WSRC-TR-93-274

665482

FIRST QUARTER 1993

K-AREA AND PAR POND SEWAGE SLUDGE APPLICATION SITES GROUNDWATER MONITORING REPORT (U)

PUBLICATION DATE: JULY 1993

Authorized Derivative Classifier:

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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

DISCLAIMER

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Abstract

Samples from the three wells at the K-Area Sewage Sludge Application Site (KSS wells) and the three wells at the Par Pond Sewage Sludge Application Site (PSS wells) are analyzed quarterly for constituents required by South Carolina Department of Health and Environmental Control Construction Permit 13,173 and, as requested, for other constituents as part of the Savannah River Site Groundwater Monitoring Program. Annual analyses for other constituents, primarily metals, also are required by the permit.

During first quarter 1993, no permit-required constituents exceeded standards at the two sites except iron, which was elevated in one KSS well and two PSS wells. Aluminum, not required by the permit, was the only other constituent that exceeded standards. Elevated levels of aluminum and iron at these two sites may be concurrent with a change in analytical methodology. As in previous quarters, chlordane concentrations did not exceed the detection limit in any of the wells.

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Executive Summary

During first quarter 1993, samples from the three monitoring wells at the K-Area site (KSS series) and the three monitoring wells at the Par Pond site (PSS series) were analyzed for constituents required by South Carolina Department of Health and Environmental Control Construction Permit 13,173 and for other constituents as part of the Savannah River Site (SRS) Groundwater Monitoring Program. This report describes monitoring results that exceeded the final Primary Drinking Water Standards (PDWS) or the SRS flagging criteria.

During first quarter 1993, no constituents exceeded the final PDWS at the K-Area and Par Pond Sewage Sludge Application Sites. Aluminum and iron exceeded the SRS Flag 2 criteria in one or more of the KSS and the PSS wells. In the KSS well series, the field measurement for alkalinity ranged as high as 25 mg/L in well KSS 1D. Alkalinity measurements were zero in the PSS wells.

Historical and current water-level elevations at the K-Area Sewage Sludge Application Site indicate that the groundwater flow direction is south to southwest (SRS grid coordinates). The groundwater flow direction at the Par Pond Sewage Sludge Application Site could not be determined first quarter 1993. Historically, flow direction at this site has been south to southwest.

Introduction

The sewage sludge application sites at the Savannah River Site (SRS) were originally the subject of a research program, begun in 1980, using domestic sewage sludge to reclaim borrow pits and to enhance forest productivity at SRS. After sludge was applied to the sites, hardwoods and pines were planted to quantify the wood biomass that could be produced using the sludge as a fertilizer and soil conditioner.

The 17-acre K-Area Sewage Sludge Application Site lies southeast of K Area on the west bank of Pen Branch (Figures 1 and 2, Appendix C). The Par Pond Sewage Sludge Application Site includes 22 acres south of Par Pond (Figures 1 and 3, Appendix C). As part of the research program, wastewater sludge was applied to the K-Area and Par Pond sites in 1981 under Industrial Waste Permit 175. These sites received a second application of sludge in 1988. This last application, from the Central Shops Sanitary Sludge Lagoon, was a one-time occurrence in accordance with Construction Permit 13,173, issued in April 1987 by the South Carolina Department of Health and Environmental Control (SCDHEC). Both sites are now inactive.

In 1988, SRS determined that new monitoring wells were required at the K-Area and Par Pond Sewage Sludge Application Sites to assess the effects of sewage sludge application on groundwater quality. SRS installed three wells at the K-Area site and three wells at the Par Pond site after approval by SCDHEC. These wells, which were first sampled during fourth quarter 1988, are designated KSS 1D, 2D, and 3D and PSS 1D, 2D, and 3D. All wells monitor the water table and are constructed of 4-in. polyvinyl chloride pipe.

In 1989, the K-Area and Par Pond Sewage Sludge Application Sites became part of the Resource Conservation and Recovery Act Facilities Investigation/Remedial Investigation program because chlordane was found in the sludge from the Central Shops lagoon.

The SRS Environmental Protection Department/Environmental Monitoring Section (EPD/EMS) samples the KSS and PSS wells each quarter, and the SRS Environmental Restoration Department reports the results of this sampling to SCDHEC as required by Special Condition 4 of Construction Permit 13,173.

Discussion

Groundwater Monitoring Data

The EPD/EMS sampling procedure (WSRC, 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 of each of these parameters, 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 from a single sampling event. On the second visit within 24 hours, samples are taken without purging or stability measurements; thus, these samples may not be representative of groundwater quality. Tables 5 and 6 (Appendix D) list the number of well volumes purged from the KSS and PSS wells, respectively, during first quarter 1993. Wells KSS 1D and PSS 3D went dry during purging; both recovered sufficiently to sample within 24 hours. Well PSS 3D has consistently purged dry since its installation. At present, all KSS and PSS wells have single-speed centrifugal pumps.

Samples from the monitoring wells at the K-Area and Par Pond Sewage Sludge Application Sites are analyzed for the following parameters as required by SCDHEC Construction Permit 13,173:

- Quarterly analyses for specific conductance and pH (laboratory measurements)
- Quarterly analyses for water quality indicators: chloride, nitrate, nitrite, sodium, and total dissolved solids
- Annual analyses for cadmium, calcium, copper, iron, lead, magnesium, manganese, nickel, potassium, and total phosphates (as phosphorus)

The KSS and PSS wells may also receive additional analyses for other constituents, including chlordane, as part of the SRS Groundwater Monitoring Program.

Monitoring 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); or SRS flagging criteria based on final and proposed PDWS, Secondary Drinking Water Standards, and method detection limits (Appendix B) are described in this report. Constituent levels that equaled or exceeded the final PDWS or SRS Flag 2 criteria are described as *elevated* or as *exceeding* or *above* standards.

The final PDWS for individual analytes given in Appendix A may not always match the SRS flagging criteria in Appendix B. The final PDWS are used as guidelines in this compliance

report 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 sampling.

Appendix C provides the locations of the monitored sites at SRS (Figure 1), the individual KSS and PSS monitoring wells (Figures 2 and 3, respectively), and the groundwater flow directions beneath the sites (Figures 4 and 5). Monitoring results tables and analyses that exceeded EPA-approved holding times are in Appendix D, and information on the assessment of data quality and useability is in Appendix E.

Analytical Results Exceeding Standards

Tables 1 and 2 (Appendix D) summarize constituents that exceeded the final PDWS (see Appendix A) at the K-Area Sewage Sludge Application Site or the Par Pond Sewage Sludge Application Site, respectively, during first quarter 1993. None of the constituents analyzed exceeded the final PDWS in the KSS or PSS wells.

Constituents exceeding other flagging criteria (see Appendix B) during first quarter 1993 are summarized in Table 3 (Appendix D) for the KSS wells and Table 4 (Appendix D) for the PSS wells. Aluminum was elevated in wells KSS 1D (969 μg/L), KSS 2D (72 μg/L), PSS 1D (1,380 μg/L), and PSS 3D (964 μg/L). Iron was elevated in wells KSS 1D (914 μg/L), PSS 1D (550 μg/L), and PSS 3D (2,360 μg/L).

Results are presented for all analyzed constituents for the KSS and PSS wells in Tables 5 and 6, respectively (Appendix D). Chlordane was not detected in any of the three KSS or the three PSS wells during the quarter.

Presently, SRS sets no flagging criteria for alkalinity. In the KSS well series, alkalinity ranged as high as 25 mg/L in well KSS 1D. Alkalinity measurements were zero in the PSS wells.

Water Elevations and Groundwater Flow Directions

Water-level elevations at the K-Area Sewage Sludge Application Site indicate that the groundwater flow direction is generally south to southwest (SRS coordinates), although the nearly linear orientation of these wells makes such a determination tentative. Upgradient well KSS 1D contained elevated aluminum and iron concentrations; well KSS 2D, downgradient within the southern border of the application area, exhibited an elevated concentration of aluminum; and downgradient well KSS 3D contained no elevated constituents.

During first quarter 1993, only two water-level elevations were obtained at the Par Pond Sewage Sludge Application Site. At the time of sampling, there was no water in the standpipe of well PSS 3D. Thus, determination of flow direction during this quarter was not possible. Historically, flow direction has been reported as south to southwest (SRS coordinates). Based upon this precedent, well PSS 1D is upgradient, and wells PSS 2D and 3D are

downgradient. Upgradient well PSS 1D and downgradient well PSS 3D contained elevated concentrations of aluminum and iron.

Conclusions

- During first quarter 1993, as in all quarters of 1992, no constituents exceeded the final PDWS at the K-Area and Par Pond Sewage Sludge Application Sites.

- Aluminum was elevated in wells KSS 1D and 2D and PSS 1D and 3D. Iron was elevated in wells KSS 1D and PSS 1D and 3D. Aluminum was not analyzed for in groundwater samples from KSS or PSS wells during 1992. Iron was analyzed only during first quarter in KSS wells and only during first and third quarters 1992 in PSS wells; elevated iron concentrations were infrequent. The occurrence of elevated iron during first quarter 1993 may reflect the change to analyses of unfiltered metals samples.

- Results for chlordane were less than the detection limit in the three KSS and the three PSS wells during first quarter 1993.

- Groundwater flow direction at the K-Area Sewage Sludge Application Site was generally south to southwest (SRS grid coordinates); groundwater flow direction at the Par Pond Sewage Sludge Application Site could not be determined during first quarter 1993, but historically it has been toward the south to southwest.

- In the KSS well series, alkalinity ranged as high as 25 mg/L in well KSS 1D. Alkalinity measurements were zero in the PSS wells.

- Wells KSS 1D and PSS 3D went dry during purging; thus, the samples from these wells may not be representative groundwater samples.

References Cited

WSRC (Westinghouse Savannah River Company), 1992. **Hydrogeologic Data Collection Procedures and Specifications: Sampling Groundwater Monitoring Wells**. Manual 3Q5, Chapter 15, Rev. 1. Environmental Protection Department, Environmental Monitoring Section, Savannah River Site, Aiken, SC.

Errata

First through Third Quarters 1992:

- Chlordane analysis was requested as part of the Base/Neutral/Acid suite of analyses as described in the Environmental Protection Department/Environmental Monitoring Section contract with the analytical laboratory. However, Roy F. Weston, Inc., which conducted the analyses for first through third quarters 1992, does not include chlordane in its Base/Neutral/Acid suite of analyses. Chlordane analysis was conducted by General Engineering Laboratories for fourth quarter 1992.

First through Fourth Quarters 1992:

- Some results for earlier quarters of 1992 that are presented in the results tables of the fourth quarter 1992 report may differ from the results presented in the earlier reports, and reported results may not match reported sample dates. These differences arise from the following: (1) the computer program that creates the results tables was revised beginning second quarter 1992 to present the highest value for analytes with more than one result (previously, the program presented the first value encountered in the database); (2) a new computer program, which rounds numbers differently from the former computer program, was first used during third quarter 1992; and (3) some reanalyses may have been performed by the laboratories after the quarterly reports had gone to press. The sample dates in the tables are the dates when the field data were collected. These dates may differ from the dates of the laboratory analyses if the highest results were obtained for samples collected on different dates.

Appendix A – Final Primary Drinking Water Standards

Final Primary Drinking Water Standards

Analyte	Unit	Level	Status	Reference
Antimony	µg/L	6	Final	EPA, 1992b
Arsenic	µg/L	50	Final	EPA, 1992a
Asbestos	fibers/L	7,000,000	Final	EPA, 1992a
Barium	µg/L	2,000	Final	EPA, 1992a
Benzene	µg/L	5	Final	EPA, 1992a
Benzo[a]pyrene	µg/L	0.2	Final	EPA, 1992b
Beryllium	µg/L	4	Final	EPA, 1992b
Bis(2-ethylhexyl) phthalate	µg/L	6	Final	EPA, 1992b
Bromodichloromethane	µg/L	100[a]	Final	EPA, 1992a
Bromoform	µg/L	100[a]	Final	EPA, 1992a
2-sec-Butyl-4,6-dinitrophenol	µg/L	7	Final	EPA, 1992b
Cadmium	µg/L	5	Final	EPA, 1992a
Carbon tetrachloride	µg/L	5	Final	EPA, 1992a
Chlordane	µg/L	2	Final	EPA, 1992a
Chlorobenzene	µg/L	100	Final	EPA, 1992a
Chloroethene (Vinyl chloride)	µg/L	2	Final	EPA, 1992a
Chloroform	µg/L	100[a]	Final	EPA, 1992a
Chromium	µg/L	100	Final	EPA, 1992a
Copper	µg/L	1,300	Final	EPA, 1992a
Cyanide	µg/L	200	Final	EPA, 1992b
Dibromochloromethane	µg/L	100[a]	Final	EPA, 1992a
Dibromochloropropane	µg/L	0.2	Final	EPA, 1992a
1,2-Dibromoethane (Ethylene dibromide)	µg/L	0.05	Final	EPA, 1992a
1,2-Dichlorobenzene	µg/L	600	Final	EPA, 1992a
1,4-Dichlorobenzene	µg/L	75	Final	EPA, 1992a
1,2-Dichloroethane	µg/L	5	Final	EPA, 1992a
1,1-Dichloroethene	µg/L	7	Final	EPA, 1992a
1,2-Dichloroethene	µg/L	50	Final	EPA, 1992b
cis-1,2-Dichloroethene	µg/L	70	Final	EPA, 1992a
trans-1,2-Dichloroethene	µg/L	100	Final	EPA, 1992a
Dichloromethane (Methylene chloride)	µg/L	5	Final	EPA, 1992b
2,4-Dichlorophenoxyacetic acid	µg/L	70	Final	EPA, 1992a
1,2-Dichloropropane	µg/L	5	Final	EPA, 1992a
Endrin	µg/L	2	Final	EPA, 1992b
Ethylbenzene	µg/L	700	Final	EPA, 1992a
Fluoride	µg/L	4,000	Final	EPA, 1992a
Gross alpha[b]	pCi/L	1.5E+01	Final	EPA, 1992a
Heptachlor	µg/L	0.4	Final	EPA, 1992a
Heptachlor epoxide	µg/L	0.2	Final	EPA, 1992a
Hexachlorobenzene	µg/L	1	Final	EPA, 1992b
Hexachlorocyclopentadiene	µg/L	50	Final	EPA, 1992b
Lead	µg/L	50	Final	SCDHEC, 1981
Lindane	µg/L	0.2	Final	EPA, 1992a
Mercury	µg/L	2	Final	EPA, 1992a
Methoxychlor	µg/L	40	Final	EPA, 1992a
Nickel	µg/L	100	Final	EPA, 1992b
Nitrate as nitrogen	µg/L	10,000	Final	EPA, 1992a
Nitrate-nitrite as nitrogen	µg/L	10,000	Final	EPA, 1992a
Nitrite as nitrogen	µg/L	1,000	Final	EPA, 1992a
Nonvolatile beta[c]	pCi/L	5E+01	Final	EPA, 1977
PCBs[d]	µg/L	0.5	Final	EPA, 1992a
Pentachlorophenol	µg/L	1	Final	EPA, 1992a
Selenium	µg/L	50	Final	EPA, 1992a

Analyte	Unit	Level	Status	Reference
Strontium-89/90[e]	pCi/L	8E+00	Final	EPA, 1992a
Strontium-90	pCi/L	8E+00	Final	EPA, 1992a
Styrene	µg/L	100	Final	EPA, 1992a
2,3,7,8-TCDD	µg/L	0.00003	Final	EPA, 1992b
Tetrachloroethylene	µg/L	5	Final	EPA, 1992a
Thallium	µg/L	2	Final	EPA, 1992b
Toluene	µg/L	1,000	Final	EPA, 1992a
Total radium (Radium-226 and -228)	pCi/L	5E+00	Final	EPA, 1992a
Total trihalomethanes	µg/L	100	Final	EPA, 1992a
Toxaphene	µg/L	3	Final	EPA, 1992a
2,4,5-TP (Silvex)	µg/L	50	Final	EPA, 1992a
1,2,4-Trichlorobenzene	µg/L	70	Final	EPA, 1992b
1,1,1-Trichloroethane	µg/L	200	Final	EPA, 1992a
1,1,2-Trichloroethane	µg/L	5	Final	EPA, 1992b
Trichloroethylene	µg/L	5	Final	EPA, 1992a
Tritium	pCi/mL	2E+01	Final	EPA, 1992a
Xylenes	µg/L	10,000	Final	EPA, 1992a

[a] This value is the drinking water standard for total trihalomethanes (the sum of bromoform, bromodichloromethane, chloroform, and dibromochloromethane).

[b] The standard given is for gross alpha including radium-226 but excluding radon and uranium.

[c] This is the screening level above which providers of public drinking water should perform analyses for specific man-made radionuclides. The standard for the total dose equivalent from all such radionuclides is 4 mrem per year.

[d] Analyses were conducted in 1992 for the following: PCB 1016, PCB 1221, PCB 1232, PCB 1242, PCB 1248, PCB 1254, and PCB 1260.

[e] 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), 1992a. *National Primary Drinking Water Regulations,* **Code of Federal Regulations**, Title 40, Part 141, pp. 589–729. Washington, DC.

EPA (U.S. Environmental Protection Agency), 1992b. *National Primary Drinking Water Regulations—Synthetic Organic Chemicals and Inorganic Chemicals; National Primary Drinking Water Regulations Implementation.* **Federal Register**, July 17, 1992, pp. 31776–31849. Washington, DC.

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

Appendix B – Flagging Criteria

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 not assigned flagging criteria: alkalinity, calcium, color, corrosivity, Eh, magnesium, odor, potassium, silica, sodium, total dissolved solids, total phosphates (as P), total phosphorus, and turbidity. In addition, common laboratory contaminants and cleaners including some phthalates, ketones, and toluene are not assigned flagging criteria.

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
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, 1992c)
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, 1992b)
Antimony-125	pCi/L	1.5E+02	3E+02	Final PDWS (EPA, 1977)
Aramite	µg/L	50	100	EPA Method 8270
Arsenic	µg/L	25	50	Final PDWS (EPA, 1992a)
Asbestos	Fibers/L	3,500,000	7,000,000	Final PDWS (EPA, 1992a)

Analyte	Unit	Flag 1	Flag 2	Source[a]
Azobenzene	µg/L	50	100	EPA Method 625
Barium	µg/L	1,000	2,000	Final PDWS (EPA, 1992a)
Barium-140	pCi/L	4.5E+01	9E+01	Final PDWS (EPA, 1977)
Benzene	µg/L	2.5	5	Final PDWS (EPA, 1992a)
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, 1992b)
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, 1992b)
Beryllium-7	pCi/L	3E+03	6E+03	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, 1992b)
Bromide	µg/L	5,000	10,000	EPA Method 300.0
Bromodichloromethane	µg/L	50	100	Final PDWS (EPA, 1992a)
Bromoform	µg/L	50	100	Final PDWS (EPA, 1992a)
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, 1992b)
Butylbenzyl phthalate		No flag	No flag	Set by EPD/EMS
Cadmium	µg/L	2.5	5	Final PDWS (EPA, 1992a)
Calcium		No flag	No flag	Set by EPD/EMS
Carbon disulfide	µg/L	5	10	EPA Method 8240
Carbon tetrachloride	µg/L	2.5	5	Final PDWS (EPA, 1992a)
Carbon-14	pCi/L	1E+03	2E+03	Final PDWS (EPA, 1977)
Carbonate		No flag	No flag	Set by EPD/EMS
Cerium-141	pCi/L	1.5E+02	3E+02	Final PDWS (EPA, 1977)
Cerium-144	pCi/L	1.31E+02	2.61E+02	Proposed PDWS (EPA, 1991)
Cesium-134[b]	pCi/L	4.07E+01	8.13E+01	Proposed PDWS (EPA, 1991)
Cesium-137	pCi/L	1E+02	2E+02	Final PDWS (EPA, 1977)
Chlordane	µg/L	1	2	Final PDWS (EPA, 1992a)
Chloride	µg/L	125,000	250,000	SDWS (EPA, 1992c)
4-Chloroaniline	µg/L	50	100	EPA Method 8270
Chlorobenzene	µg/L	50	100	Final PDWS (EPA, 1992a)
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, 1992a)
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, 1992a)
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

Analyte	Unit	Flag 1	Flag 2	Source[a]
Chloroprene	µg/L	1,000	2,000	EPA Method 8240
Chromium	µg/L	50	100	Final PDWS (EPA, 1992a)
Chromium-51	pCi/L	3E+03	6E+03	Final PDWS (EPA, 1977)
Chrysene	µg/L	0.1	0.2	Proposed PDWS (EPA, 1990)
Cobalt	µg/L	20	40	EPA Method 6010
Cobalt-57	pCi/L	5E+02	1E+03	Final PDWS (EPA, 1977)
Cobalt-58	pCi/L	4.5E+03	9E+03	Final PDWS (EPA, 1977)
Cobalt-60	pCi/L	5E+01	1E+02	Final PDWS (EPA, 1977)
Color		No flag	No flag	Set by EPD/EMS
Copper	µg/L	650	1,300	Final PDWS (EPA, 1992a)
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[c]	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[c]	pCi/L	3.12E+00	6.23E+00	Proposed PDWS (EPA, 1991)
Curium-246	pCi/L	3.14E+00	6.27E+00	Proposed PDWS (EPA, 1991)
Cyanide	µg/L	100	200	Final PDWS (EPA, 1992b)
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, 1992a)
1,2-Dibromo-3-chloropropane	µg/L	0.1	0.2	Final PDWS (EPA, 1992a)
1,2-Dibromoethane (Ethylene dibromide)	µg/L	0.025	0.05	Final PDWS (EPA, 1992a)
Dibromomethane (Methylene bromide)	µg/L	5	10	EPA Method 8240
1,2-Dichlorobenzene	µg/L	300	600	Final PDWS (EPA, 1992a)
1,3-Dichlorobenzene	µg/L	50	100	EPA Method 8270
1,4-Dichlorobenzene	µg/L	37.5	75	Final PDWS (EPA, 1992a)
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, 1992a)
1,1-Dichloroethene	µg/L	3.5	7	Final PDWS (EPA, 1992a)
1,2-Dichloroethene	µg/L	25	50	Final PDWS (EPA, 1992b)
cis-1,2-Dichloroethene	µg/L	35	70	Final PDWS (EPA, 1992a)
trans-1,2-Dichloroethene	µg/L	50	100	Final PDWS (EPA, 1992a)
Dichloromethane (Methylene chloride)	µg/L	2.5	5	Final PDWS (EPA, 1992b)
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, 1992a)
1,2-Dichloropropane	µg/L	2.5	5	Final PDWS (EPA, 1992a)
cis-1,3-Dichloropropene	µg/L	5	10	EPA Method 8240
trans-1,3-Dichloropropene	µg/L	5	10	EPA Method 8240

Analyte	Unit	Flag 1	Flag 2	Source[a]
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
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
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
alpha-Endosulfan	µg/L	50	100	EPA Method 8270
beta-Endosulfan	µg/L	50	100	EPA Method 8270
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
Endrin	µg/L	1	2	Final PDWS (EPA, 1992b)
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, 1992a)
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	Final PDWS (EPA, 1977)
Europium-154	pCi/L	1E+02	2E+02	Final PDWS (EPA, 1977)
Europium-155	pCi/L	3E+02	6E+02	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, 1992a)
Gross alpha	pCi/L	7.5E+00	1.5E+01	Final PDWS (EPA, 1992a)
Heptachlor	µg/L	0.2	0.4	Final PDWS (EPA, 1992a)
Heptachlor epoxide	µg/L	0.1	0.2	Final PDWS (EPA, 1992a)
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, 1992b)
Hexachlorobutadiene	µg/L	50	100	EPA Method 8270
Hexachlorocyclopentadiene	µg/L	25	50	Final PDWS (EPA, 1992b)
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

Analyte	Unit	Flag 1	Flag 2	Source[a]
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	Final PDWS (EPA, 1977)
Iodine-131	pCi/L	1.5E+00	3E+00	Final PDWS (EPA, 1977)
Iodomethane (Methyl iodide)	µg/L	75	150	EPA Method 8240
Iron	µg/L	150	300	SDWS (EPA, 1992c)
Iron-55	pCi/L	1E+03	2E+03	Final PDWS (EPA, 1977)
Iron-59	pCi/L	1E+02	2E+02	Final PDWS (EPA, 1977)
Isobutyl alcohol	µg/L	500	1,000	EPA Method 8240
Isodrin	µg/L	50	100	EPA Method 8270
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	pCi/L	3E+01	6E+01	Final PDWS (EPA, 1977)
Lead	µg/L	7.5	15	Final PDWS (EPA, 1992a)
Lindane	µg/L	0.1	0.2	Final PDWS (EPA, 1992a)
Lithium	µg/L	25	50	EPA Method 6010
Magnesium		No flag	No flag	Set by EPD/EMS
Manganese	µg/L	25	50	SDWS (EPA, 1992c)
Manganese-54	pCi/L	1.5E+02	3E+02	Final PDWS (EPA, 1977)
Mercury	µg/L	1	2	Final PDWS (EPA, 1992a)
Methacrylonitrile	µg/L	250	500	EPA Method 8240
Methapyrilene	µg/L	50	100	EPA Method 8270
Methoxychlor	µg/L	20	40	Final PDWS (EPA, 1992a)
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
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, 1992b)
Nickel-59	pCi/L	1.5E+02	3E+02	Final PDWS (EPA, 1977)
Nickel-63	pCi/L	2.5E+01	5E+01	Final PDWS (EPA, 1977)
Niobium-95	pCi/L	1.5E+02	3.E+02	Final PDWS (EPA, 1977)
Nitrate as nitrogen	µg/L	5,000	10,000	Final PDWS (EPA, 1992a)
Nitrate-nitrite as nitrogen	µg/L	5,000	10,000	Final PDWS (EPA, 1992a)
Nitrite as nitrogen	µg/L	500	1,000	Final PDWS (EPA, 1992a)
2-Nitroaniline	µg/L	50	100	EPA Method 8270
3-Nitroaniline	µg/L	50	100	EPA Method 8270
4-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
4-Nitrophenol	µg/L	50	100	EPA Method 8270
4-Nitroquinoline-1-oxide	µg/L	50	100	EPA Method 8270

Analyte	Unit	Flag 1	Flag 2	Source[a]
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	Proposed PDWS (EPA, 1986)
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
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, 1992a)
PCB 1221	µg/L	0.25	0.5	Final PDWS (EPA, 1992a)
PCB 1232	µg/L	0.25	0.5	Final PDWS (EPA, 1992a)
PCB 1242	µg/L	0.25	0.5	Final PDWS (EPA, 1992a)
PCB 1248	µg/L	0.25	0.5	Final PDWS (EPA, 1992a)
PCB 1254	µg/L	0.25	0.5	Final PDWS (EPA, 1992a)
PCB 1260	µg/L	0.25	0.5	Final PDWS (EPA, 1992a)
PCB 1262	µg/L	0.25	0.5	Final PDWS (EPA, 1992a)
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, 1992a)
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
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[c]	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	pCi/L	3.13E+01	6.26E+01	Proposed PDWS (EPA, 1991)
Plutonium-242	pCi/L	3.27E+01	6.54E+01	Proposed PDWS (EPA, 1991)
Potassium		No flag	No flag	Set by EPD/EMS
Potassium-40	pCi/L	1.5E+02	3E+02	Proposed PDWS (EPA, 1986)
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)[d]	pCi/L	1E+01	2E+01	Proposed PDWS (EPA, 1991)

Analyte	Unit	Flag 1	Flag 2	Source[a]
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	pCi/L	1E+02	2E+02	Final PDWS (EPA, 1977)
Ruthenium-106	pCi/L	1.5E+01	3E+01	Final PDWS (EPA, 1977)
Safrole	µg/L	50	100	EPA Method 8270
Selenium	µg/L	25	50	Final PDWS (EPA, 1992a)
Silica		No flag	No flag	Set by EPD/EMS
Total silica	µg/L	500	1,000	EPA Method 6010
Silver	µg/L	50	100	SDWS (EPA, 1992c)
Sodium		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	Final PDWS (EPA, 1977)
Strontium-89/90[c]	pCi/L	4E+00	8E+00	Final PDWS (EPA, 1992a)
Strontium-90	pCi/L	4E+00	8E+00	Final PDWS (EPA, 1992a)
Styrene	µg/L	50	100	Final PDWS (EPA, 1992a)
Sulfate	µg/L	200,000	400,000	Proposed PDWS (EPA, 1990)
Sulfide	µg/L	5,000	10,000	EPA Method 9030
Sulfotepp	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, 1992b)
2,3,7,8-TCDF	µg/L	0.002	0.004	EPA Method 8280
Technetium-99	pCi/L	4.5E+02	9E+02	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, 1992a)
2,3,4,6-Tetrachlorophenol	µg/L	50	100	EPA Method 8270
Tetraethyl dithiopyrophosphate	µg/L	50	100	EPA Method 8270
Thallium	µg/L	1	2	Final PDWS (EPA, 1992b)
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-113	pCi/L	1.5E+02	3E+02	Final PDWS (EPA, 1977)
Toluene	µg/L	500	1,000	Final PDWS (EPA, 1992a)
o-Toluidine	µg/L	50	100	EPA Method 8270
Total carbon	µg/L	5,000	10,000	EPA Method 9060
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, 1992a)

Analyte	Unit	Flag 1	Flag 2	Source[a]
2,4,5-TP (Silvex)	µg/L	25	50	Final PDWS (EPA, 1992a)
Tributyl phosphate	µg/L	50	100	EPA Method 8270
1,2,4-Trichlorobenzene	µg/L	35	70	Final PDWS (EPA, 1992b)
1,1,1-Trichloroethane	µg/L	100	200	Final PDWS (EPA, 1992a)
1,1,2-Trichloroethane	µg/L	2.5	5	Final PDWS (EPA, 1992b)
Trichloroethylene	µg/L	2.5	5	Final PDWS (EPA, 1992a)
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, 1992a)
Turbidity		No flag	No flag	Set by EPD/EMS
Uranium	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[c]	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
Vinyl acetate	µg/L	5	10	EPA Method 8240
Xylenes	µg/L	5,000	10,000	Final PDWS (EPA, 1992a)
Zinc	µg/L	2,500	5,000	SDWS (EPA, 1992c)
Zinc-65	pCi/L	1.5E+02	3E+02	Final PDWS (EPA, 1977)
Zirconium-95	pCi/L	1E+02	2E+02	Final PDWS (EPA, 1977)
Zirconium/Niobium-95[c]	pCi/L	1E+02	2E+02	Final PDWS (EPA, 1977)

[a] References for methods are found in Appendix E; references for dated sources are at the end of this appendix.
[b] EPD/EMS set this flagging criterion using the 1991 proposed PDWS because the final PDWS in 1977 may have been in error.
[c] When radionuclide analyses are combined, the lower PDWS of the two isotopes is used for flagging.
[d] The applied standard is for radium-226.

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EPA (U.S. Environmental Protection Agency), 1992c. *National Secondary Drinking Water Regulations,* **Code of Federal Regulations,** Section 40, Part 143, pp. 772–776. Washington, DC.

Appendix C – Figures

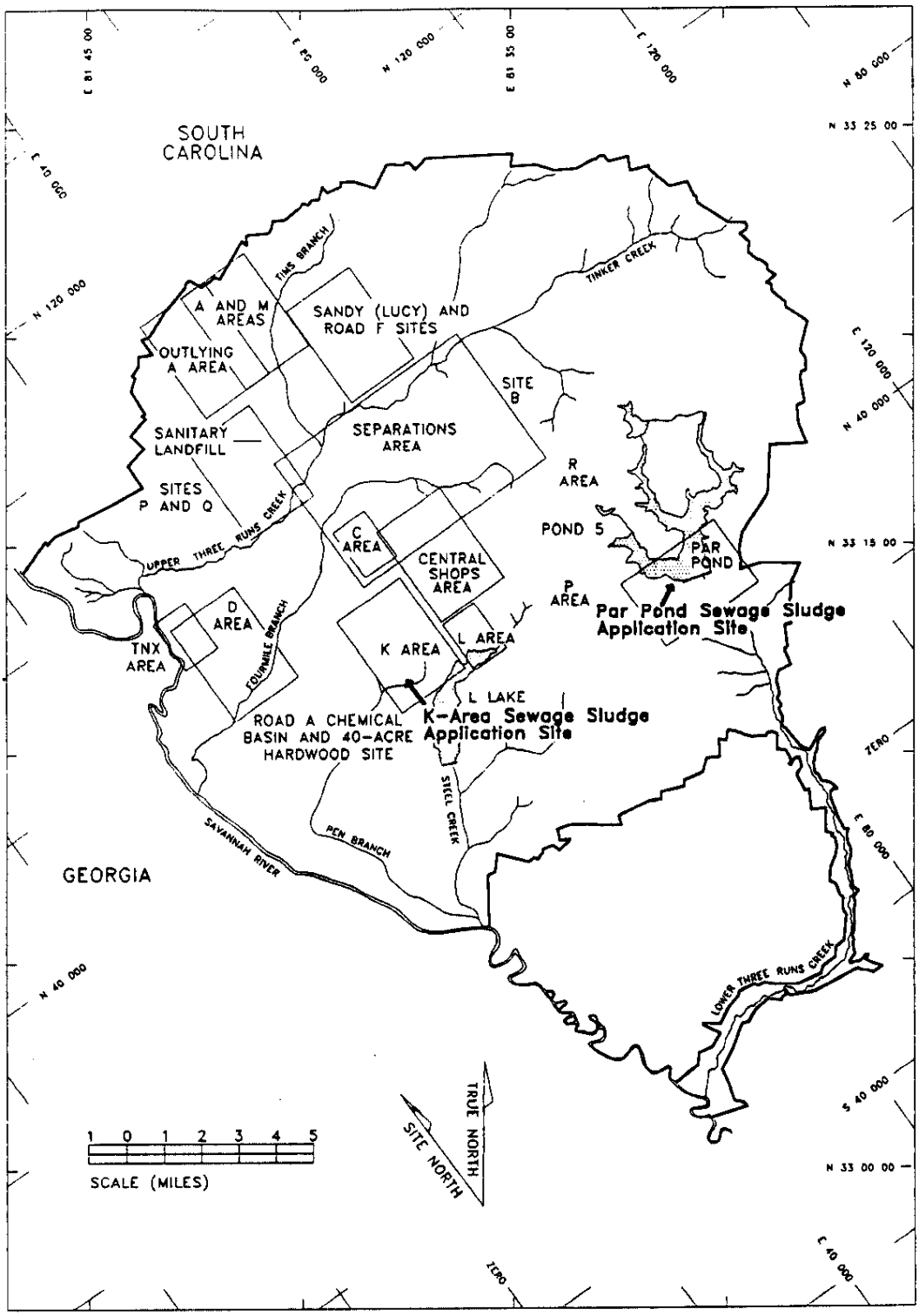

Figure 1. Location of the K-Area and Par Pond Sewage Sludge Application Sites at the Savannah River Site

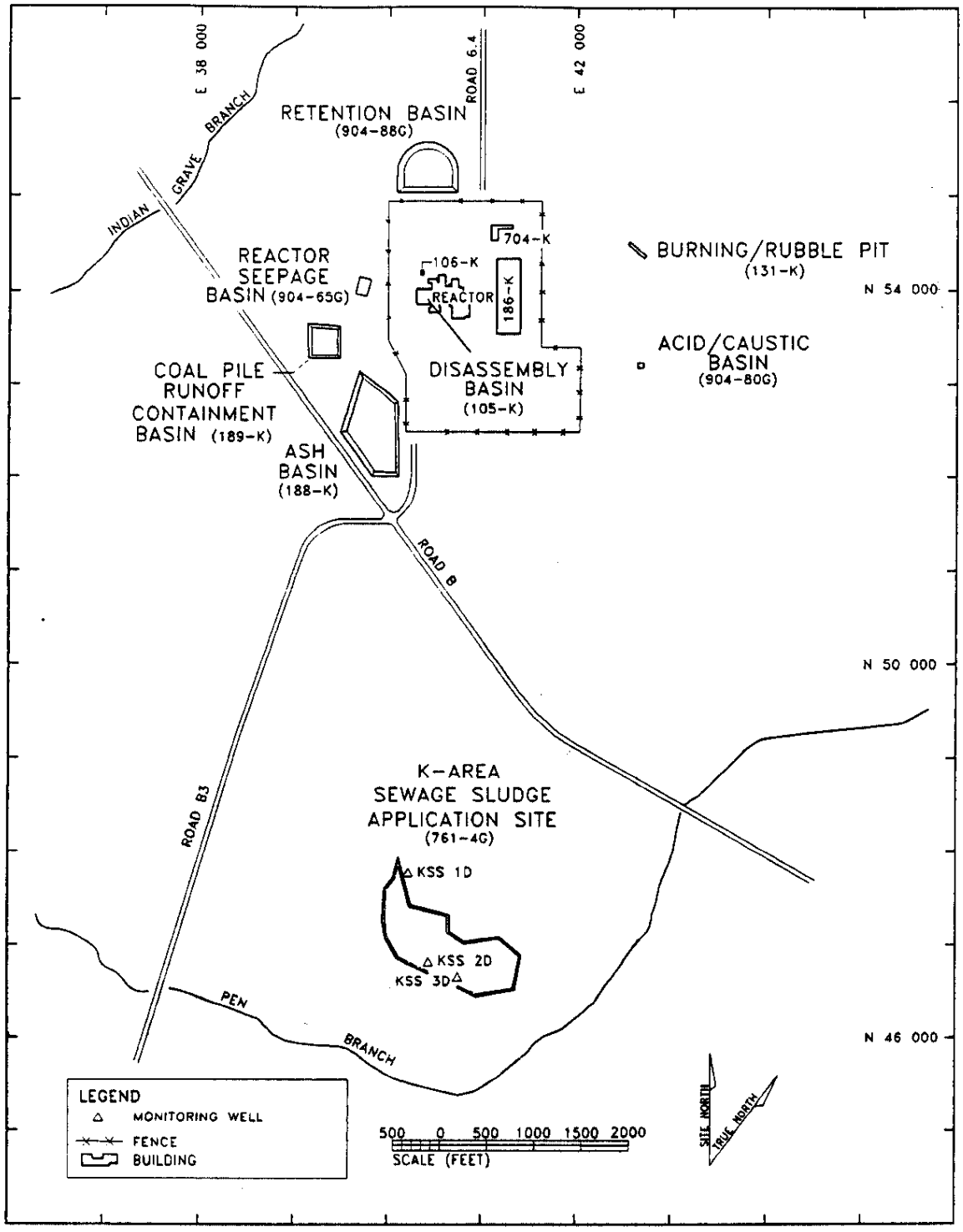

Figure 2. Location of Groundwater Monitoring Wells at the K-Area Sewage Sludge Application Site

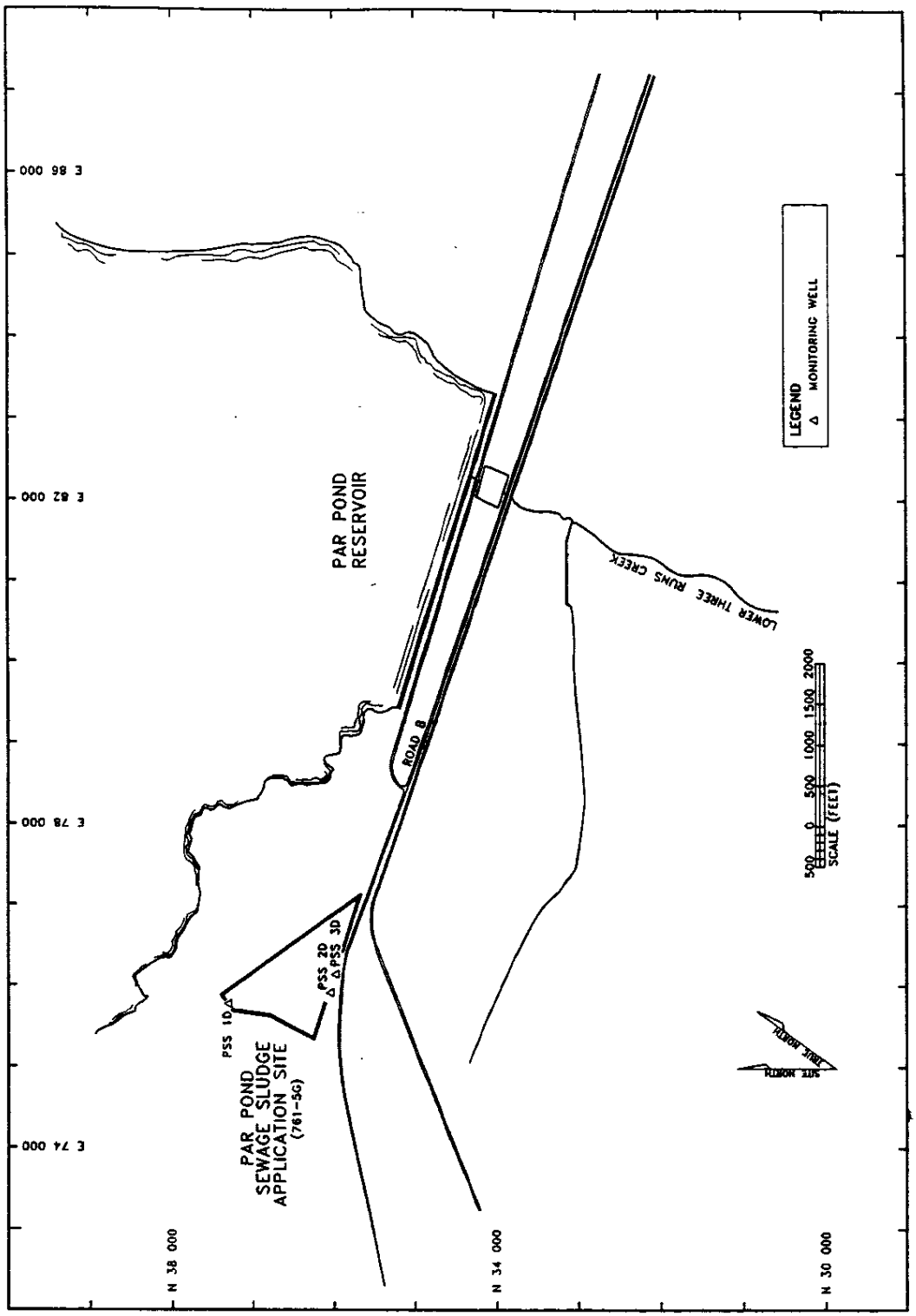

Figure 3. Location of Groundwater Monitoring Wells at the Par Pond Sewage Sludge Application Site

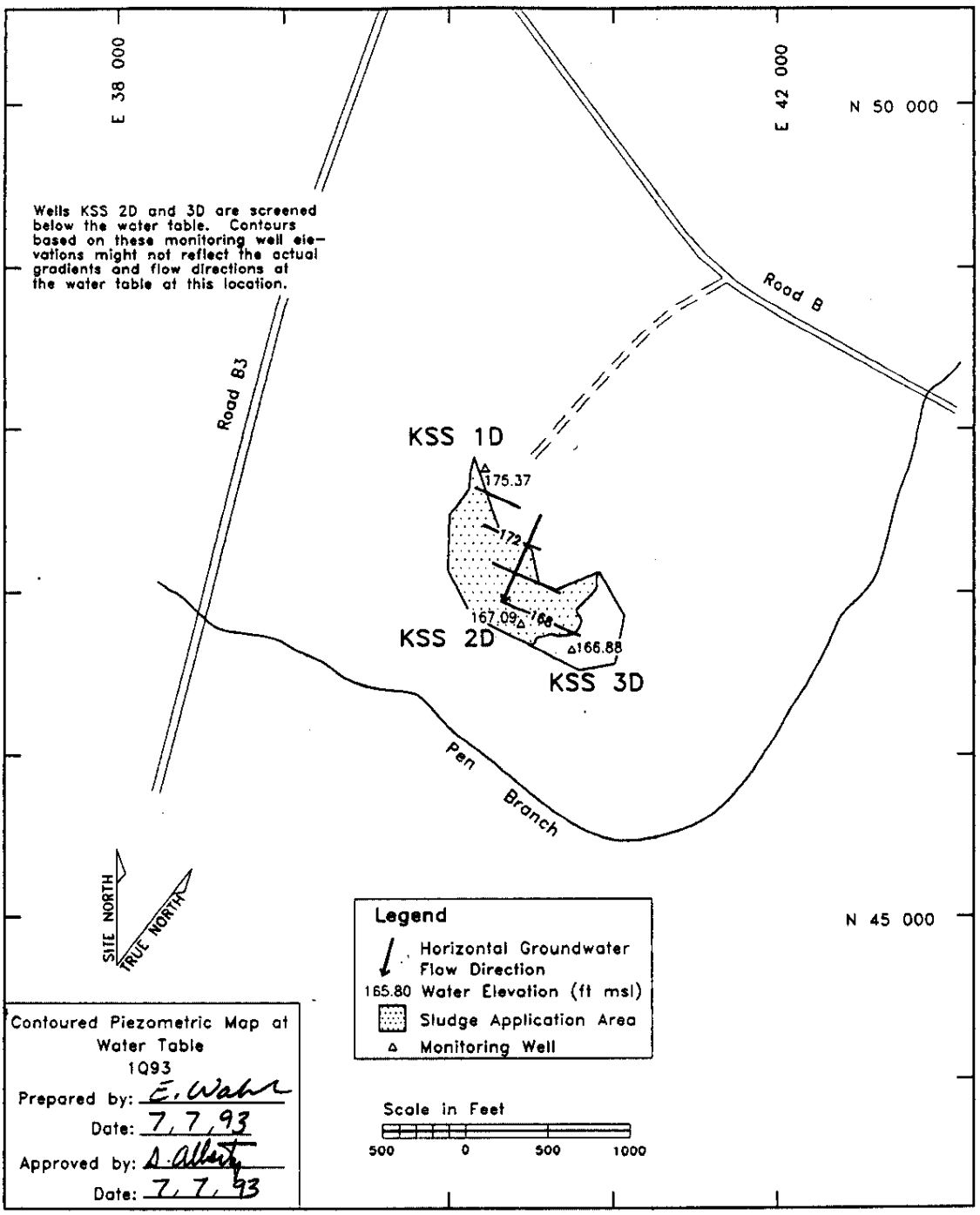

Figure 4. Piezometric Map of the Water Table at the K-Area Sewage Sludge Application Site

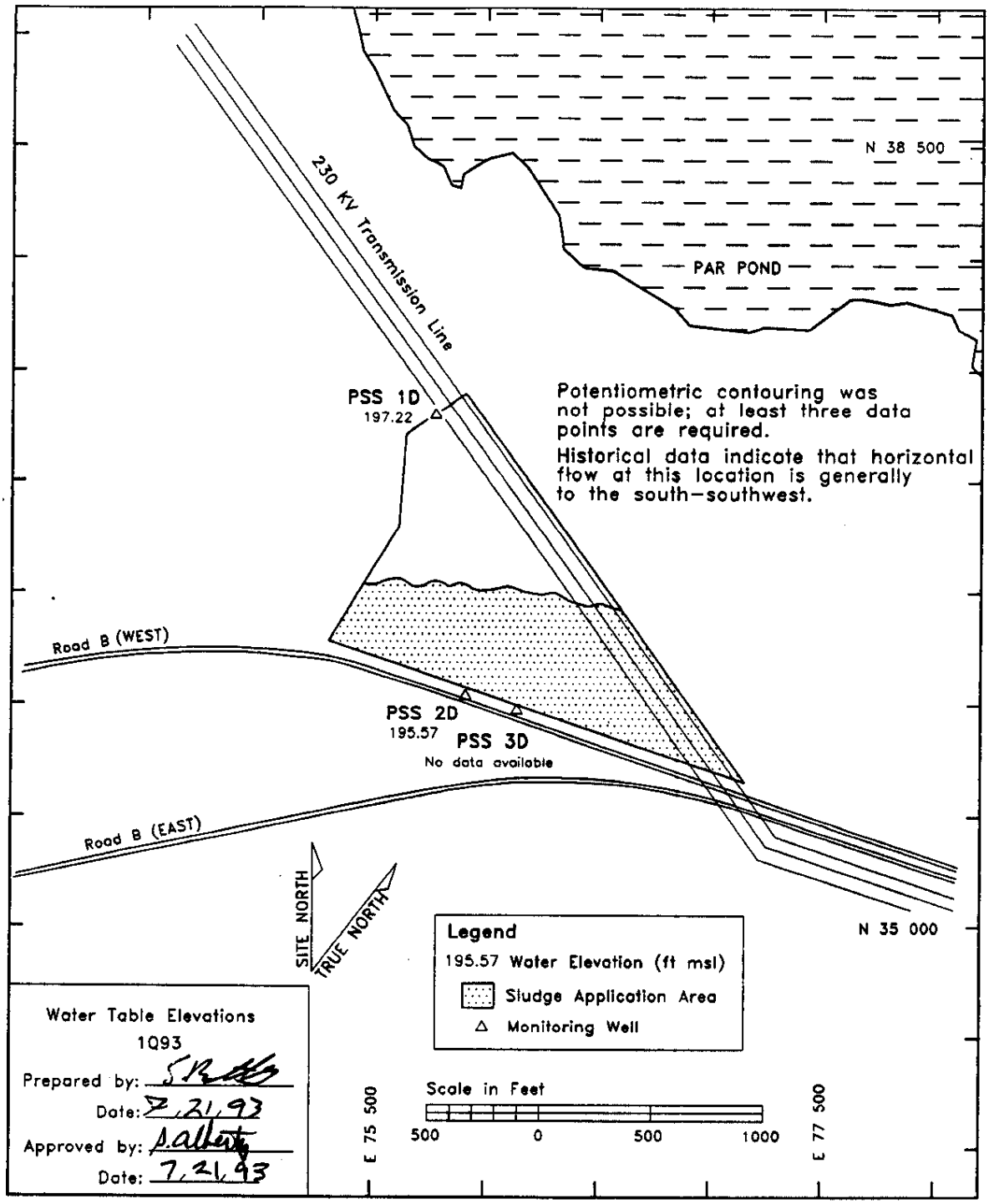

Figure 5. Water Table Elevations at the Par Pond Sewage Sludge Application Site

Appendix D – Groundwater Monitoring Results Tables

Key to Reading the Tables

The following abbreviations may appear in the tabular data:

B = sample collected from well using an open bucket bailer
BA = Barringer Laboratories, Inc.
CN = Clemson Technical Center, Inc.
CS = carbon steel
D = primary drinking water standard (PDWS)
E = exponential notation (e.g., 1.1E−09 = 1.1 × 10^{-9} = 0.0000000011)
EM = Environmental Protection Department/Environmental Monitoring Section (EPD/EMS) Laboratory
GE = General Engineering Laboratories
GP = Environmental Physics, Inc.
H = holding time
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
mg/L = milligrams per liter
Mod = modifier
msl = mean sea level
MSL = million structures per liter
NTU = turbidity unit
P = sample collected from well using a bladder pump
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
pCi/L = picocuries per liter
pCi/mL = picocuries per milliliter
PDWS = primary drinking water standard
pH = pH unit
PVC = polyvinyl chloride
S = sample collected from well using a single-speed centrifugal downhole pump
Sp. conductance = specific conductance
SP = Spencer Testing Services, Inc.
TCDD = tetrachlorodibenzo-p-dioxin
TCDF = tetrachlorodibenzo-p-furan
TM = TMA/Eberline
TOC = top of casing
V = sample collected from well using a variable-speed pump
WA = Roy F. Weston, Inc.
µg/L = micrograms per liter
µS/cm = microsiemens per centimeter

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 dot (•) in the H (holding time) column indicates that holding time was exceeded. Analyses performed beyond holding time 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 will always exceed it.

Laboratory-initiated procedures for reducing the number of other analyses performed out of holding time include subcontracting analyses when difficulties with equipment, personnel, or work load would prevent timely analyses. SRS reduces the compensation to laboratories for analyses performed out of holding time.

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 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	Definition
(Blank)	Data are not qualified. Number should be interpreted exactly as reported.
A	Value reported is the mean of two or more determinations.
J	Value is estimated because quantitation in the sample or in associated quality control samples did not meet specifications.
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.
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.

Result modifier	Definition
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 Levels of Constituents Exceeding the Final Primary Drinking Water Standards at the K-Area Sewage Sludge Application Site

Well	Constituent	Unit	4Q92	1Q93	Mod
N[a]	None	N	N	N	N

[a] N = not applicable.

Table 2. Maximum Levels of Constituents Exceeding the Final Primary Drinking Water Standards at the Par Pond Sewage Sludge Application Site

Well	Constituent	Unit	4Q92	1Q93	Mod
N[a]	None	N	N	N	N

[a] N = not applicable.

Table 3. Maximum Levels of Constituents Exceeding Half the Final Primary Drinking Water Standards or Other Flag 1 or Flag 2 Criteria at the K-Area Sewage Sludge Application Site

Well	Constituent	Unit	1Q93	Mod	Flag
KSS 1D	Aluminum	µg/L	969		2
	Iron	µg/L	914		2
	Lead	µg/L	7.5	J3	1
KSS 2D	Aluminum	µg/L	72		2
	Iron	µg/L	192		1
	Lead	µg/L	12		1
	Manganese	µg/L	37		1
	Total organic halogens	µg/L	30		1

Note: Constituents exceeding half the final PDWS appear *italicized*. These results do not include field data.

Table 4. Maximum Levels of Constituents Exceeding Half the Final Primary Drinking Water Standards or Other Flag 1 or Flag 2 Criteria at the Par Pond Sewage Sludge Application Site

Well	Constituent	Unit	1Q93	Mod	Flag
PSS 1D	Aluminum	µg/L	1,380		2
	Iron	µg/L	550		2
PSS 3D	Aluminum	µg/L	964		2
	Iron	µg/L	2,360		2

Table 5. Groundwater Monitoring Results for Individual Wells at the K-Area Sewage Sludge Application Site

WELL KSS 1D

SRS Coord.	Lat/Longitude	Screen Zone Elevation	Top of Casing	Casing	Pump	Formation
N47758.9 E40219.1	33.197023 °N 81.653674 °W	177.5-157.4 ft msl	229.8 ft msl	4" PVC	S	Water table

FIELD MEASUREMENTS

Sample date: 01/26/93
Depth to water: 54.43 ft (16.59 m) below TOC
Water elevation: 175.37 ft (53.45 m) msl
Sp. conductance: 94 µS/cm
Water evacuated before sampling: 14 gal
The well went dry during purging.

Time: 15:36
pH: 6.3
Alkalinity: 25 mg/L
Water temperature: 15.7 °C
Volumes purged: 1.2 well volumes

LABORATORY ANALYSES

H	D	Analyte	Result	Mod	Unit	Flag	Lab
●		pH	5.3	J	pH	0	WA
●		pH	5.3	J	pH	0	WA
●		Specific conductance	68	J	µS/cm	0	WA
●		Specific conductance	68	J	µS/cm	0	WA
		Aluminum	692		µg/L	2	WA
		Aluminum	733		µg/L	2	WA
		Aluminum	969		µg/L	2	WA
		Arsenic	<2.0		µg/L	0	WA
		Arsenic	<2.0		µg/L	0	WA
		Barium	12		µg/L	0	WA
		Barium	13		µg/L	0	WA
		Cadmium	<2.0		µg/L	0	WA
		Cadmium	<2.0		µg/L	0	WA
		Calcium	8,460	V	µg/L	0	WA
		Calcium	8,870	V	µg/L	0	WA
		Chlordane	<0.50		µg/L	0	GE
		Chloride	2,560		µg/L	0	WA
		Chromium	<4.0		µg/L	0	WA
		Chromium	<4.0		µg/L	0	WA
		Copper	6.6	J3	µg/L	0	WA
		Copper	10	J3	µg/L	0	WA
		2,4-Dichlorophenoxyacetic acid	<1.1		µg/L	0	WA
		Endrin	<0.11		µg/L	0	WA
		Endrin	<0.22		µg/L	0	WA
		Fluoride	<100		µg/L	0	WA
		Iron	914		µg/L	2	WA
		Iron	382	J3	µg/L	2	WA
		Iron	578	J3	µg/L	2	WA
		Lead	6.7	J3	µg/L	0	WA
		Lead	7.5	J3	µg/L	1	WA
		Lindane	<0.055		µg/L	0	WA
		Lindane	<0.11		µg/L	0	WA
		Magnesium	372		µg/L	0	WA
		Magnesium	376		µg/L	0	WA
		Manganese	10		µg/L	0	WA
		Manganese	10		µg/L	0	WA
		Mercury	<0.20		µg/L	0	WA
		Methoxychlor	<1.1		µg/L	0	WA
		Methoxychlor	<1.1		µg/L	0	WA

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

WELL KSS 1D collected on 01/26/93, laboratory analyses (cont.)

H	D	Analyte	Result	Mod	Unit	Flag	Lab
		Methoxychlor	<0.55		µg/L	0	WA
		Nickel	<4.0		µg/L	0	WA
		Nickel	<4.0		µg/L	0	WA
		Nitrate as nitrogen	516		µg/L	0	WA
		Nitrite as nitrogen	<10		µg/L	0	WA
		Phenols	<5.0		µg/L	0	WA
		Phenols	<5.0		µg/L	0	WA
		Potassium	<500		µg/L	0	WA
		Potassium	<500		µg/L	0	WA
		Selenium	<2.0		µg/L	0	WA
		Selenium	<2.0		µg/L	0	WA
		Silica	6,210		µg/L	0	WA
		Silica	6,380		µg/L	0	WA
		Silver	<2.0		µg/L	0	WA
		Silver	<2.0		µg/L	0	WA
		Sodium	1,630	V	µg/L	0	WA
		Sodium	1,710	V	µg/L	0	WA
		Sulfate	<1,000		µg/L	0	WA
		Sulfate	<1,000		µg/L	0	WA
		Total dissolved solids	<1,000		µg/L	0	WA
		Total organic carbon	2,860		µg/L	0	WA
		Total organic halogens	<5.0		µg/L	0	WA
		Total phosphates (as P)	341		µg/L	0	WA
		Toxaphene	<1.1		µg/L	0	WA
		Toxaphene	<2.2		µg/L	0	WA
		Toxaphene	<2.2		µg/L	0	WA
		2,4,5-TP (Silvex)	<0.55		µg/L	0	WA
		Gross alpha	2.0E+00 ± 1.4E+00		pCi/L	0	TM
		Gross alpha	1.3E+00 ± 1.2E+00		pCi/L	0	TM
		Nonvolatile beta	2.1E+00 ± 1.9E+00		pCi/L	0	TM
		Nonvolatile beta	2.7E+00 ± 1.9E+00		pCi/L	0	TM
		Radium-226	2.4E-01 ± 2.0E-01		pCi/L	0	TM
		Radium-226	<2.3E-01		pCi/L	0	TM
		Radium-228	<2.0E-01		pCi/L	0	TM
		Radium-228	<3.0E-01		pCi/L	0	TM
		Tritium	2.6E+00 ± 7.4E-01		pCi/mL	0	TM
		Tritium	2.5E+00 ± 7.0E-01		pCi/mL	0	TM

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

WELL KSS 2D

SRS Coord.	Lat/Longitude	Screen Zone Elevation	Top of Casing	Casing	Pump	Formation
N46803.8 E40437.0	33.195266 °N 81.651247 °W	164.7-144.6 ft msl	192.3 ft msl	4" PVC	S	Water table

FIELD MEASUREMENTS

Sample date: 01/26/93
Depth to water: 25.21 ft (7.68 m) below TOC
Water elevation: 167.09 ft (50.93 m) msl
Sp. conductance: 24 µS/cm
Water evacuated before sampling: 134 gal
Time: 14:45
pH: 5.6
Alkalinity: 2 mg/L
Water temperature: 19.1 °C
Volumes purged: 9.1 well volumes

LABORATORY ANALYSES

H	D	Analyte	Result	Mod	Unit	Flag	Lab
•		pH	5.5	J	pH	0	GE
•		pH	5.6	J	pH	0	GE
•		pH	5.4	J	pH	0	GE
•		pH	5.2	J	pH	0	WA
•		pH	5.2	J	pH	0	WA
		Specific conductance	25		µS/cm	0	GE
		Specific conductance	25		µS/cm	0	GE
		Specific conductance	25		µS/cm	0	GE
•		Specific conductance	23	J	µS/cm	0	WA
•		Specific conductance	24	J	µS/cm	0	WA
		Aluminum	71		µg/L	2	GE
		Aluminum	47		µg/L	1	GE
		Aluminum	63		µg/L	2	WA
		Aluminum	72		µg/L	2	WA
		Arsenic	<2.0		µg/L	0	GE
		Arsenic	<2.0		µg/L	0	GE
		Arsenic	<2.0		µg/L	0	WA
		Arsenic	<2.0		µg/L	0	WA
		Barium	5.5		µg/L	0	GE
		Barium	5.2		µg/L	0	GE
		Barium	4.0	J3	µg/L	0	WA
		Barium	<4.0		µg/L	0	WA
		Cadmium	<2.0		µg/L	0	GE
		Cadmium	<2.0		µg/L	0	GE
		Cadmium	<2.0		µg/L	0	WA
		Cadmium	<2.0		µg/L	0	WA
		Calcium	1,220		µg/L	0	GE
		Calcium	1,190		µg/L	0	GE
		Calcium	745	V	µg/L	0	WA
		Calcium	965	V	µg/L	0	WA
		Chlordane	<0.50		µg/L	0	GE
		Chloride	2,090		µg/L	0	GE
		Chloride	2,060		µg/L	0	GE
		Chloride	2,090		µg/L	0	GE
		Chloride	2,130		µg/L	0	WA
		Chloride	2,140		µg/L	0	WA
		Chromium	<4.0		µg/L	0	GE
		Chromium	<4.0		µg/L	0	GE
		Chromium	14		µg/L	0	WA

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

WELL KSS 2D collected on 01/26/93, laboratory analyses (cont.)

H	D	Analyte	Result	Mod	Unit	Flag	Lab
		Chromium	18		µg/L	0	WA
		Copper	150		µg/L	0	GE
		Copper	128		µg/L	0	GE
		Copper	82		µg/L	0	WA
		Copper	92		µg/L	0	WA
		2,4-Dichlorophenoxyacetic acid	<0.30		µg/L	0	GE
		2,4-Dichlorophenoxyacetic acid	<0.30		µg/L	0	GE
		2,4-Dichlorophenoxyacetic acid	<0.30		µg/L	0	GE
		2,4-Dichlorophenoxyacetic acid	<1.1		µg/L	0	WA
		2,4-Dichlorophenoxyacetic acid	<1.1		µg/L	0	WA
		2,4-Dichlorophenoxyacetic acid	<2.2		µg/L	0	WA
		Endrin	<0.0060		µg/L	0	GE
		Endrin	<0.0060		µg/L	0	GE
		Endrin	<0.11		µg/L	0	WA
		Endrin	<0.11		µg/L	0	WA
		Fluoride	<100		µg/L	0	GE
		Fluoride	<100		µg/L	0	GE
		Fluoride	<100		µg/L	0	WA
		Fluoride	<100		µg/L	0	WA
		Fluoride	<100		µg/L	0	WA
		Iron	71		µg/L	0	GE
		Iron	53		µg/L	0	GE
		Iron	134		µg/L	0	WA
		Iron	192		µg/L	1	WA
		Lead	18		µg/L	2	GE
		Lead	16		µg/L	2	GE
		Lead	12		µg/L	1	WA
		Lead	12		µg/L	1	WA
		Lindane	<0.0050		µg/L	0	GE
		Lindane	<0.0050		µg/L	0	GE
		Lindane	<0.054		µg/L	0	WA
		Lindane	<0.055		µg/L	0	WA
		Magnesium	378		µg/L	0	GE
		Magnesium	369		µg/L	0	GE
		Magnesium	228		µg/L	0	WA
		Magnesium	306		µg/L	0	WA
		Manganese	37		µg/L	1	GE
		Manganese	34		µg/L	1	GE
		Manganese	22		µg/L	0	WA
		Manganese	27		µg/L	1	WA
		Mercury	<0.20		µg/L	0	GE
		Mercury	<0.20		µg/L	0	GE
		Mercury	<0.20		µg/L	0	GE
		Mercury	<0.20		µg/L	0	WA
		Mercury	<0.20		µg/L	0	WA
		Methoxychlor	<0.50		µg/L	0	GE
		Methoxychlor	<0.50		µg/L	0	GE
		Methoxychlor	<0.54		µg/L	0	WA
		Methoxychlor	<0.55		µg/L	0	WA
		Nickel	4.9		µg/L	0	GE
		Nickel	<4.0		µg/L	0	GE
		Nickel	6.8	J3	µg/L	0	WA
		Nickel	11	J3	µg/L	0	WA
		Nitrate as nitrogen	487		µg/L	0	WA
		Nitrate as nitrogen	500		µg/L	0	WA
		Nitrate-nitrite as nitrogen	590		µg/L	0	GE

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

WELL KSS 2D collected on 01/26/93, laboratory analyses (cont.)

H	D	Analyte	Result	Mod	Unit	Flag	Lab
		Nitrate-nitrite as nitrogen	560		µg/L	0	GE
●		Nitrite as nitrogen	<10	J	µg/L	0	GE
●		Nitrite as nitrogen	<10	J	µg/L	0	GE
		Nitrite as nitrogen	<10		µg/L	0	WA
		Nitrite as nitrogen	<10		µg/L	0	WA
		Phenols	<5.0		µg/L	0	GE
		Phenols	<5.0		µg/L	0	GE
		Phenols	<5.0		µg/L	0	GE
		Phenols	<5.0		µg/L	0	WA
		Phenols	<5.0		µg/L	0	WA
		Potassium	<500		µg/L	0	GE
		Potassium	<500		µg/L	0	GE
		Potassium	<500		µg/L	0	WA
		Potassium	<500		µg/L	0	WA
		Selenium	<2.0		µg/L	0	GE
		Selenium	<2.0		µg/L	0	GE
		Selenium	<2.0		µg/L	0	WA
		Selenium	<2.0		µg/L	0	WA
		Silica	8,150		µg/L	0	GE
		Silica	7,990		µg/L	0	GE
		Silica	4,260		µg/L	0	WA
		Silica	5,520		µg/L	0	WA
		Silver	<2.0		µg/L	0	GE
		Silver	<2.0		µg/L	0	GE
		Silver	<2.0		µg/L	0	WA
		Silver	<2.0		µg/L	0	WA
		Sodium	1,990		µg/L	0	GE
		Sodium	1,940		µg/L	0	GE
		Sodium	1,180	V	µg/L	0	WA
		Sodium	1,570	V	µg/L	0	WA
		Sulfate	<1,000		µg/L	0	GE
		Sulfate	<1,000		µg/L	0	GE
		Sulfate	<1,000		µg/L	0	GE
		Sulfate	<1,000		µg/L	0	WA
		Sulfate	<1,000		µg/L	0	WA
		Total dissolved solids	31,000	V	µg/L	0	GE
		Total dissolved solids	22,000	V	µg/L	0	GE
		Total dissolved solids	10,000		µg/L	0	WA
		Total dissolved solids	<1,000		µg/L	0	WA
		Total organic carbon	<1,000		µg/L	0	GE
		Total organic carbon	<1,000		µg/L	0	GE
		Total organic carbon	<1,000		µg/L	0	WA
		Total organic carbon	<1,000		µg/L	0	WA
		Total organic halogens	29		µg/L	1	GE
		Total organic halogens	30		µg/L	1	GE
		Total organic halogens	24		µg/L	0	GE
		Total organic halogens	<5.0		µg/L	0	WA
		Total organic halogens	<5.0		µg/L	0	WA
		Total phosphates (as P)	<50		µg/L	0	GE
		Total phosphates (as P)	<50		µg/L	0	GE
		Total phosphates (as P)	<50		µg/L	0	WA
		Total phosphates (as P)	<50		µg/L	0	WA
		Toxaphene	<0.24		µg/L	0	GE
		Toxaphene	<0.24		µg/L	0	GE
		Toxaphene	<1.1		µg/L	0	WA
		Toxaphene	<1.1		µg/L	0	WA

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

WELL KSS 2D collected on 01/26/93, laboratory analyses (cont.)

H	D	Analyte	Result	Mod	Unit	Flag	Lab
		2,4,5-TP (Silvex)	<0.090		µg/L	0	GE
		2,4,5-TP (Silvex)	<0.090		µg/L	0	GE
		2,4,5-TP (Silvex)	<0.090		µg/L	0	GE
		2,4,5-TP (Silvex)	<1.1		µg/L	0	WA
		2,4,5-TP (Silvex)	<0.55		µg/L	0	WA
		2,4,5-TP (Silvex)	<0.55		µg/L	0	WA
		Gross alpha	<2.0E+00		pCi/L	0	GE
		Gross alpha	<2.0E+00		pCi/L	0	GE
		Gross alpha	<5.0E-01		pCi/L	0	TM
		Gross alpha	<5.0E-01		pCi/L	0	TM
		Nonvolatile beta	<2.0E+00		pCi/L	0	GE
		Nonvolatile beta	<2.0E+00		pCi/L	0	GE
		Nonvolatile beta	2.5E+00 ± 1.8E+00		pCi/L	0	TM
		Nonvolatile beta	<7.0E-01		pCi/L	0	TM
		Radium-226	<1.4E-01		pCi/L	0	TM
		Radium-226	<1.9E-01		pCi/L	0	TM
		Radium-228	<2.0E-01		pCi/L	0	TM
		Radium-228	4.0E-01 ± 8.0E-01		pCi/L	0	TM
		Radium, total alpha-emitting	<1.0E+00		pCi/L	0	GE
		Radium, total alpha-emitting	1.1E+00 ± 7.0E-01		pCi/L	0	GE
		Tritium	1.8E+00 ± 3.0E-01		pCi/mL	0	GE
		Tritium	2.3E+00 ± 3.0E-01		pCi/mL	0	GE
		Tritium	3.1E+00 ± 9.9E-01		pCi/mL	0	TM
		Tritium	3.1E+00 ± 8.5E-01		pCi/mL	0	TM

WELL KSS 3D

SRS Coord.	Lat/Longitude	Screen Zone Elevation	Top of Casing	Casing	Pump	Formation
N46644.3 E40748.0	33.195420 °N 81.650120 °W	159.3-139.3 ft msl	185.2 ft msl	4" PVC	S	Water table

FIELD MEASUREMENTS

Sample date: 01/26/93
Depth to water: 18.32 ft (5.58 m) below TOC
Water elevation: 166.88 ft (50.87 m) msl
Sp. conductance: 31 µS/cm
Water evacuated before sampling: 111 gal
Time: 15:21
pH: 6.0
Alkalinity: 7 mg/L
Water temperature: 17.5 °C
Volumes purged: 6.1 well volumes

LABORATORY ANALYSES

H	D	Analyte	Result	Mod	Unit	Flag	Lab
•		pH	5.7	J	pH	0	WA
•		Specific conductance	31	J	µS/cm	0	WA
		Aluminum	<20		µg/L	0	WA
		Arsenic	<2.0		µg/L	0	WA
		Barium	<4.0		µg/L	0	WA
		Cadmium	<2.0		µg/L	0	WA
		Calcium	3,170	V	µg/L	0	WA
		Chlordane	<0.50		µg/L	0	GE
		Chloride	2,050		µg/L	0	WA
		Chromium	<4.0		µg/L	0	WA

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

WELL KSS 3D collected on 01/26/93, laboratory analyses (cont.)

H	D	Analyte	Result	Mod	Unit	Flag	Lab
		Copper	6.3		µg/L	0	WA
		2,4-Dichlorophenoxyacetic acid	<1.1		µg/L	0	WA
		Endrin	<0.11		µg/L	0	WA
		Fluoride	<100		µg/L	0	WA
		Iron	<4.0		µg/L	0	WA
		Lead	<3.0		µg/L	0	WA
		Lindane	<0.054		µg/L	0	WA
		Magnesium	203		µg/L	0	WA
		Manganese	<2.0		µg/L	0	WA
		Mercury	<0.20		µg/L	0	WA
		Methoxychlor	<0.54		µg/L	0	WA
		Nickel	<4.0		µg/L	0	WA
		Nitrate as nitrogen	294		µg/L	0	WA
		Nitrite as nitrogen	<10		µg/L	0	WA
		Phenols	<5.0		µg/L	0	WA
		Potassium	<500		µg/L	0	WA
		Selenium	<2.0		µg/L	0	WA
		Silica	6,550		µg/L	0	WA
		Silver	<2.0		µg/L	0	WA
		Sodium	1,290	V	µg/L	0	WA
		Sulfate	<1,000		µg/L	0	WA
		Total dissolved solids	28,000		µg/L	0	WA
		Total organic carbon	<1,000		µg/L	0	WA
		Total organic halogens	<5.0		µg/L	0	WA
		Total phosphates (as P)	<50		µg/L	0	WA
		Toxaphene	<1.1		µg/L	0	WA
		2,4,5-TP (Silvex)	<0.53		µg/L	0	WA
		Gross alpha	6.0E-01 ± 9.0E-01		pCi/L	0	TM
		Nonvolatile beta	<7.0E-01		pCi/L	0	TM
		Radium-226	<1.8E-01		pCi/L	0	TM
		Radium-228	3.0E-01 ± 8.0E-01		pCi/L	0	TM
		Tritium	3.8E+00 ± 1.0E+00		pCi/mL	0	TM

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

Table 6. Groundwater Monitoring Results for Individual Wells at the Par Pond Sewage Sludge Application Site

WELL PSS 1D

SRS Coord.	Lat/Longitude	Screen Zone Elevation	Top of Casing	Casing	Pump	Formation
N37298.4 E75773.3	33.231837 °N 81.539797 °W	202.1-182.1 ft msl	219.6 ft msl	4" PVC	S	Water table

FIELD MEASUREMENTS

Sample date: 02/16/93
Depth to water: 22.38 ft (6.82 m) below TOC
Water elevation: 197.22 ft (60.11 m) msl
Sp. conductance: 14 µS/cm
Water evacuated before sampling: 133 gal
Time: 11:34
pH: 4.9
Alkalinity: 0 mg/L
Water temperature: 20.0 °C
Volumes purged: 13.4 well volumes

LABORATORY ANALYSES

H	D	Analyte	Result	Mod	Unit	Flag	Lab
•		pH	5.4	J	pH	0	WA
•		pH	5.4	J	pH	0	WA
•		Specific conductance	18	J	µS/cm	0	WA
•		Specific conductance	18	J	µS/cm	0	WA
		Aluminum	1,260		µg/L	2	WA
		Aluminum	1,380		µg/L	2	WA
		Arsenic	<2.0		µg/L	0	WA
		Arsenic	<2.0		µg/L	0	WA
		Barium	9.2		µg/L	0	WA
		Barium	10		µg/L	0	WA
		Cadmium	<2.0		µg/L	0	WA
		Cadmium	<2.0		µg/L	0	WA
		Calcium	342		µg/L	0	WA
		Calcium	372		µg/L	0	WA
		Chlordane	<0.50		µg/L	0	GE
		Chloride	1,960		µg/L	0	WA
		Chromium	<4.0		µg/L	0	WA
		Chromium	<4.0		µg/L	0	WA
		Copper	4.5	J3	µg/L	0	WA
		Copper	5.3	J3	µg/L	0	WA
		2,4-Dichlorophenoxyacetic acid	<1.1		µg/L	0	WA
		Endrin	<0.11		µg/L	0	WA
		Endrin	<0.22		µg/L	0	WA
		Fluoride	<100		µg/L	0	WA
		Iron	515		µg/L	2	WA
		Iron	550		µg/L	2	WA
		Lead	<3.0		µg/L	0	WA
		Lead	<3.0		µg/L	0	WA
		Lindane	<0.055		µg/L	0	WA
		Lindane	<0.11		µg/L	0	WA
		Magnesium	359		µg/L	0	WA
		Magnesium	381		µg/L	0	WA
		Manganese	2.0		µg/L	0	WA
		Manganese	2.1		µg/L	0	WA
		Mercury	<0.20		µg/L	0	WA
		Methoxychlor	<1.1		µg/L	0	WA
		Methoxychlor	<1.1		µg/L	0	WA
		Methoxychlor	<0.55		µg/L	0	WA
		Nickel	<4.0		µg/L	0	WA

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

WELL PSS 1D collected on 02/16/93, laboratory analyses (cont.)

H	D	Analyte	Result	Mod	Unit	Flag	Lab
		Nickel	<4.0		µg/L	0	WA
		Nitrate as nitrogen	415		µg/L	0	WA
●		Nitrite as nitrogen	19	J	µg/L	0	WA
●		Nitrite as nitrogen	21	J	µg/L	0	WA
		Phenols	<5.0		µg/L	0	WA
		Phenols	<5.0		µg/L	0	WA
		Potassium	<500		µg/L	0	WA
		Potassium	<500		µg/L	0	WA
		Selenium	<2.0		µg/L	0	WA
		Selenium	<2.0		µg/L	0	WA
		Silica	6,670		µg/L	0	WA
		Silica	7,290		µg/L	0	WA
		Silver	<2.0		µg/L	0	WA
		Silver	<2.0		µg/L	0	WA
		Sodium	718	V	µg/L	0	WA
		Sodium	766	V	µg/L	0	WA
		Sulfate	<1,000		µg/L	0	WA
		Total dissolved solids	36,000		µg/L	0	WA
		Total organic carbon	<1,000		µg/L	0	WA
		Total organic carbon	<1,000		µg/L	0	WA
		Total organic halogens	<5.0		µg/L	0	WA
		Total organic halogens	<5.0		µg/L	0	WA
		Total phosphates (as P)	<50		µg/L	0	WA
		Toxaphene	<1.1		µg/L	0	WA
		Toxaphene	<2.2		µg/L	0	WA
		Toxaphene	<2.2		µg/L	0	WA
		2,4,5-TP (Silvex)	<0.56		µg/L	0	WA
		Gross alpha	1.3E+00 ± 9.0E-01		pCi/L	0	TM
		Gross alpha	9.0E-01 ± 7.0E-01		pCi/L	0	TM
		Nonvolatile beta	1.6E+00 ± 1.7E+00		pCi/L	0	TM
		Nonvolatile beta	1.6E+00 ± 1.7E+00		pCi/L	0	TM
		Radium-226	<3.0E-01		pCi/L	0	TM
		Radium-226	<2.2E-01		pCi/L	0	TM
		Radium-228	<3.0E-01		pCi/L	0	TM
		Radium-228	8.0E-01 ± 9.0E-01		pCi/L	0	TM
		Tritium	1.1E+00 ± 4.1E-01		pCi/mL	0	TM
		Tritium	9.7E-01 ± 3.5E-01		pCi/mL	0	TM

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

WELL PSS 2D

SRS Coord.	Lat/Longitude	Screen Zone Elevation	Top of Casing	Casing	Pump	Formation
N36037.9 E75910.1	33.229270 °N 81.536993 °W	197.1-177.1 ft msl	228.7 ft msl	4" PVC	S	Water table

FIELD MEASUREMENTS

Sample date: 02/15/93
Depth to water: 33.13 ft (10.10 m) below TOC
Water elevation: 195.57 ft (59.61 m) msl
Sp. conductance: 20 µS/cm
Water evacuated before sampling: 65 gal

Time: 11:44
pH: 4.9
Alkalinity: 0 mg/L
Water temperature: 19.2 °C
Volumes purged: 5.4 well volumes

LABORATORY ANALYSES

H	D	Analyte	Result	Mod	Unit	Flag	Lab
•		pH	5.2	J	pH	0	GE
•		pH	4.7	J	pH	0	GE
•		pH	4.9	J	pH	0	WA
•		pH	4.9	J	pH	0	WA
•		pH	5.0	J	pH	0	WA
		Specific conductance	18		µS/cm	0	GE
		Specific conductance	18		µS/cm	0	GE
		Specific conductance	20		µS/cm	0	GE
•		Specific conductance	17	J	µS/cm	0	WA
•		Specific conductance	18	J	µS/cm	0	WA
•		Specific conductance	19	J	µS/cm	0	WA
		Aluminum	<20		µg/L	0	GE
		Aluminum	<20		µg/L	0	GE
		Aluminum	<20		µg/L	0	WA
		Aluminum	<20		µg/L	0	WA
		Aluminum	<20		µg/L	0	WA
		Arsenic	<2.0		µg/L	0	GE
		Arsenic	<2.0		µg/L	0	GE
		Arsenic	<2.0		µg/L	0	WA
		Arsenic	<2.0		µg/L	0	WA
		Arsenic	<2.0		µg/L	0	WA
		Barium	7.0		µg/L	0	GE
		Barium	7.1		µg/L	0	GE
		Barium	5.9		µg/L	0	WA
		Barium	6.4		µg/L	0	WA
		Barium	6.8		µg/L	0	WA
		Cadmium	<2.0		µg/L	0	GE
		Cadmium	<2.0		µg/L	0	GE
		Cadmium	<2.0		µg/L	0	WA
		Cadmium	<2.0		µg/L	0	WA
		Cadmium	<2.0		µg/L	0	WA
		Calcium	583		µg/L	0	GE
		Calcium	560		µg/L	0	GE
		Calcium	564		µg/L	0	WA
		Calcium	574		µg/L	0	WA
		Calcium	595		µg/L	0	WA
		Chlordane	<0.50		µg/L	0	GE
		Chloride	1,570		µg/L	0	GE
		Chloride	1,460		µg/L	0	GE

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

WELL PSS 2D collected on 02/15/93, laboratory analyses (cont.)

H	D	Analyte	Result	Mod	Unit	Flag	Lab
		Chloride	1,420		µg/L	0	WA
		Chloride	1,470		µg/L	0	WA
		Chromium	<4.0		µg/L	0	GE
		Chromium	<4.0		µg/L	0	GE
		Chromium	6.0	J3	µg/L	0	WA
		Chromium	<4.0		µg/L	0	WA
		Chromium	<4.0		µg/L	0	WA
		Copper	<4.0		µg/L	0	GE
		Copper	<4.0		µg/L	0	GE
		Copper	<4.0		µg/L	0	WA
		Copper	<4.0		µg/L	0	WA
		Copper	<4.0		µg/L	0	WA
		2,4-Dichlorophenoxyacetic acid	<0.30		µg/L	0	GE
		2,4-Dichlorophenoxyacetic acid	<0.30		µg/L	0	GE
		2,4-Dichlorophenoxyacetic acid	<0.30		µg/L	0	GE
		2,4-Dichlorophenoxyacetic acid	<1.1		µg/L	0	WA
		2,4-Dichlorophenoxyacetic acid	<1.1		µg/L	0	WA
		2,4-Dichlorophenoxyacetic acid	<2.2		µg/L	0	WA
		Endrin	<0.0060		µg/L	0	GE
		Endrin	<0.0060		µg/L	0	GE
		Endrin	<0.0060		µg/L	0	GE
		Endrin	<0.11		µg/L	0	WA
		Endrin	<0.11		µg/L	0	WA
		Endrin	<0.22		µg/L	0	WA
		Fluoride	<100		µg/L	0	GE
		Fluoride	<100		µg/L	0	GE
		Fluoride	<100		µg/L	0	WA
		Fluoride	<100		µg/L	0	WA
		Iron	6.1	J2	µg/L	0	GE
		Iron	11		µg/L	0	GE
		Iron	21		µg/L	0	WA
		Iron	11	J3	µg/L	0	WA
		Iron	20	J3	µg/L	0	WA
		Lead	<3.0		µg/L	0	GE
		Lead	<3.0		µg/L	0	GE
		Lead	<3.0		µg/L	0	WA
		Lead	<3.0		µg/L	0	WA
		Lead	<3.0		µg/L	0	WA
		Lindane	<0.0050		µg/L	0	GE
		Lindane	<0.0050		µg/L	0	GE
		Lindane	<0.0050		µg/L	0	GE
		Lindane	<0.055		µg/L	0	WA
		Lindane	<0.056		µg/L	0	WA
		Lindane	<0.11		µg/L	0	WA
		Magnesium	483		µg/L	0	GE
		Magnesium	474		µg/L	0	GE
		Magnesium	436		µg/L	0	WA
		Magnesium	453		µg/L	0	WA
		Magnesium	458		µg/L	0	WA
		Manganese	2.2		µg/L	0	GE
		Manganese	2.6		µg/L	0	GE
		Manganese	2.2		µg/L	0	WA
		Manganese	2.4		µg/L	0	WA
		Manganese	2.7		µg/L	0	WA
		Mercury	<0.20		µg/L	0	GE
		Mercury	<0.20		µg/L	0	GE

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

WELL PSS 2D collected on 02/15/93, laboratory analyses (cont.)

H	D	Analyte	Result	Mod	Unit	Flag	Lab
		Mercury	<0.20		µg/L	0	WA
		Mercury	<0.20		µg/L	0	WA
		Methoxychlor	<0.50		µg/L	0	GE
		Methoxychlor	<0.50		µg/L	0	GE
		Methoxychlor	<0.50		µg/L	0	GE
		Methoxychlor	<1.1		µg/L	0	WA
		Methoxychlor	<1.1		µg/L	0	WA
		Methoxychlor	<0.55		µg/L	0	WA
		Methoxychlor	<0.56		µg/L	0	WA
		Nickel	<4.0		µg/L	0	GE
		Nickel	<4.0		µg/L	0	GE
		Nickel	<4.0		µg/L	0	WA
		Nickel	<4.0		µg/L	0	WA
		Nickel	<4.0		µg/L	0	WA
		Nitrate as nitrogen	717		µg/L	0	WA
		Nitrate as nitrogen	767		µg/L	0	WA
		Nitrate-nitrite as nitrogen	880		µg/L	0	GE
		Nitrate-nitrite as nitrogen	800		µg/L	0	GE
●		Nitrite as nitrogen	<10	J6	µg/L	0	GE
●		Nitrite as nitrogen	<10	J	µg/L	0	GE
●		Nitrite as nitrogen	15	J	µg/L	0	WA
●		Nitrite as nitrogen	<10	J	µg/L	0	WA
		Phenols	<5.0		µg/L	0	GE
		Phenols	<5.0		µg/L	0	GE
		Phenols	<5.0		µg/L	0	WA
		Phenols	<5.0		µg/L	0	WA
		Phenols	<5.0		µg/L	0	WA
		Potassium	<500		µg/L	0	GE
		Potassium	<500		µg/L	0	GE
		Potassium	<500		µg/L	0	WA
		Potassium	<500		µg/L	0	WA
		Potassium	<500		µg/L	0	WA
		Selenium	<2.0		µg/L	0	GE
		Selenium	<2.0		µg/L	0	GE
		Selenium	<2.0		µg/L	0	WA
		Selenium	<2.0		µg/L	0	WA
		Selenium	<2.0		µg/L	0	WA
		Silica	5,570		µg/L	0	GE
		Silica	5,360		µg/L	0	GE
		Silica	4,640		µg/L	0	WA
		Silica	4,670		µg/L	0	WA
		Silica	4,840		µg/L	0	WA
		Silver	<2.0		µg/L	0	GE
		Silver	<2.0		µg/L	0	GE
		Silver	<2.0		µg/L	0	WA
		Silver	<2.0		µg/L	0	WA
		Silver	<2.0		µg/L	0	WA
		Sodium	1,230		µg/L	0	GE
		Sodium	1,160		µg/L	0	GE
		Sodium	1,130	V	µg/L	0	WA
		Sodium	1,180	V	µg/L	0	WA
		Sodium	1,200	V	µg/L	0	WA
		Sulfate	<1,000		µg/L	0	GE
		Sulfate	<1,000		µg/L	0	GE
		Sulfate	<1,000		µg/L	0	WA
		Sulfate	<1,000		µg/L	0	WA

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

WELL PSS 2D collected on 02/15/93, laboratory analyses (cont.)

H	D	Analyte	Result	Mod	Unit	Flag	Lab
		Total dissolved solids	30,000	V	µg/L	0	GE
		Total dissolved solids	22,000	V	µg/L	0	GE
		Total dissolved solids	5,000		µg/L	0	WA
		Total dissolved solids	20,000		µg/L	0	WA
		Total organic carbon	<1,000		µg/L	0	GE
		Total organic carbon	<1,000		µg/L	0	GE
		Total organic carbon	<1,000		µg/L	0	GE
		Total organic carbon	1,030		µg/L	0	WA
		Total organic carbon	1,250		µg/L	0	WA
		Total organic halogens	<5.0		µg/L	0	GE
		Total organic halogens	<5.0		µg/L	0	GE
		Total organic halogens	<5.0		µg/L	0	WA
		Total organic halogens	<5.0		µg/L	0	WA
		Total phosphates (as P)	<50		µg/L	0	GE
		Total phosphates (as P)	<50		µg/L	0	GE
		Total phosphates (as P)	<50		µg/L	0	WA
		Total phosphates (as P)	<50		µg/L	0	WA
		Toxaphene	<0.24		µg/L	0	GE
		Toxaphene	<0.24		µg/L	0	GE
		Toxaphene	<0.24		µg/L	0	GE
		Toxaphene	<1.1		µg/L	0	WA
		Toxaphene	<1.1		µg/L	0	WA
		Toxaphene	<2.2		µg/L	0	WA
		Toxaphene	<2.2		µg/L	0	WA
		2,4,5-TP (Silvex)	<0.090		µg/L	0	GE
		2,4,5-TP (Silvex)	<0.090		µg/L	0	GE
		2,4,5-TP (Silvex)	<0.090		µg/L	0	GE
		2,4,5-TP (Silvex)	<1.1		µg/L	0	WA
		2,4,5-TP (Silvex)	<0.53		µg/L	0	WA
		2,4,5-TP (Silvex)	<0.55		µg/L	0	WA
		Gross alpha	<2.0E+00		pCi/L	0	GE
		Gross alpha	<2.0E+00		pCi/L	0	GE
		Gross alpha	<6.0E-01		pCi/L	0	TM
		Gross alpha	9.0E-01 ± 1.0E+00		pCi/L	0	TM
		Gross alpha	<6.0E-01		pCi/L	0	TM
		Nonvolatile beta	<2.0E+00		pCi/L	0	GE
		Nonvolatile beta	<2.0E+00		pCi/L	0	GE
		Nonvolatile beta	<8.0E-01		pCi/L	0	TM
		Nonvolatile beta	9.0E-01 ± 1.7E+00		pCi/L	0	TM
		Nonvolatile beta	9.0E-01 ± 1.7E+00		pCi/L	0	TM
		Radium-226	3.7E-01 ± 2.6E-01		pCi/L	0	TM
		Radium-226	2.3E-01 ± 2.0E-01		pCi/L	0	TM
		Radium-226	2.6E-01 ± 2.0E-01		pCi/L	0	TM
		Radium-228	1.7E+00 ± 1.0E+00		pCi/L	0	TM
		Radium-228	6.0E-01 ± 8.0E-01		pCi/L	0	TM
		Radium-228	8.0E-01 ± 7.0E-01		pCi/L	0	TM
		Radium, total alpha-emitting	<1.0E+00		pCi/L	0	GE
		Radium, total alpha-emitting	<1.0E+00		pCi/L	0	GE
		Tritium	<7.0E-01		pCi/mL	0	GE
		Tritium	<7.0E-01		pCi/mL	0	GE
		Tritium	1.5E+00 ± 7.6E-01		pCi/mL	0	TM
		Tritium	1.2E+00 ± 6.3E-01		pCi/mL	0	TM
		Tritium	1.3E+00 ± 6.8E-01		pCi/mL	0	TM

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

WELL PSS 3D

SRS Coord.	Lat/Longitude	Screen Zone Elevation	Top of Casing	Casing	Pump	Formation
N35974.1 E76138.7	33.229501 °N 81.536268 °W	198.5-178.5 ft msl	234 ft msl	4" PVC	S	Water table

FIELD MEASUREMENTS

Sample date: 02/16/93
Depth to water: Not available
Water elevation: Not available
Sp. conductance: 12 µS/cm
Water evacuated before sampling: 8 gal
The well went dry during purging.

Time: 9:20
pH: 4.4
Alkalinity: 0 mg/L
Water temperature: 17.6 °C

LABORATORY ANALYSES

H	D	Analyte	Result	Mod	Unit	Flag	Lab
•		pH	5.2	J	pH	0	WA
•		Specific conductance	19	J	µS/cm	0	WA
		Aluminum	964		µg/L	2	WA
		Arsenic	<2.0		µg/L	0	WA
		Barium	6.4		µg/L	0	WA
		Cadmium	2.0	J3	µg/L	0	WA
		Calcium	271		µg/L	0	WA
		Chlordane	<0.50		µg/L	0	GE
		Chloride	1,650		µg/L	0	WA
		Chromium	<4.0		µg/L	0	WA
		Copper	12		µg/L	0	WA
		2,4-Dichlorophenoxyacetic acid	<1.1		µg/L	0	WA
		Endrin	<0.11		µg/L	0	WA
		Fluoride	<100		µg/L	0	WA
		Iron	2,360		µg/L	2	WA
		Lead	22		µg/L	2	WA
		Lindane	<0.054		µg/L	0	WA
		Magnesium	145		µg/L	0	WA
		Manganese	12		µg/L	0	WA
		Mercury	<0.20		µg/L	0	WA
		Methoxychlor	<0.54		µg/L	0	WA
		Nickel	<4.0		µg/L	0	WA
		Nitrate as nitrogen	148		µg/L	0	WA
•		Nitrite as nitrogen	10	J	µg/L	0	WA
		Phenols	<5.0		µg/L	0	WA
		Potassium	<500		µg/L	0	WA
		Selenium	<2.0		µg/L	0	WA
		Silica	4,470		µg/L	0	WA
		Silver	2.0	J3	µg/L	0	WA
		Sodium	759	V	µg/L	0	WA
		Sulfate	<1,000		µg/L	0	WA
		Total dissolved solids	23,000		µg/L	0	WA
		Total dissolved solids	23,000		µg/L	0	WA
		Total organic carbon	<1,000		µg/L	0	WA
		Total organic halogens	<5.0		µg/L	0	WA
		Total phosphates (as P)	83		µg/L	0	WA
		Toxaphene	<1.1		µg/L	0	WA
		2,4,5-TP (Silvex)	<0.56		µg/L	0	WA
		Gross alpha	1.9E+00 ± 1.0E+00		pCi/L	0	TM

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

WELL PSS 3D collected on 02/16/93, laboratory analyses (cont.)

H	D	Analyte	Result	Mod	Unit	Flag	Lab
		Nonvolatile beta	<7.0E-01		pCi/L	0	TM
		Radium-226	<2.0E-01		pCi/L	0	TM
		Radium-228	<4.0E-01		pCi/L	0	TM
		Tritium	1.1E+00 ± 5.0E-01		pCi/mL	0	TM

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

Appendix E – Data Quality/Useability Assessment

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 Environmental Protection Department/ Environmental Monitoring Section's (EPD/EMS) review 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 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 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 quarterly report, *The Savannah River Site's Groundwater Monitoring Program.* 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 exceeded 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 to four acid compounds and three to four base/neutral compounds are used. Other surrogates are used in 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 re-run the samples or attach result 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 sample is spiked with known concentrations of compounds appropriate to the analyses being performed, typically 5 volatile organic compounds for volatile organics analyses, 11 semivolatile compounds for semivolatiles, 6 pesticide compounds for pesticides, all metals for metals analyses, 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 lab 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 can be assigned on the basis of the percentage of spike recovery and 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 (laboratory-initiated) and blind replicates (provided by EPD/EMS). The results of duplicate and replicate analyses are presented in the results tables of the first, second, and third quarter reports. 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. During 1992, at least one of the contract laboratories used a data qualifier (J3) to modify metals analyses when the RPD for laboratory duplicates was 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 com-

pound, either inter- or intralaboratory, 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 replicate and duplicate 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 the 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 first quarter 1992 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.

Method	Used to Analyze	Source
EPA120.1	Specific conductance	EPA EMSL 1983
EPA150.1	pH	EPA EMSL 1983
EPA160.1	Filterable residue (total dissolved solids)	EPA EMSL 1983
EPA160.2	Nonfilterable residue	EPA EMSL 1983
EPA180.1	Turbidity	EPA EMSL 1983
EPA200.7	Trace elements	EPA EMSL 1983
EPA206.2	Arsenic	EPA EMSL 1983
EPA208.2	Barium	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	Inorganics, non-metallics	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
EPA353.3	Nitrogen, nitrate-nitrite, or nitrite only	EPA EMSL 1983
EPA354.1	Nitrogen, nitrite	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
EPA375.4	Sulfate, turbidimetric	EPA EMSL 1983
EPA376.2	Sulfide	EPA EMSL 1983
APHA403	Alkalinity	APHA 1985
EPA413.1	Oil & grease	EPA EMSL 1983
APHA415A	Iodine	APHA 1985
EPA415.1	Total organic carbon	EPA EMSL 1983
EPA418.1	Petroleum hydrocarbons	EPA EMSL 1983
EPA420.1	Phenolics	EPA EMSL 1983
EPA420.2	Phenolics	EPA EMSL 1983
APHA705	Total alpha-emitting radium	APHA 1985

Method	Used to Analyze	Source
ASTMD3869C	Iodide	ASTM 1992
APHA5320	Dissolved organic halogen	APHA 1989
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	Halogenated volatile organics	EPA 1986
EPA8020	Aromatic volatile organics	EPA 1986
EPA8080	Organochlorine pesticides and PCBs	EPA 1986
EPA8140	Organophosphorus pesticides	EPA 1986
EPA8150	Chlorinated herbicides	EPA 1986
EPA8240	GCMS VOA	EPA 1986
EPA8270	GCMS semivolatiles	EPA 1986
EPA8280	Dioxins and furans	EPA 1986
EPA9012	Total cyanide	EPA 1986
EPA9020	Total organic halides	EPA 1986
EPA9030	Sulfides	EPA 1986

An example of the 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 dosed 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 (µg/L)	Mean reported value (µg/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

Element	True value (µg/L)	Mean reported value (µg/L)	Mean percent RSD[a]
Vanadium	70	69	2.9
Zinc	16	19	45

Note: In EPA (1986), the column heading is Mean Standard Deviation (%).

[a] Relative 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] (µg/L)	Single analyst precision (µg/L)[b]	Overall precision (µg/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	$0.93C-0.09$	$0.15\bar{X}+0.29$	$0.20\bar{X}+0.41$
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	$0.97C-0.16$	$0.11\bar{X}+1.46$	$0.17\bar{X}+1.46$
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]	$1.00C$	$0.18\bar{X}$	$0.32\bar{X}$
Methylene chloride	$0.91C-0.93$	$0.11\bar{X}+0.33$	$0.21\bar{X}+1.43$
1,1,2,2-Tetrachlorethane	$0.95C+0.19$	$0.14\bar{X}+2.41$	$0.23\bar{X}+2.79$
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 µg/L.
[b] Expected single analyst standard deviation of measurements.

[c] Expected interlaboratory standard deviation of measurements.
[d] C = true value for the concentration, in µg/L.
[e] $\bar{X}$ = average recovery found for measurements of samples containing a concentration of C, in µg/L.
[f] Estimates based on performance in a single laboratory.

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