | pCi/L | 0 | TM |
| | | Radium-228 | 3.1E+00 | 1 | | pCi/L | 0 | TM |
| | | Tritium | 3.0E+00 | 1 | | pCi/mL | 0 | TM |

WELL PAC 5

| <u>SRS Coord.</u> | <u>Lat/Longitude</u> | <u>Screen Zone Elevation</u> | <u>Top of Casing</u> | <u>Casing</u> | <u>Pump</u> | <u>Formation</u> |
|-------------------|----------------------|------------------------------|----------------------|---------------|-------------|------------------|
| N43561.7 | 33.231254 °N | 275.1-255.1 ft msl | 289.3 ft msl | 4" PVC | S | Water Table |
| E66907.1 | 81.575289 °W | | | | | |

FIELD MEASUREMENTS

Sample date: 05/10/94
Depth to water: 14.69 ft (4.48 m) below TOC
Water elevation: 274.61 ft (83.70 m) msl
Sp. conductance: 663 µS/cm
Turbidity: 16.9 NTU
Water evacuated before sampling: 12 gal
The well went dry during purging.

Time: 9:58
pH: 7.2
Alkalinity: 114 mg/L
Water temperature: 18.0 °C

Volumes purged: 0.9 well volumes

LABORATORY ANALYSES

| <u>H</u> | <u>D</u> | <u>Analyte</u> | <u>Result</u> | <u>DF</u> | <u>Mod</u> | <u>Unit</u> | <u>Flag</u> | <u>Lab</u> |
|----------|----------|----------------------|---------------|-----------|------------|-------------|-------------|------------|
| • | | pH | 7.1 | 1 | J | pH | 0 | WA |
| | | Specific conductance | 638 | 1 | | µS/cm | 2 | WA |
| | | Specific conductance | 640 | 1 | | µS/cm | 2 | WA |

• = exceeded holding time. ■ = exceeded screening level or final primary drinking water standard.

WELL PAC 5 collected on 05/10/94, laboratory analyses (cont.)

| <u>H</u> | <u>D</u> | <u>Analyte</u> | <u>Result</u> | <u>DF</u> | <u>Mod</u> | <u>Unit</u> | <u>Flag</u> | <u>Lab</u> |
|----------|----------|--------------------------------|---------------|-----------|------------|-------------|-------------|------------|
| • | | Turbidity | 9.7 | 1 | J | NTU | 0 | WA |
| | | Aluminum, total recoverable | 771 | 1 | | µg/L | 2 | WA |
| | | Arsenic, total recoverable | <2.0 | 1 | | µg/L | 0 | WA |
| | | Barium, total recoverable | 126 | 1 | | µg/L | 0 | WA |
| | | Cadmium, total recoverable | <2.0 | 1 | | µg/L | 0 | WA |
| | | Calcium, total recoverable | 66,900 | 1 | | µg/L | 0 | WA |
| | | Chloride | 12,400 | 2 | | µg/L | 0 | WA |
| | | Chromium, total recoverable | <4.0 | 1 | | µg/L | 0 | WA |
| | | 2,4-Dichlorophenoxyacetic acid | <1.1 | 1.1 | | µg/L | 0 | WA |
| | | Endrin | <0.11 | 1.05 | | µg/L | 0 | WA |
| | | Fluoride | <100 | 1 | | µg/L | 0 | WA |
| | | Iron, total recoverable | 1,240 | 1 | | µg/L | 2 | WA |
| | | Lead, total recoverable | <3.0 | 1 | | µg/L | 0 | WA |
| | | Lindane | <0.053 | 1.05 | | µg/L | 0 | WA |
| | | Magnesium, total recoverable | 18,700 | 1 | | µg/L | 0 | WA |
| | | Manganese, total recoverable | 384 | 1 | | µg/L | 2 | WA |
| | | Mercury, total recoverable | <0.20 | 1 | | µg/L | 0 | WA |
| | | Methoxychlor | <0.53 | 1.05 | | µg/L | 0 | WA |
| | | Nitrate as nitrogen | 97 | 1 | | µg/L | 0 | WA |
| | | Phenols | <5.0 | 1 | | µg/L | 0 | WA |
| | | Potassium, total recoverable | 2,370 | 1 | | µg/L | 0 | WA |
| | | Selenium, total recoverable | <2.0 | 1 | | µg/L | 0 | WA |
| | | Silica, total recoverable | 17,800 | 2.1 | | µg/L | 0 | WA |
| | | Silver, total recoverable | 2.1 | 1 | | µg/L | 0 | WA |
| | | Sodium, total recoverable | 56,700 | 1 | | µg/L | 0 | WA |
| | | Sulfate | 58,300 | 10 | | µg/L | 0 | WA |
| | | Total dissolved solids | 467,000 | 1 | | µg/L | 0 | WA |
| | | Total organic carbon | 2,350 | 1 | | µg/L | 0 | WA |
| | | Total organic halogens | 13 | 1 | | µg/L | 0 | WA |
| | | Total phosphates (as P) | <50 | 1 | | µg/L | 0 | WA |
| | | Toxaphene | <1.0 | 1.05 | | µg/L | 0 | WA |
| | | 2,4,5-TP (Silvex) | <0.55 | 1.1 | | µg/L | 0 | WA |
| | | Gross alpha | 2.6E+00 | 1 | | pCi/L | 0 | TM |
| | | Nonvolatile beta | 9.1E+00 | 1 | | pCi/L | 0 | TM |
| | | Radium-226 | 5.7E-01 | 1 | | pCi/L | 0 | TM |
| | | Radium-228 | 3.1E+00 | 1 | | pCi/L | 0 | TM |
| | | Tritium | 3.5E+00 | 1 | | pCi/mL | 0 | TM |

• = exceeded holding time. ■ = exceeded screening level or final primary drinking water standard.

WELL PAC 6

| SRS Coord. | Lat/Longitude | Screen Zone Elevation | Top of Casing | Casing | Pump | Formation |
|----------------------|------------------------------|-----------------------|---------------|--------|------|-------------|
| N43580.1 E66894.7 | 33.231274 °N 81.575358 °W | 275.2-255.2 ft msl | 289.4 ft msl | 4" PVC | S | Water Table |

FIELD MEASUREMENTS

Sample date: 05/10/94
Depth to water: 14.74 ft (4.49 m) below TOC
Water elevation: 274.66 ft (83.72 m) msl
Sp. conductance: 250 μ S/cm
Turbidity: 337 NTU
Water evacuated before sampling: 10 gal
The well went dry during purging.

Time: 9:43
pH: 6.4
Alkalinity: 55 mg/L
Water temperature: 19.0 °C

Volumes purged: 0.8 well volumes

LABORATORY ANALYSES

| H | D | Analyte | Result | DF | Mod | Unit | Flag | Lab |
|---|---|--------------------------------|---------|------|-----|------------|------|-----|
| • | | pH | 6.7 | 1 | J | pH | 0 | WA |
| | | Specific conductance | 220 | 1 | | μ S/cm | 0 | WA |
| • | | Turbidity | 39 | 1 | J | NTU | 0 | WA |
| | | Aluminum, total recoverable | 523 | 1 | | μ g/L | 2 | WA |
| | | Arsenic, total recoverable | <2.0 | 1 | | μ g/L | 0 | WA |
| | | Barium, total recoverable | 43 | 1 | | μ g/L | 0 | WA |
| | | Cadmium, total recoverable | <2.0 | 1 | | μ g/L | 0 | WA |
| | | Calcium, total recoverable | 8,650 | 1 | | μ g/L | 0 | WA |
| | | Chloride | 7,170 | 1 | | μ g/L | 0 | WA |
| | | Chromium, total recoverable | 5.2 | 1 | | μ g/L | 0 | WA |
| | | 2,4-Dichlorophenoxyacetic acid | <1.1 | 1.1 | | μ g/L | 0 | WA |
| | | Endrin | <0.10 | 1.04 | | μ g/L | 0 | WA |
| | | Fluoride | <100 | 1 | | μ g/L | 0 | WA |
| | | Fluoride | <100 | 1 | | μ g/L | 0 | WA |
| | | Iron, total recoverable | 14,400 | 1 | | μ g/L | 2 | WA |
| | | Lead, total recoverable | 5.0 | 1 | | μ g/L | 0 | WA |
| | | Lindane | <0.052 | 1.04 | | μ g/L | 0 | WA |
| | | Magnesium, total recoverable | 2,810 | 1 | | μ g/L | 0 | WA |
| | | Manganese, total recoverable | 175 | 1 | | μ g/L | 2 | WA |
| | | Mercury, total recoverable | <0.20 | 1 | | μ g/L | 0 | WA |
| | | Methoxychlor | <0.52 | 1.04 | | μ g/L | 0 | WA |
| | | Nitrate as nitrogen | <20 | 1 | | μ g/L | 0 | WA |
| | | Phenols | <5.0 | 1 | | μ g/L | 0 | WA |
| | | Potassium, total recoverable | 852 | 1 | | μ g/L | 0 | WA |
| | | Selenium, total recoverable | <2.0 | 1 | | μ g/L | 0 | WA |
| | | Silica, total recoverable | 17,400 | 2.1 | | μ g/L | 0 | WA |
| | | Silver, total recoverable | 20 | 1 | | μ g/L | 0 | WA |
| | | Sodium, total recoverable | 26,400 | 1 | | μ g/L | 0 | WA |
| | | Sulfate | 38,600 | 10 | | μ g/L | 0 | WA |
| | | Total dissolved solids | 198,000 | 1 | | μ g/L | 0 | WA |
| | | Total organic carbon | 2,640 | 1 | | μ g/L | 0 | WA |
| | | Total organic halogens | 15 | 1 | | μ g/L | 0 | WA |
| | | Total phosphates (as P) | 113 | 1 | | μ g/L | 0 | WA |
| | | Toxaphene | <1.0 | 1.04 | | μ g/L | 0 | WA |
| | | 2,4,5-TP (Silvex) | <0.55 | 1.1 | | μ g/L | 0 | WA |
| | | Gross alpha | 1.2E+00 | 1 | | pCi/L | 0 | TM |
| | | Nonvolatile beta | 3.9E+00 | 1 | | pCi/L | 0 | TM |
| | | Radium-226 | 5.3E-01 | 1 | | pCi/L | 0 | TM |

• = exceeded holding time. ■ = exceeded screening level or final primary drinking water standard.

WELL PAC 6 collected on 05/10/94, laboratory analyses (cont.)

| <u>H</u> | <u>D</u> | <u>Analyte</u> | <u>Result</u> | <u>DF</u> | <u>Mod</u> | <u>Unit</u> | <u>Flag</u> | <u>Lab</u> |
|----------|----------|----------------|---------------|-----------|------------|-------------|-------------|------------|
| | | Radium-228 | 1.1E+00 | 1 | | pCi/L | 0 | TM |
| | | Tritium | 3.5E+00 | 1 | | pCi/mL | 0 | TM |

● = exceeded holding time. ■ = exceeded screening level or final primary drinking water standard.

P-Area Acid/Caustic Basin

D-14

Second Quarter 1994

Appendix E

Data Quality/Useability Assessment

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Data Quality/Useability Assessment

Quality assurance/quality control (QA/QC) procedures relating to accuracy and precision of analyses performed on groundwater samples are followed in the field and laboratory and are reviewed prior to publication of results. The review by the Environmental Protection Department/Environmental Monitoring Section (EPD/EMS) of the volume of analytical data acquired each quarter and presented in various reports is an ongoing process; its review of the QA/QC data cannot be completed in time to meet the deadlines for the reports required by the Resource Conservation and Recovery Act and associated regulations. Other site and regulatory personnel can obtain further information on the data quality and useability in a variety of ways, including those described below.

Data Qualification

The contract laboratories continually assess their own accuracy and precision according to U.S. Environmental Protection Agency (EPA) guidelines. They submit sample- or batch-specific QA/QC information either at the same time as analytical results or in quarterly summaries. Properly defined and used result modifiers (also referred to as qualifiers) can be a key component in assessing data useability. Result modifiers designed by EPD/EMS and used by the primary laboratories are presented in Appendix D.

Assessment of Accuracy of the Data

Accuracy, or the nearness of the reported result to the true concentration of a constituent in a sample, can be assessed in several ways.

A laboratory's general accuracy can be judged by analysis of results obtained from known samples. The non-radionuclide contract laboratories analyze commercial reference samples every quarter at EPD/EMS' request. The results of these analyses are presented in the EPD/EMS groundwater monitoring quarterly reports. The primary laboratories also seek or maintain state certification by participating periodically in performance studies; reference samples and analysis of results are provided by EPA. Results of these studies also are published in the EPD/EMS quarterly reports.

Analysis of blanks provides a tool for assessing the accuracy of both sampling and laboratory analysis. Results for all field blanks for the quarter can be found in the EPD/EMS quarterly reports. Any field or laboratory blanks that exceed established minimums are identified in the same reports, in tables associating them with groundwater samples analyzed in the same batches.

Surrogates, organic compounds similar in chemical behavior to the compounds of interest but not normally found in environmental samples, are used to monitor the effect of the matrix on the accuracy of analyses for organic parameters. For example, for analyses of volatile organics by EPA Method 8240, three surrogate compounds are added to all samples and blanks in each analytical batch. In analyses of semivolatile organics, three acid compounds and three base/neutral compounds are used. Two surrogates are used in organochlorine pesticides analyses. Percent recoveries for surrogate analyses are calculated by laboratory personnel, reported to EPD/EMS, reviewed, and entered into the database, but they are not published. If recoveries are not within specified limits, the laboratory is expected to reanalyze the samples or attach qualifiers to the data identifying the anomalous results.

Sample-specific accuracy for both organic and inorganic parameters can be assessed by examination of matrix spike/matrix spike duplicate results. A sample is analyzed unspiked to determine a baseline set of values. A second portion of the sample is spiked with known concentrations of compounds appropriate to the analyses being performed, typically five volatile organic compounds for volatile organics analyses, eleven semivolatile compounds for semivolatiles, six pesticide compounds for pesticides, all metals for metals analyses by SW-846 methods (EPA, 1986), and a known quantity of cyanide for cyanide analysis. The percentage of the spike compound that is recovered (i.e., measured in excess of the value obtained for the unspiked sample) is a direct measure of analytical accuracy. EPA requires matrix spike/matrix spike duplicates to be run at least once per 20 samples of similar matrix.

Matrix spike/matrix spike duplicate results are reported to EPD/EMS but are not published. For organic compounds, according to EPA guidelines, no action is taken on the basis of matrix spike/matrix spike duplicate data alone (i.e., no result modifiers are assigned solely on the basis of matrix spike results); however, the results can indicate if a laboratory is having a systematic problem in the analysis of one or more analytes.

In the case of inorganic compounds, such as metals, the matrix spike sample analysis provides information about the effect of each sample matrix on the digestion and measurement methodology. Data qualifiers assigned by the laboratories on the basis of the percentage of spike recovery are reported in the published results tables.

Assessment of Precision

Precision of the analyses, or agreement of a set of replicate results among themselves, is assessed through the use of duplicates initiated by the laboratory and blind replicates (provided by EPD/EMS). The results of duplicate and replicate analyses are presented in the results tables of these reports for the first, second, and third quarters of each year. Duplicate and replicate results are not presented in fourth-quarter reports; the results tables present instead only the highest result for each analyte for each quarter of the year.

The laboratories assess precision by calculating the relative percent difference, or RPD, for each pair of laboratory-initiated duplicate results. One of the contract laboratories uses a data qualifier (J3) to modify metals analyses when the RPD for laboratory duplicates is greater than 20%.

Additional statistical comparisons of laboratory duplicate and blind replicate results, both intra- and interlaboratory, are presented in the EPD/EMS quarterly reports. The calculation used for these reports is the MRD, or mean relative difference, which is similar to EPA's RPD except that the MRD provides a single value for all of the analyses of a particular compound, either intra- or interlaboratory, during one quarter. Because detection limits may vary among samples, the MRD requires calculation of a reference detection limit, which is the detection limit at the 90th percentile of the array of limits in the population of all duplicate and replicate analyses for a given analyte during a particular quarter. The MRD is not method-specific.

Method-Specific Accuracy and Precision

The contract laboratories' EPA-approved laboratory procedures include QA/QC requirements as an integral part of the methods. Thus, knowledge of the method used in obtaining data is an important component of determining data useability. EPA has conducted extensive research and development on the methods approved for the analysis of water and waste water; information on the accuracy and precision of a method is available from EPA publications, as is full information on required QA/QC procedures. A listing of the methods used by the primary laboratories during

fourth quarter 1993 is given below along with the source for the method description. Many, if not all, of these sources include presentations of representative accuracy and precision results.

Methods Used by the Contract Laboratories

| <u>Method</u> | <u>Used to Analyze</u> | <u>Source</u> |
|---------------|--|---------------|
| EPA120.1 | Specific conductance | EPA EMSL 1983 |
| EPA150.1 | pH | EPA EMSL 1983 |
| EPA160.1 | Total dissolved solids | EPA EMSL 1983 |
| EPA160.2 | Total dissolved solids, total suspended solids | EPA EMSL 1983 |
| EPA180.1 | Turbidity | EPA EMSL 1983 |
| EPA200.7 | Metals | EPA EMSL 1983 |
| EPA204.2 | Antimony | EPA EMSL 1983 |
| EPA206.2 | Arsenic | EPA EMSL 1983 |
| EPA239.2 | Lead | EPA EMSL 1983 |
| EPA245.1 | Mercury | EPA EMSL 1983 |
| EPA270.2 | Selenium | EPA EMSL 1983 |
| EPA279.2 | Thallium | EPA EMSL 1983 |
| EPA300.0 | Chloride, nitrite, sulfate | EPA EMSL 1991 |
| EPA310.1 | Alkalinity | EPA EMSL 1983 |
| EPA325.2 | Chloride | EPA EMSL 1983 |
| EPA335.3 | Cyanide | EPA EMSL 1983 |
| EPA340.2 | Fluoride | EPA EMSL 1983 |
| EPA353.1 | Nitrogen, nitrate-nitrite | EPA EMSL 1983 |
| EPA353.2 | Nitrogen, nitrate, nitrite, or combined | EPA EMSL 1983 |
| EPA365.1 | Phosphorus, all forms (reported as total phosphates) | EPA EMSL 1983 |
| EPA365.2 | Phosphorus, all forms (reported as total phosphates) | EPA EMSL 1983 |
| EPA376.2 | Sulfide | EPA EMSL 1983 |
| EPA413.1 | Oil & grease | EPA EMSL 1983 |
| EPA415.1 | Dissolved organic carbon, total inorganic carbon, total organic carbon | EPA EMSL 1983 |
| EPA418.1 | Total petroleum hydrocarbons | EPA EMSL 1983 |
| EPA420.2 | Phenols | EPA EMSL 1983 |
| EPA900.0 | Gross alpha, nonvolatile beta | EPA EMSL 1980 |
| EPA900.1 | Total alpha-emitting radium | EPA EMSL 1980 |
| EPA906.0 | Tritium | EPA EMSL 1980 |
| EPA6010 | Metals | EPA 1986 |
| EPA7041 | Antimony | EPA 1986 |
| EPA7060 | Arsenic | EPA 1986 |
| EPA7421 | Lead | EPA 1986 |
| EPA7470 | Mercury | EPA 1986 |
| EPA7740 | Selenium | EPA 1986 |
| EPA7841 | Thallium | EPA 1986 |
| EPA8010 | Chlorinated volatile organics | EPA 1986 |
| EPA8080 | Organochlorine pesticides and PCBs | EPA 1986 |
| EPA8150 | Chlorinated herbicides | EPA 1986 |
| EPA8240 | GCMS volatiles | EPA 1986 |
| EPA8270 | GCMS semivolatiles | EPA 1986 |
| EPA8280 | Dioxins and furans | EPA 1986 |
| EPA9012 | Cyanide | EPA 1986 |
| EPA9020 | Total organic halogens | EPA 1986 |
| EPA9020A | Total organic halogens | EPA 1986 |
| EPA9030 | Sulfide | EPA 1986 |
| EPA9060 | Dissolved organic carbon, total inorganic carbon, total organic carbon | EPA 1986 |

An example of available method-specific QA/QC information is that for the analysis of metals by EPA Method 6010/200.7 (EPA, 1986/EPA EMSL, 1983). The primary laboratories, General Engineering Laboratories (GE) and Roy F. Weston, Inc. (Weston), use this inductively coupled plasma (ICP) atomic emission spectrometric method.

The following precision and accuracy data are based on the experience of seven laboratories that applied the ICP technique to acid-distilled water matrices that had been spiked with various metal concentrates. (Note: Not all seven laboratories analyzed all 14 elements.) The references give results for samples having three concentration ranges; the results here are for samples having the lowest values, similar to actual groundwater results for SRS.

ICP Precision and Accuracy Data

| Element | True value ($\mu\text{g/L}$) | Mean reported value ($\mu\text{g/L}$) | Mean percent RSD ^a |
|-----------|--------------------------------|---|-------------------------------|
| Aluminum | 60 | 62 | 33 |
| Arsenic | 22 | 19 | 23 |
| Beryllium | 20 | 20 | 9.8 |
| Cadmium | 2.5 | 2.9 | 16 |
| Chromium | 10 | 10 | 18 |
| Cobalt | 20 | 20 | 4.1 |
| Copper | 11 | 11 | 40 |
| Iron | 20 | 19 | 15 |
| Lead | 24 | 30 | 32 |
| Manganese | 15 | 15 | 6.7 |
| Nickel | 30 | 28 | 11 |
| Selenium | 6 | 8.5 | 42 |
| Vanadium | 70 | 69 | 2.9 |
| Zinc | 16 | 19 | 45 |

^a Relative standard deviation. In EPA (1986), the column heading is Mean Standard Deviation (%).

As another example, EPA Method 601/8010 (EPA, 1991/EPA, 1986) is used by both GE and Weston for analyses of halogenated volatile organics. In the presentation of the method in both references, the following table gives method-specific accuracy and precision as functions of concentration. Contract laboratories are expected to achieve or at least approach these limits.

Accuracy and Precision as Functions of Concentration for EPA Method 601/8010

| Parameter | Accuracy as recovery, X^a ($\mu\text{g/L}$) | Single analyst precision ($\mu\text{g/L}$) ^b | Overall precision ($\mu\text{g/L}$) ^c |
|--|---|---|--|
| Bromodichloromethane | $1.12C - 1.02^d$ | $0.11\bar{X} + 0.04^e$ | $0.20\bar{X} + 1.00$ |
| Bromoform | $0.96C - 2.05$ | $0.12\bar{X} + 0.58$ | $0.21\bar{X} + 2.41$ |
| Bromomethane | $0.76C - 1.27$ | $0.28\bar{X} + 0.27$ | $0.36\bar{X} + 0.94$ |
| Carbon tetrachloride | $0.98C - 1.04$ | $0.15\bar{X} + 0.38$ | $0.20\bar{X} + 0.39$ |
| Chlorobenzene | $1.00C - 1.23$ | $0.15\bar{X} - 0.02$ | $0.18\bar{X} + 1.21$ |
| Chloroethane | $0.99C - 1.53$ | $0.14\bar{X} - 0.13$ | $0.17\bar{X} + 0.63$ |
| 2-Chloroethyl vinyl ether ^f | $1.00C$ | $0.20\bar{X}$ | $0.35\bar{X}$ |
| Chloroform | $0.93C - 0.39$ | $0.13\bar{X} + 0.15$ | $0.19\bar{X} - 0.02$ |
| Chloromethane | $0.77C + 0.18$ | $0.28\bar{X} - 0.31$ | $0.52\bar{X} + 1.31$ |
| Dibromochloromethane | $0.94C + 2.72$ | $0.11\bar{X} + 1.10$ | $0.24\bar{X} + 1.68$ |
| 1,2-Dichlorobenzene | $0.93C + 1.70$ | $0.20\bar{X} + 0.97$ | $0.13\bar{X} + 6.13$ |
| 1,3-Dichlorobenzene | $0.95C + 0.43$ | $0.14\bar{X} + 2.33$ | $0.26\bar{X} + 2.34$ |
| 1,4-Dichlorobenzene | $0.93C - 0.09$ | $0.15\bar{X} + 0.29$ | $0.20\bar{X} + 0.41$ |

| Parameter | Accuracy as recovery, X' ($\mu\text{g/L}$) | Single analyst precision ($\mu\text{g/L}$) | Overall precision ($\mu\text{g/L}$) |
|---|--|--|---------------------------------------|
| 1,1-Dichloroethane | $0.95C - 1.08$ | $0.09\bar{X} + 0.17$ | $0.14\bar{X} + 0.94$ |
| 1,2-Dichloroethane | $1.04C - 1.06$ | $0.11\bar{X} + 0.70$ | $0.15\bar{X} + 0.94$ |
| 1,1-Dichloroethene | $0.98C - 0.87$ | $0.21\bar{X} - 0.23$ | $0.29\bar{X} - 0.40$ |
| trans-1,2-Dichloroethene | $0.97C - 0.16$ | $0.11\bar{X} + 1.46$ | $0.17\bar{X} + 1.46$ |
| Dichloromethane (Methylene chloride) | $0.91C - 0.93$ | $0.11\bar{X} + 0.33$ | $0.21\bar{X} + 1.43$ |
| 1,2-Dichloropropane ^f | $1.00C$ | $0.13\bar{X}$ | $0.23\bar{X}$ |
| cis-1,3-Dichloropropene ^f | $1.00C$ | $0.18\bar{X}$ | $0.32\bar{X}$ |
| trans-1,3-Dichloropropene ^f | $1.00C$ | $0.18\bar{X}$ | $0.32\bar{X}$ |
| 1,1,2,2-Tetrachloroethane | $0.95C + 0.19$ | $0.14\bar{X} + 2.41$ | $0.23\bar{X} + 2.79$ |
| Tetrachloroethylene | $0.94C + 0.06$ | $0.14\bar{X} + 0.38$ | $0.18\bar{X} + 2.21$ |
| 1,1,1-Trichloroethane | $0.90C - 0.16$ | $0.15\bar{X} + 0.04$ | $0.20\bar{X} + 0.37$ |
| 1,1,2-Trichloroethane | $0.86C + 0.30$ | $0.13\bar{X} - 0.14$ | $0.19\bar{X} + 0.67$ |
| Trichloroethylene | $0.87C + 0.48$ | $0.13\bar{X} - 0.03$ | $0.23\bar{X} + 0.30$ |
| Trichlorofluoromethane | $0.89C - 0.07$ | $0.15\bar{X} + 0.67$ | $0.26\bar{X} + 0.91$ |
| Vinyl chloride | $0.97C - 0.36$ | $0.13\bar{X} + 0.65$ | $0.27\bar{X} + 0.40$ |

- ^a X' = expected recovery for one or more measurements of a sample containing a concentration of C , in $\mu\text{g/L}$.
^b Expected single analyst standard deviation of measurements.
^c Expected interlaboratory standard deviation of measurements.
^d C = true value for the concentration, in $\mu\text{g/L}$.
^e \bar{X} = average recovery found for measurements of samples containing a concentration of C , in $\mu\text{g/L}$.
^f Estimates based on performance of a single laboratory.

References

- EPA (U.S. Environmental Protection Agency), 1986. **Test Methods for Evaluating Solid Waste (SW-846)**, Volumes IA-IC. Washington, DC.
- EPA (U.S. Environmental Protection Agency), 1991. *Guidelines Establishing Test Procedures for the Analysis of Pollutants*, **Code of Federal Regulations**, Title 40, Part 136, Appendix A. Washington, DC.
- EPA EMSL (U.S. Environmental Protection Agency, Environmental Monitoring and Systems Laboratory), 1980. **Prescribed Procedures for Measurement of Radioactivity in Drinking Water**, EPA-600/4-80-032. Cincinnati, OH.
- EPA EMSL (U.S. Environmental Protection Agency, Environmental Monitoring and Systems Laboratory), 1983. **Methods for Chemical Analysis of Water and Wastes**. Cincinnati, OH.
- EPA EMSL (U.S. Environmental Protection Agency, Environmental Monitoring and Systems Laboratory), 1991. **Test Method, The Determination of Inorganic Anions in Water by Ion Chromatography—Method 300.0**. Cincinnati, OH.

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| Document Revision Number | |
| Reference Document Number(s), if Appropriate | |
| Date (YY/MM/DD) | |
| 1994 SEPTEMBER N1-434-89-8-7.6(1)(b)/1960 | |
| Circle One | Retention Period (If Nonpermanent) |
| <input checked="" type="radio"/> Lifetime <input type="radio"/> Nonpermanent | 99 |
| Classification (If Unclassified, so state. Also include UCNI) | |
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